Reparaturhandbuch
Repair manual
Manuale di officina

Type, Tipo
123

aprilia parts 8140120

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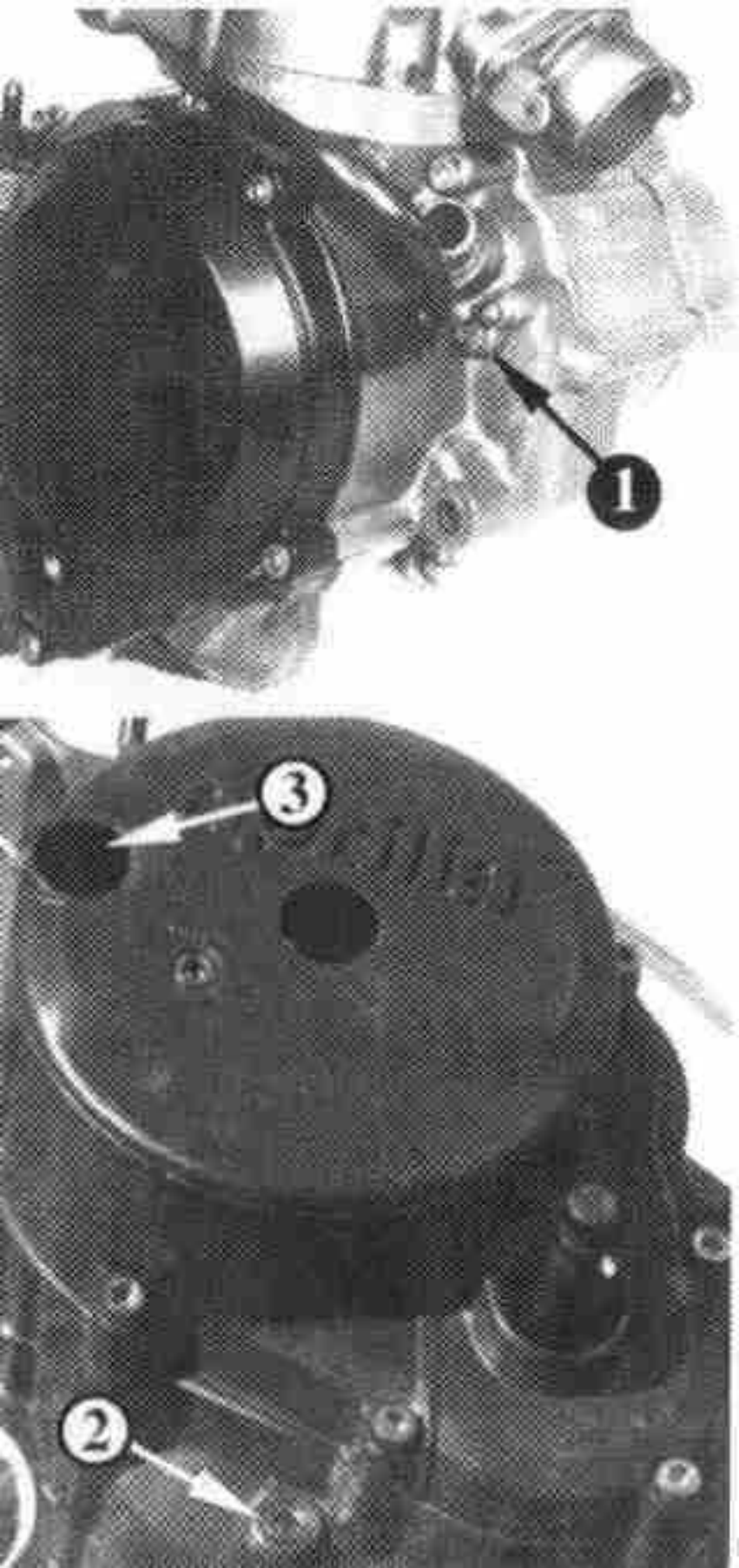
Engine removal:

Clean engine. Remove exhaust system and carburetor. water drain screw ❶, and radiator screw cap. Drain cooling liquid and disconnect all hoses. Remove magnetic drain screw ❷ from beneath clutch side crankcase half, and drain gear oil. Disconnect battery and all electrical connections between engine and frame.

Remove oil pump cover, disconnect control cable for oil pump drive and for exhaust valve (RAVE II), and remove oil pipe. Remove screw plug ❸ from clutch cover and disconnect clutch cable. Remove revolution counter drive cable and rear drive chain.
Remove engine fixing bolts and lift engine out of the frame.
The electric starter may be dismounted before removal of the engine from the frame.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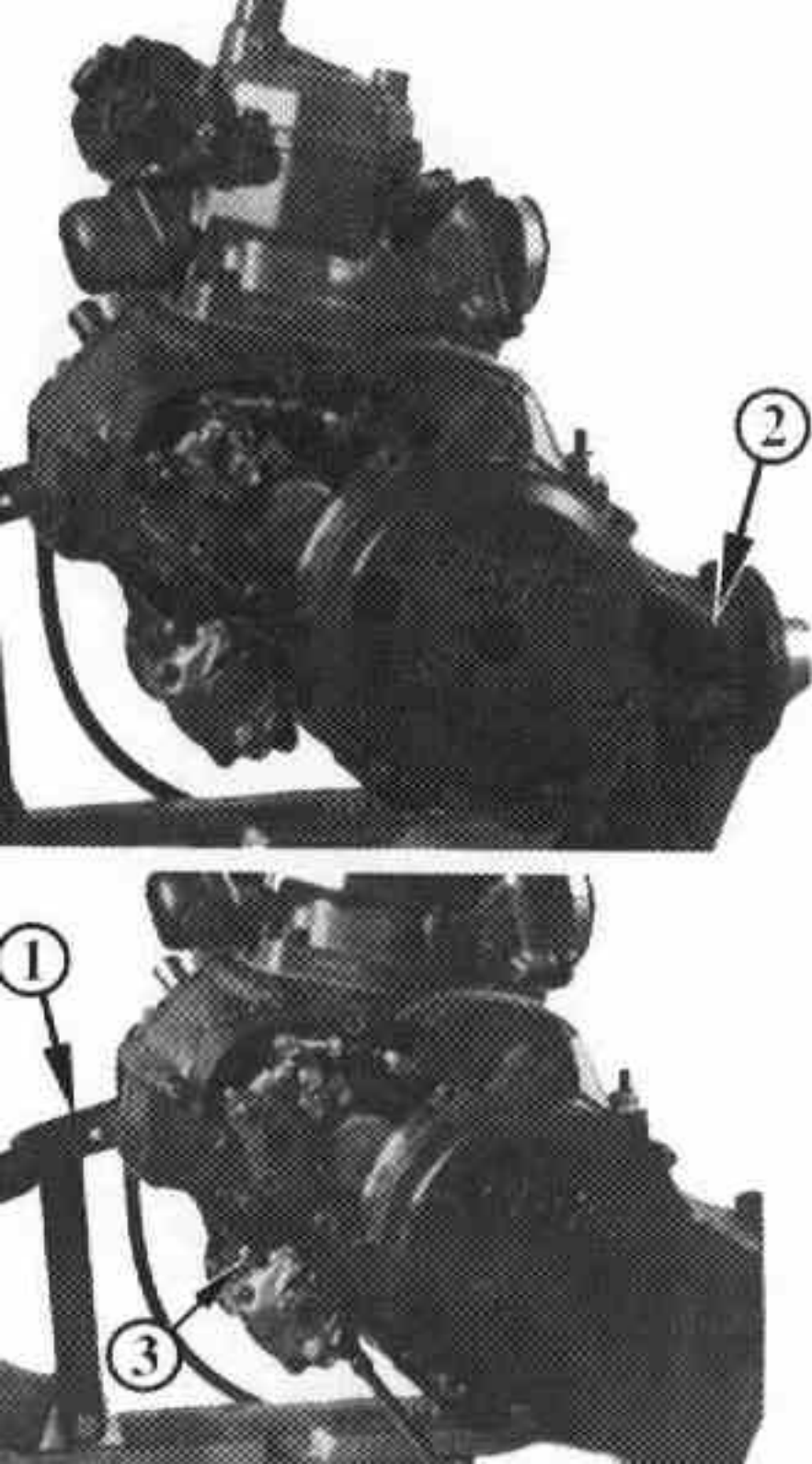
ENGINE DISMANTLING

Set up the cleaned engine on trestle with adapter ❶ for
engine type 123, and secure it with fixing screw ❷.

Removal of electric starter:

Unscrew the 2 hex. collar screws ❸ and remove electric
starter.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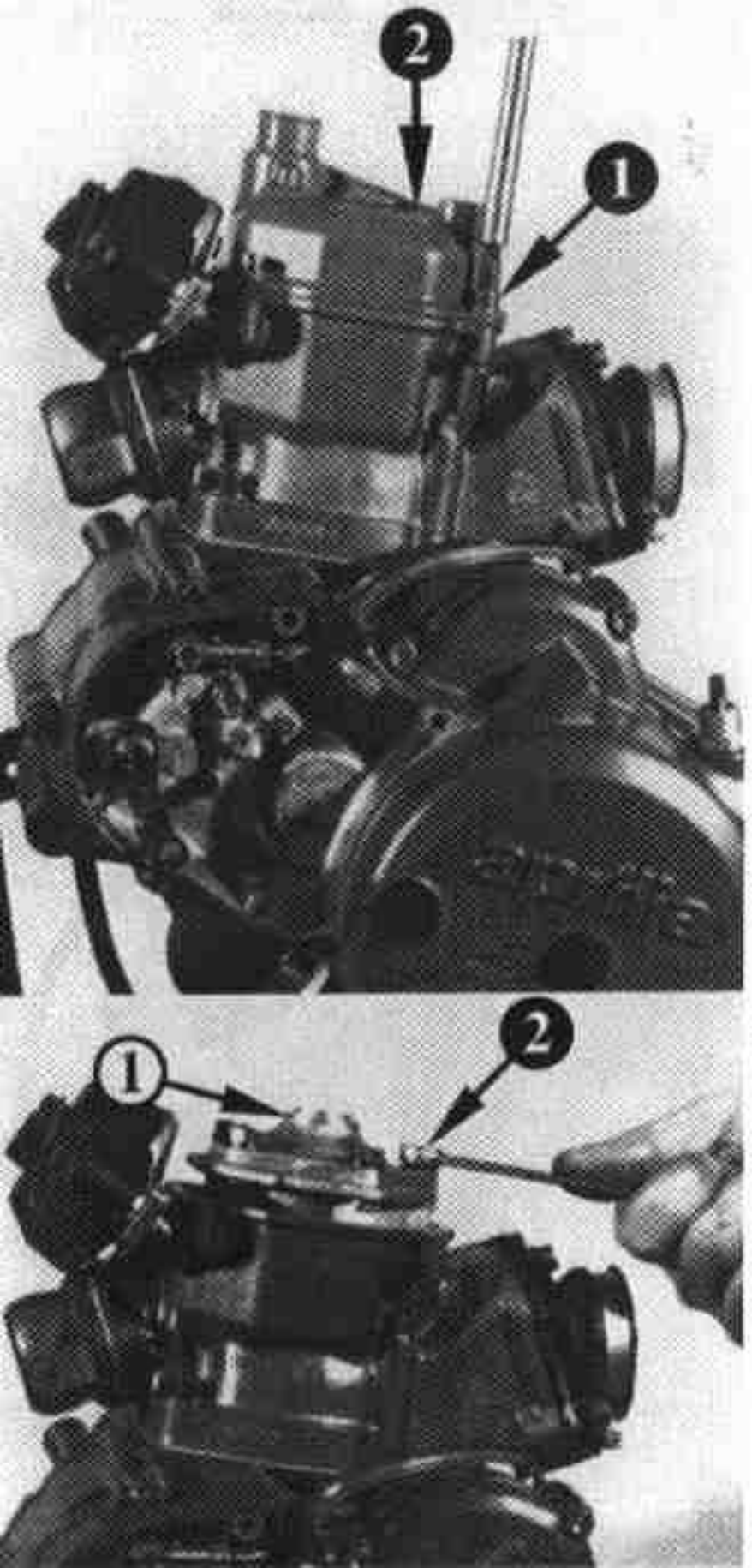
Cylinder head cover, combustin chamber:

Remove 4 Allen screws M6 ❶ and cylinder head cover ❷ with the 2 O-rings. Unscrew 5 hex. nuts M7 ❸ with washers and remove the combustion chamber insert ❹ with O-ring.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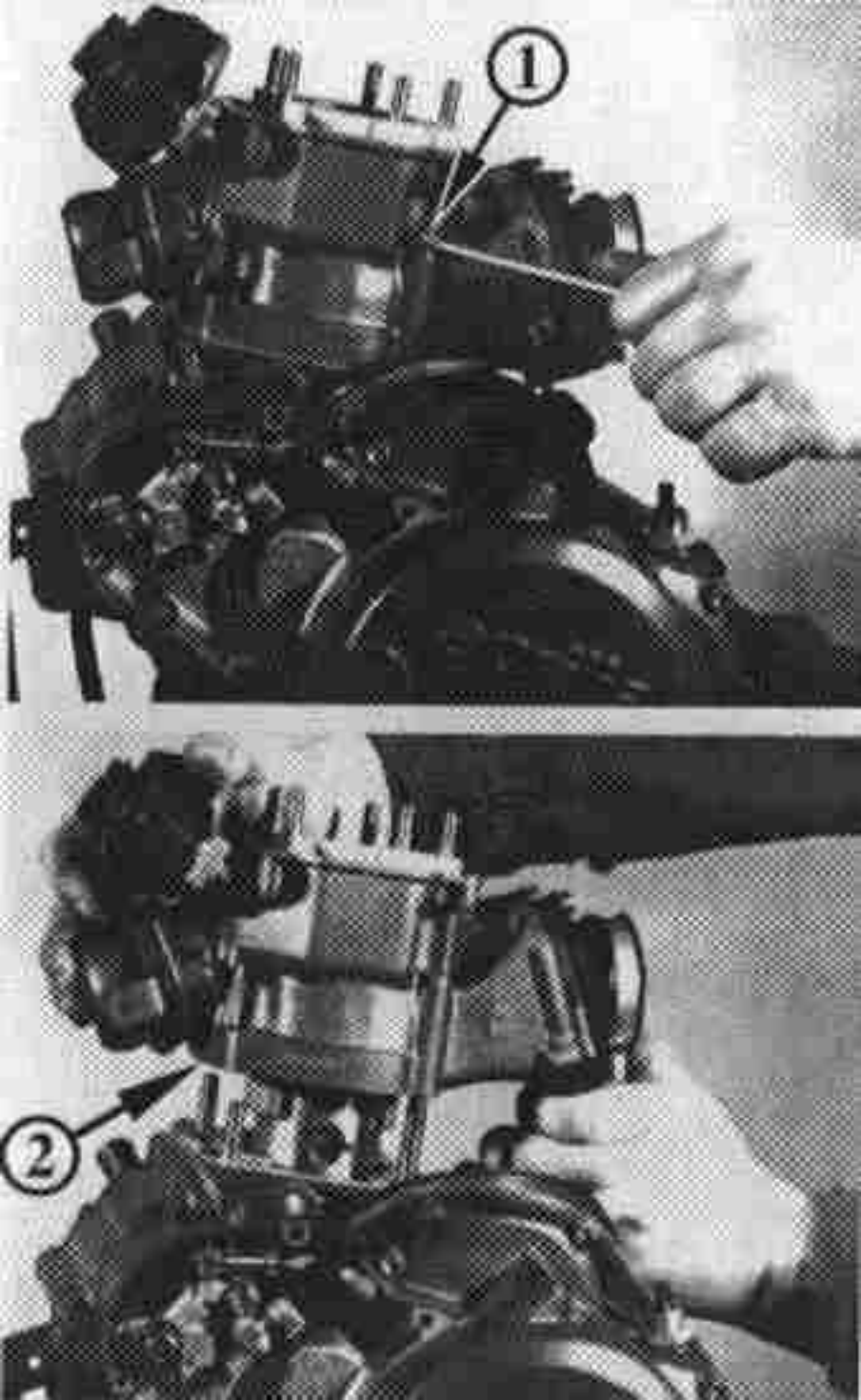
Cylinder:

Remove the 4 hex. nuts M8 ❶ and washers with wrench 11 and lift the complete cylinder ❷.

ATTENTION: Take care to prevent the piston falling against the crankcase.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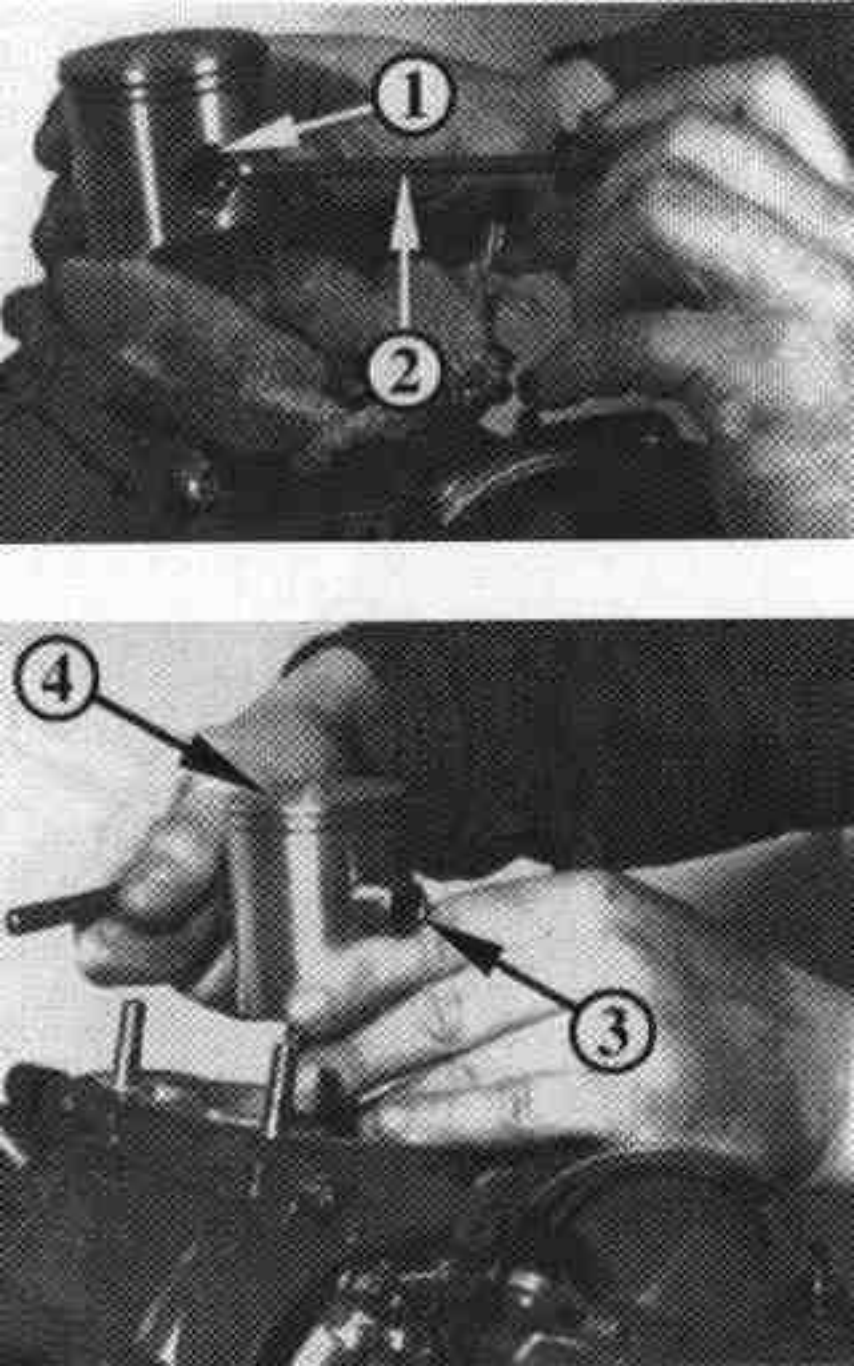
Piston:

Cover crankcase aperture with a cloth and prise out the 2 piston pin circlips ❶ using a narrow-blade screwdriver ❷. Drive out piston pin ❸ with guide bolt, gently tapping the guide bolt if necessary, and remove piston ❹ with needle bearing.

Support the piston by hand to avoid bending the connecting rod.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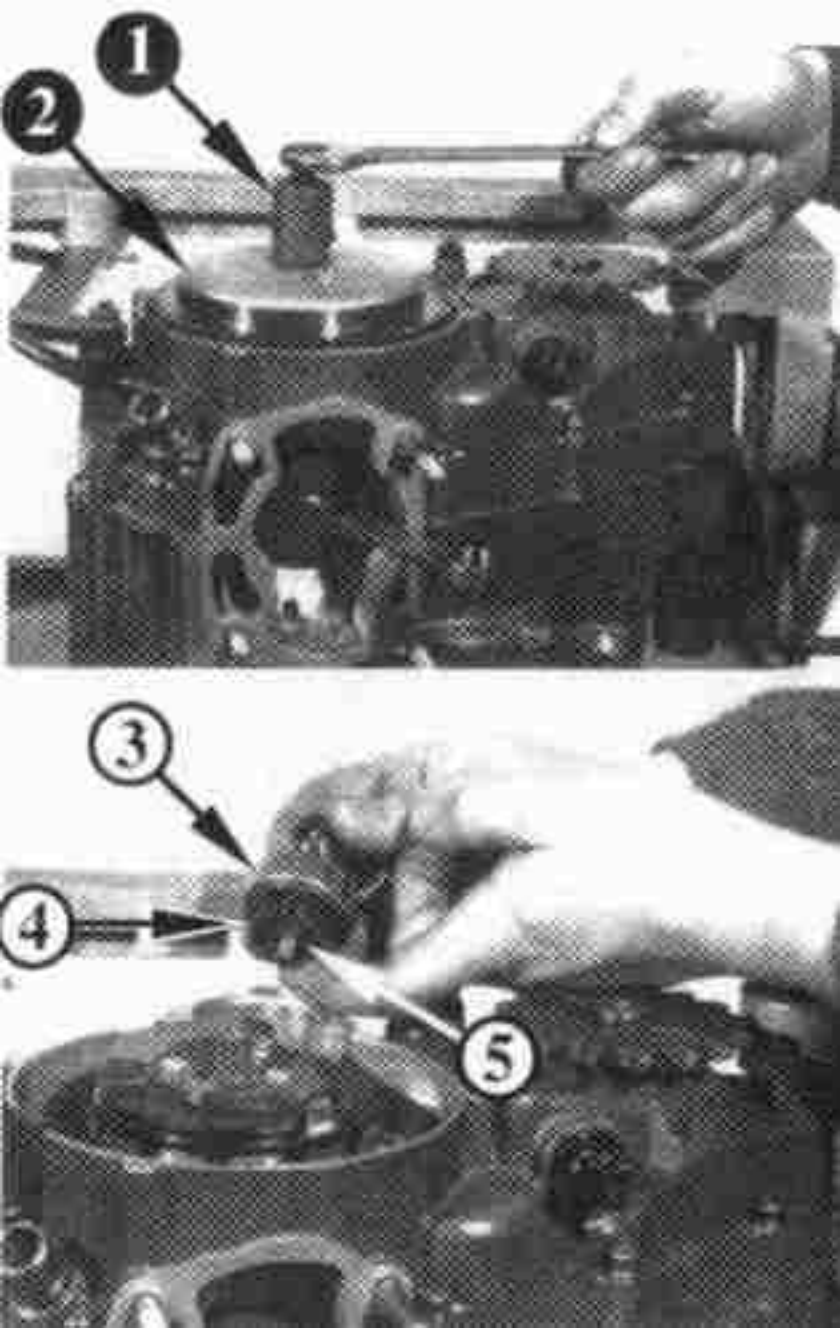
Screw puller ❶ *(276 807)* fully into flywheel thread and remove flywheel ❷ with lockwasher.
Remove starter gear assy. ❸ with drive gear ❹ and thrust washer ❺.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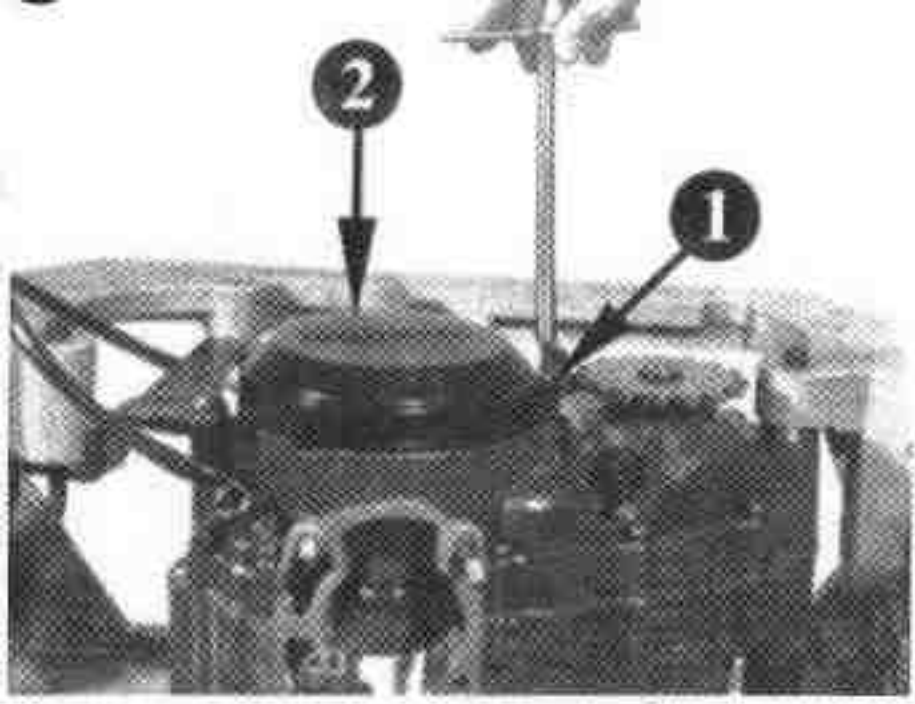
Ignition system:

Remove 4 Allen screws M6 ❶ and the ignition cover ❷. Unscrew 2 Allen screws M6 ❸ and remove the starter gear cover ❹.

ATTENTION: The thrust washer may stick at the inner side of the starter gear housing.

Remove plug screw M8 for crankshaft locking. Then set the piston to top dead centre so that the locking bolt groove can be seen through the crankcase aperture.

Fit crankshaft locking screw ❺ by hand until it engages firmly in the crankshaft recess (turning the magneto flywheel gently to and fro by hand will make this easier). Unscrew hex. nut M12x1 ❻ with socket wrench 17, then fit protection cap *(276 790)* onto crankshaft thread.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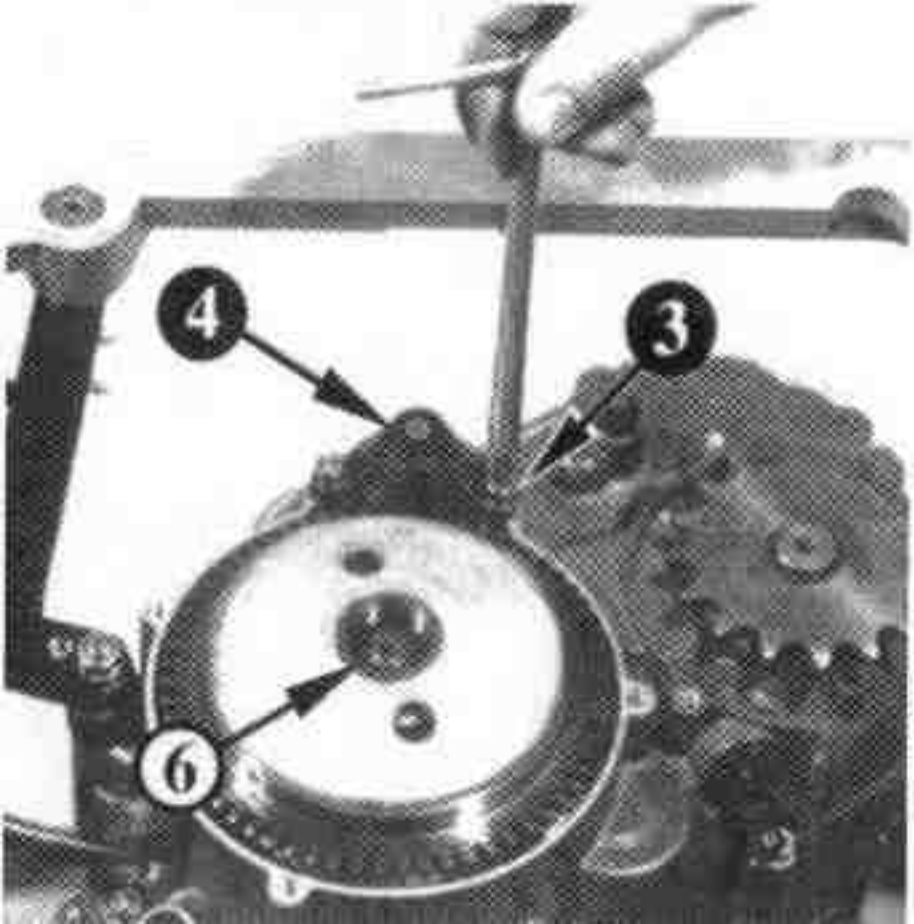
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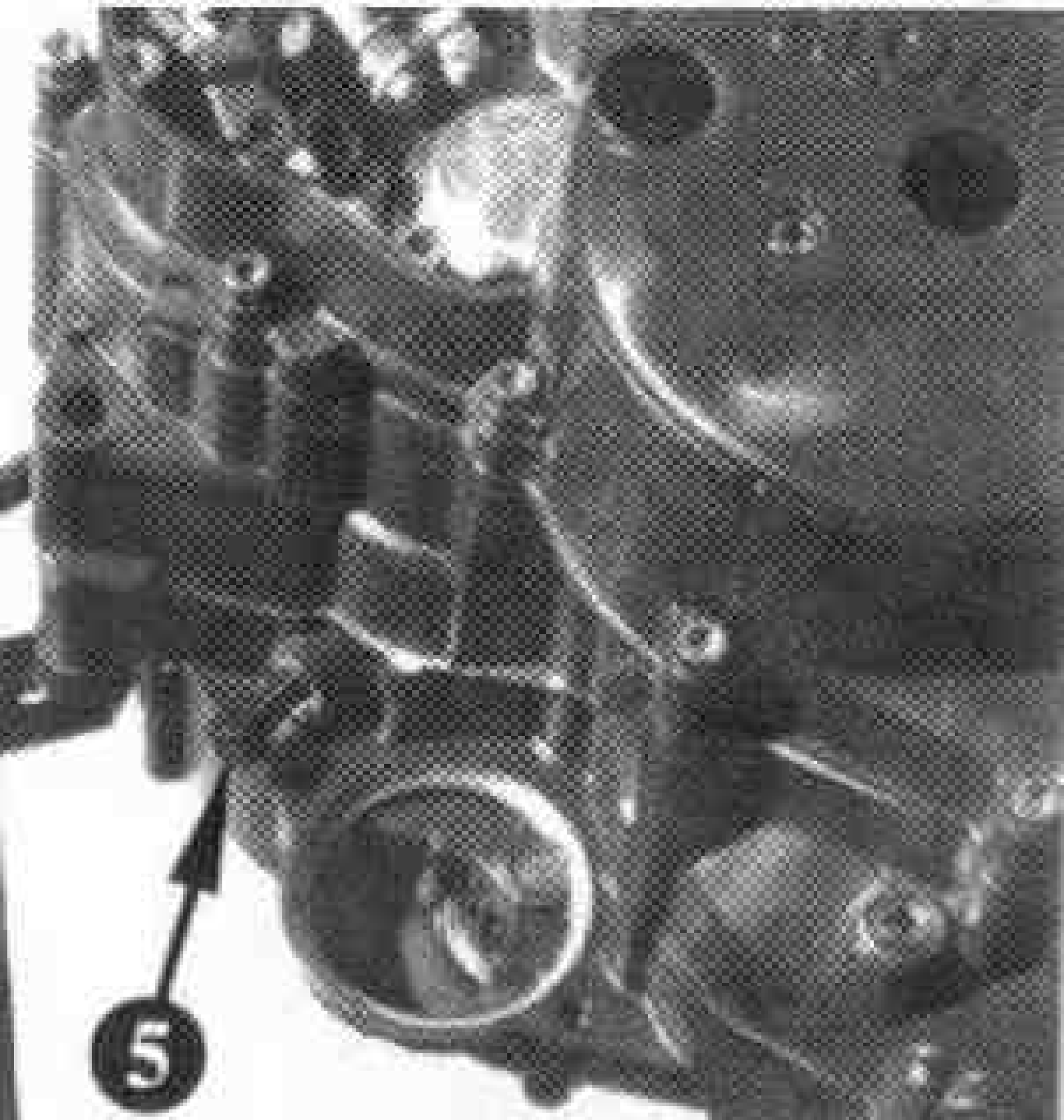
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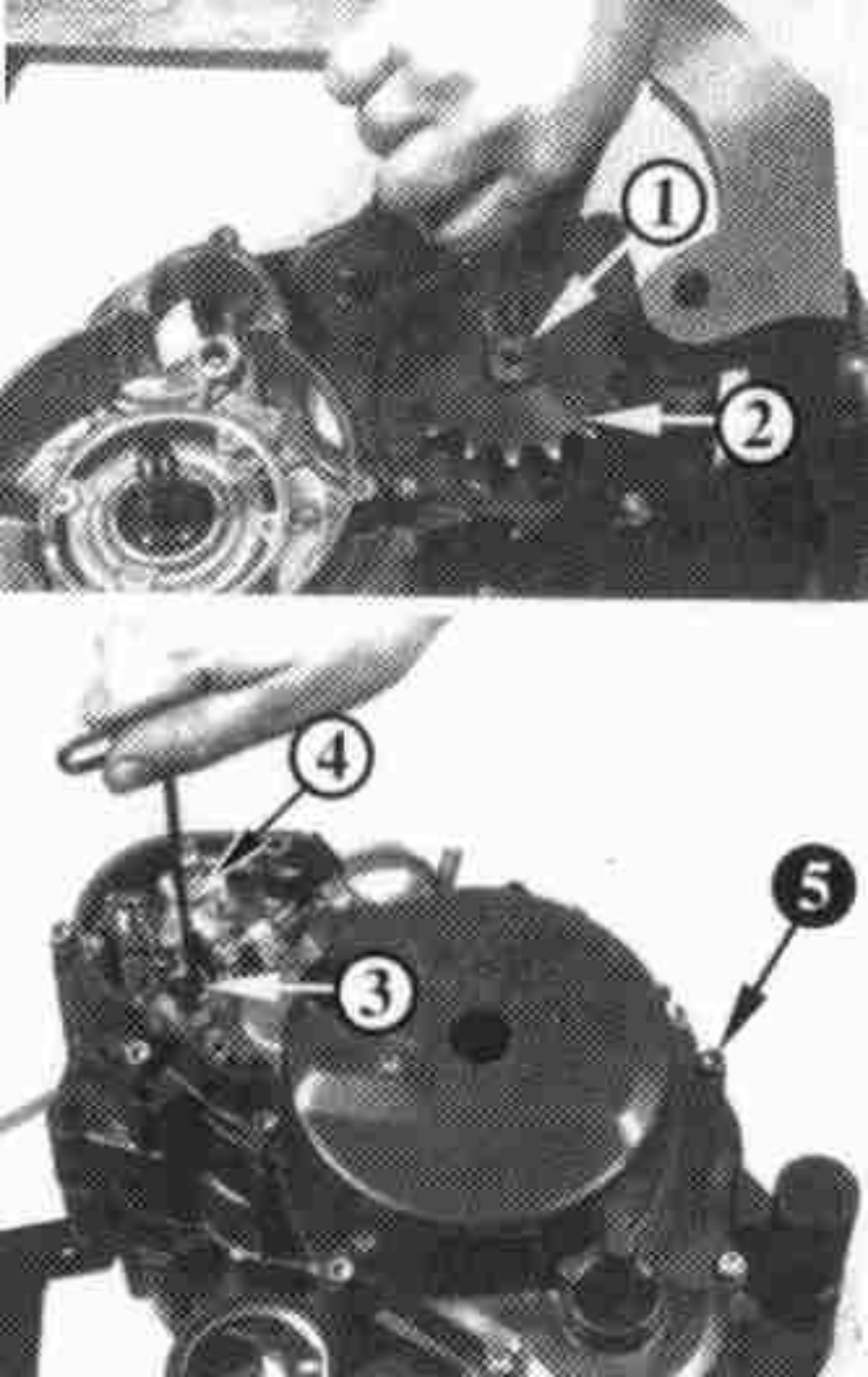
Sprocket:

Remove retaining ring ❶ with retaining ring pliers and sprocket ❷ with O-ring underneath.

Oil pump:

Turn engine on trestle, clutch side upwards. Remove 2 Allen screws M5 ❸ with lockwashers and oil pump ❹ with oil tubes, cable grommet and O-ring. Remove 11 Allen screws M6 ❺ from the clutch cover using a wrench 5.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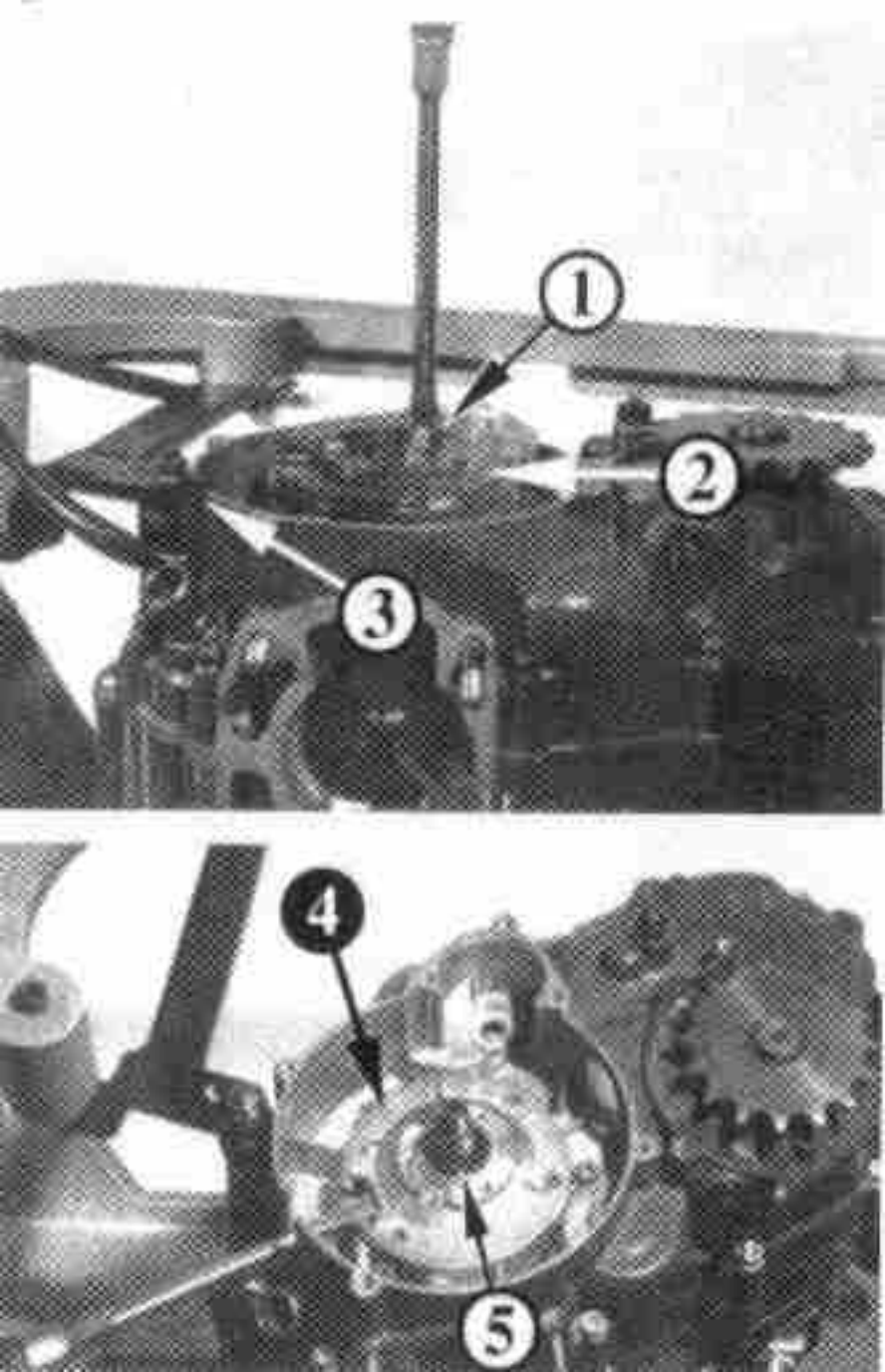
Remove 3 Allen screws ❶ with washers and stator ❷ with cable grommet ❸ from stator plate.

Remove 4 Allen screws M5 with lock washers and gently lift stator plate ❹ with a screwdriver. Remove Woodruff key ❺ from crankshaft.

ATTENTION: The stator plate only has to be removed if the magneto side oil seal is to be replaced.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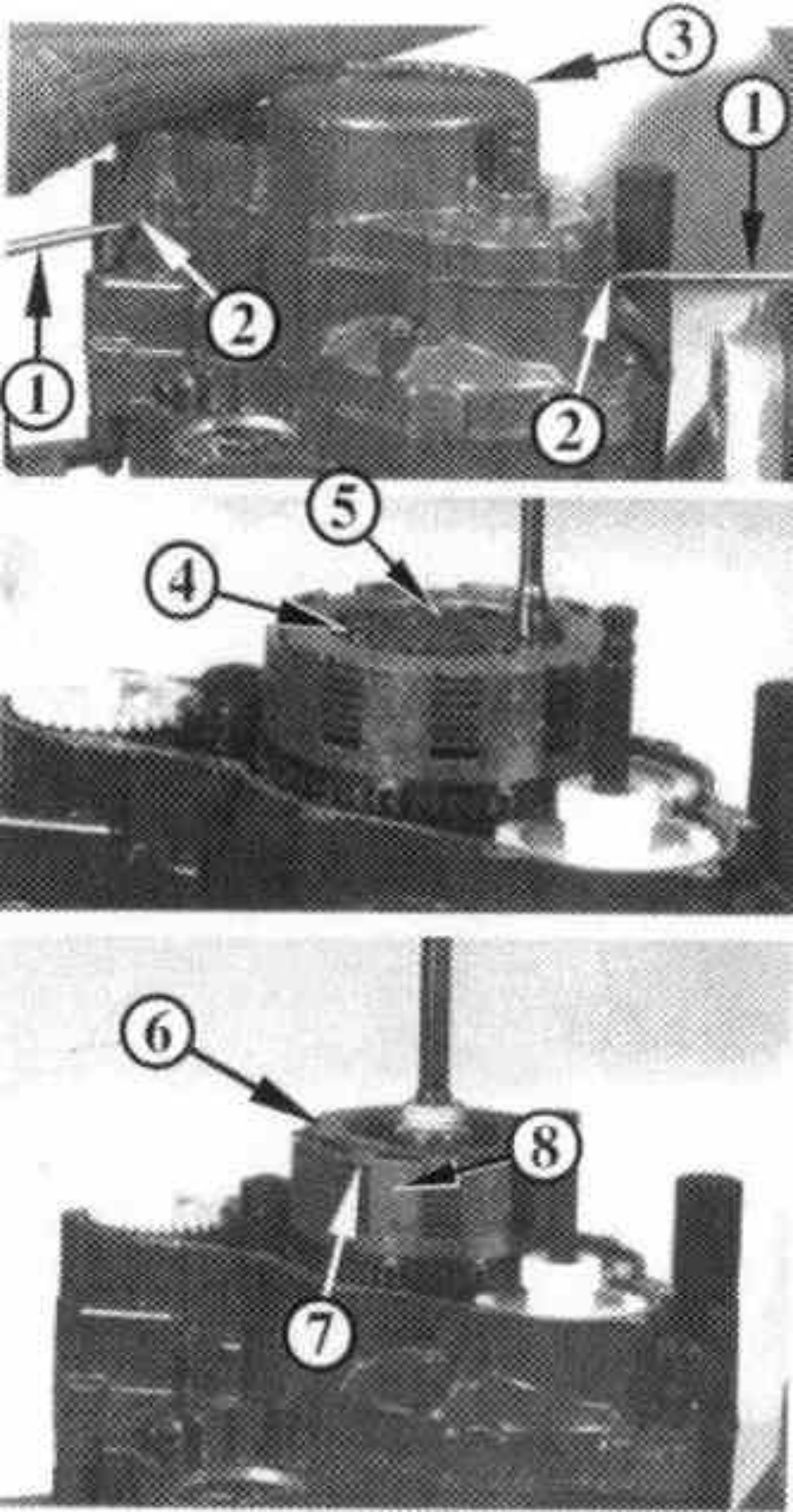
Clutch and primary drive:

Lift off clutch cover using 2 large screwdrivers ❶ applied at the lugs ❷ provided and remove clutch cover ❸ with gasket. Don't lever between sealing surfaces.

ATTENTION: When taking off the clutch cover, check that the thrust washer of the rev. counter drive gear is not stuck to the clutch cover interior.

Remove 6 hex. screws M5 ❹ from clutch thrust plate ❺ with wrench 8 in crosswise sequence, turning each screw no more than two turns at a time to ensure that spring pressure is relaxed evenly. Remove screws, lock washers, clutch thrust plate and clutch springs. Bend back tab-washer on clutch shaft. Place clutch hub locking tool ❻ over clutch assembly and turn it so that it is fully engaged in the clutch drum ❼. The clutch centre nut M18 may now be removed with wrench 27.

Remove locking tool and tab washer.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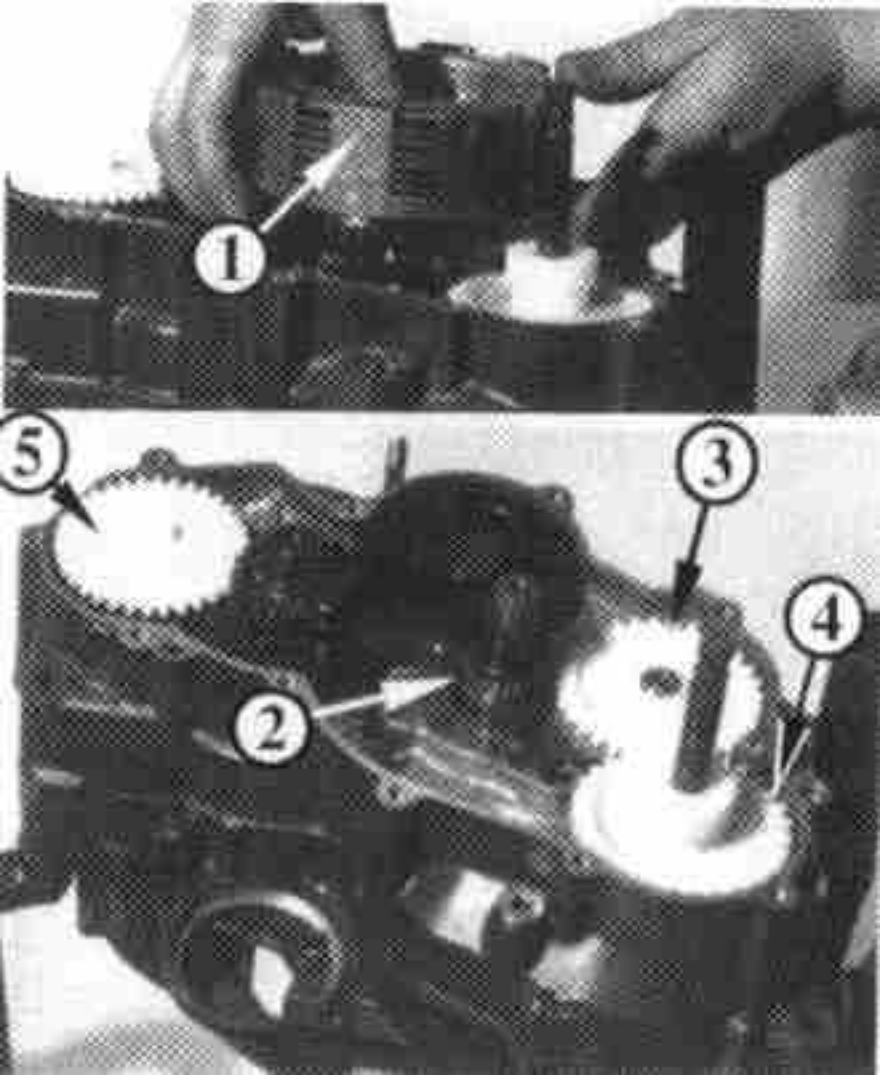
Lift off clutch drum ❶ with clutch hub and all plates.

Remove 2 needle cages ❷, thrust washer and O-ring from clutch shaft. Remove idler gear ❸ and rev.counter drive gear ❹ with thrust washer and sleeve. Next remove water pump intermediate gear ❺ with thrust washer underneath.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Drive gear:

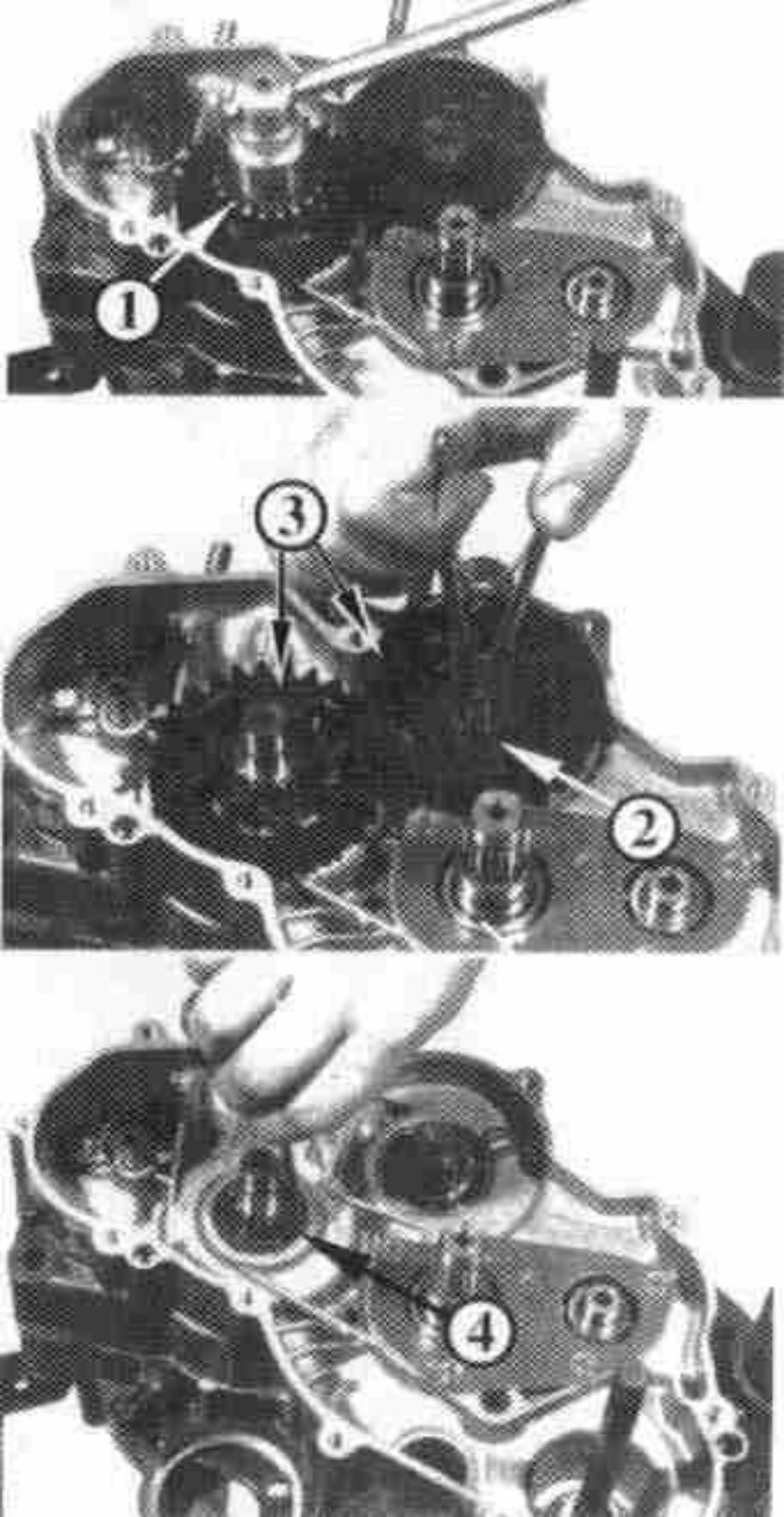
Remove crankshaft hex. nut M16 x 1.5 with wrench 24, then lift off the lockwasher and drive gear ❶.

Take Woodruff key from crankshaft keyway. Remove retaining ring ❷ from balance shaft and the 2 balance drive gears ❸. Remove O-ring ❹ from the crankshaft.

Kickstarter:

On models with kickstarter, fit the kickstart lever on the starter shaft, depress it and remove stop screw ❺ from the crankcase. Depress ratchet gear ❻ with a screwdriver and let the starter spring relax.

Remove kickstart lever, thrust washer, ratchet gear, shaft and spring.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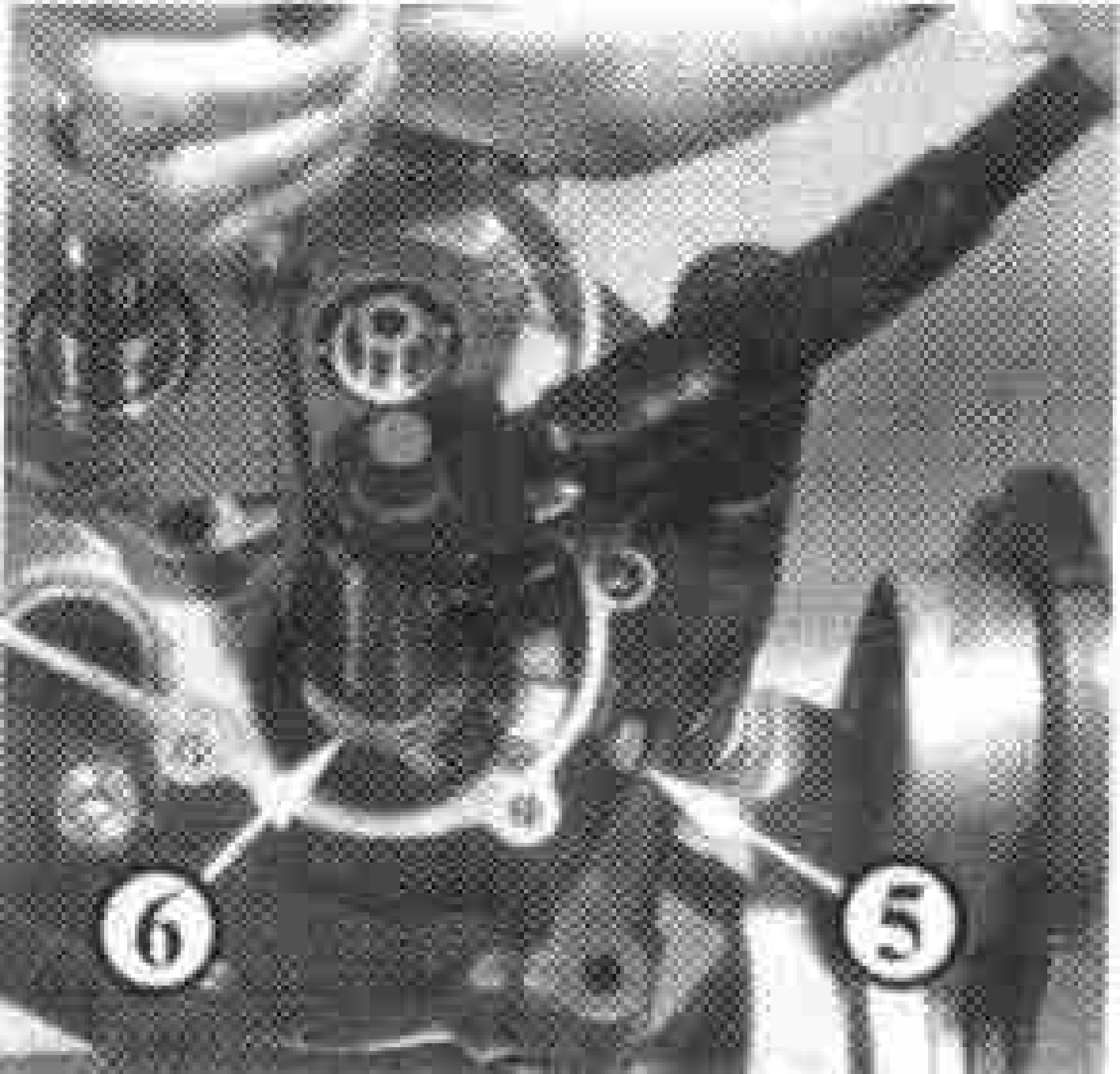
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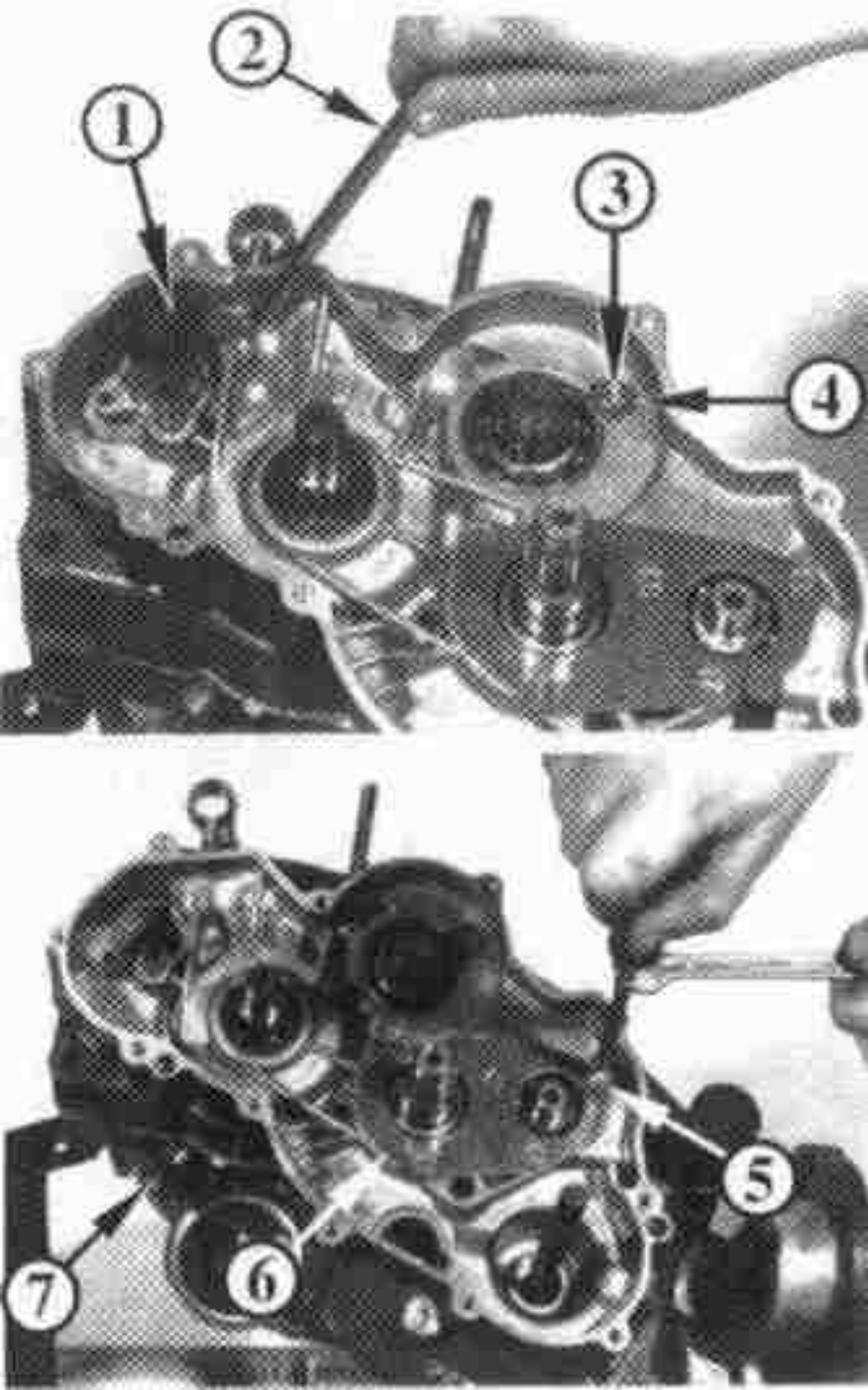
Water pump:

Remove Taptite screw M5 and lift off the complete water pump ❶ with a cranked lever ❷. Remove the countersunk screw ❸ and retaining plate ❹ for balance shaft bearing. Unscrew 5 countersunk screws ❺ with screwdriver and remove the retaining plate ❻ with shims underneath, for main- and clutch shafts. Remove crankshaft locking screw ❼.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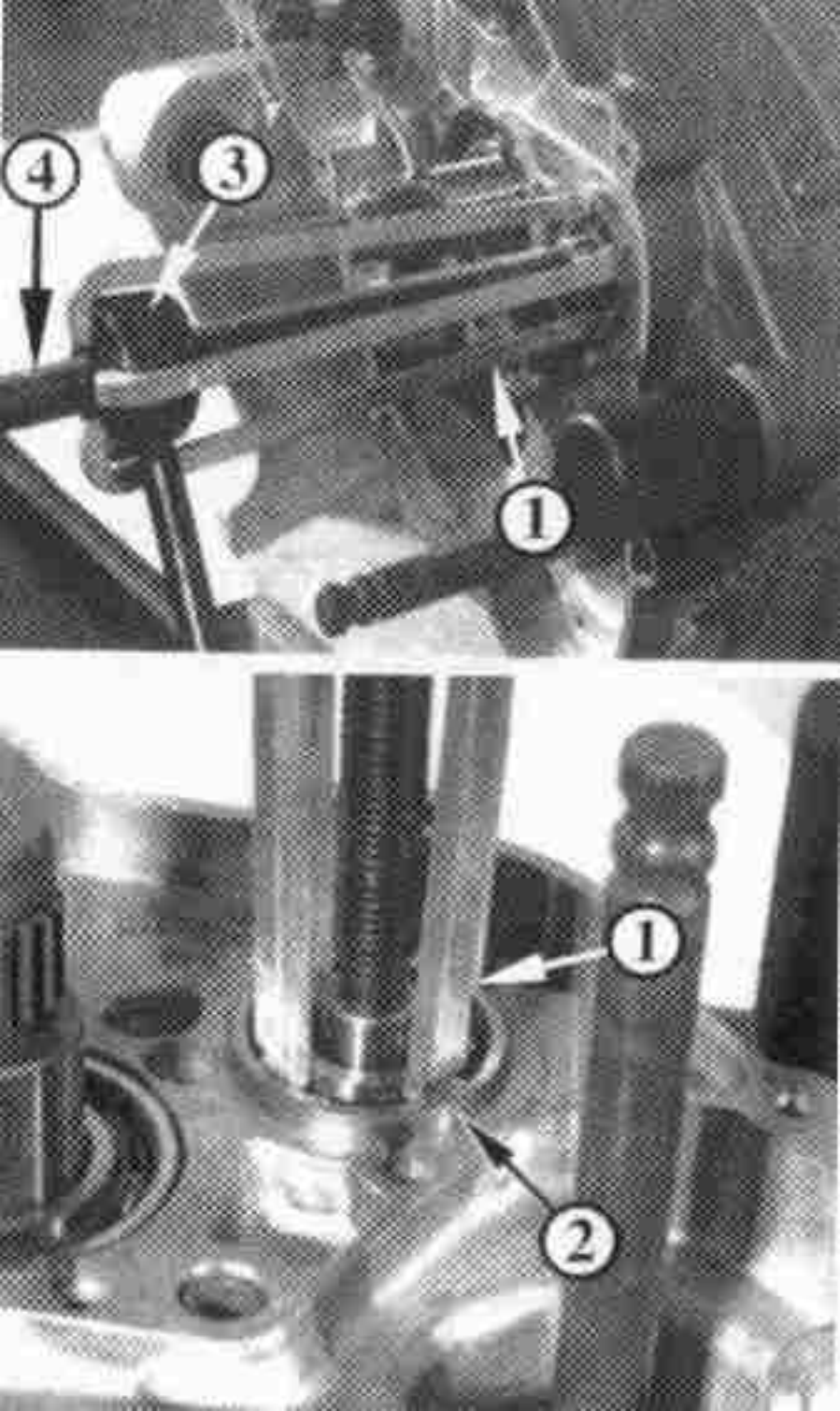
Extraction of ball bearings:

The clutch side ball bearings of gearbox mainshaft and clutch shaft can be replaced without dismantling the crankcase.
For this, a bearing extractor with appropriate extractor withappropriate "leg" setisrequired. The4 legs❶ engage in the bearing outer race ❷, and the other ends in the extractor nut ❸. The bearing will be removed as the extractor bolt ❹ is gradually tightened.

To fit a new bearing, a hollow drift of suitable length (to pass over the shaft) and diameter must be used to drive only against the bearing outer race. Never drive against the inner race.

Use leg set A-3 for ball bearings:
6006 / 6203 / 6203E / 6300
A-4 for ball bearings: 6007 / 6204 / 6204E / 6205 / 6301 / 6302 / 6303 / 6304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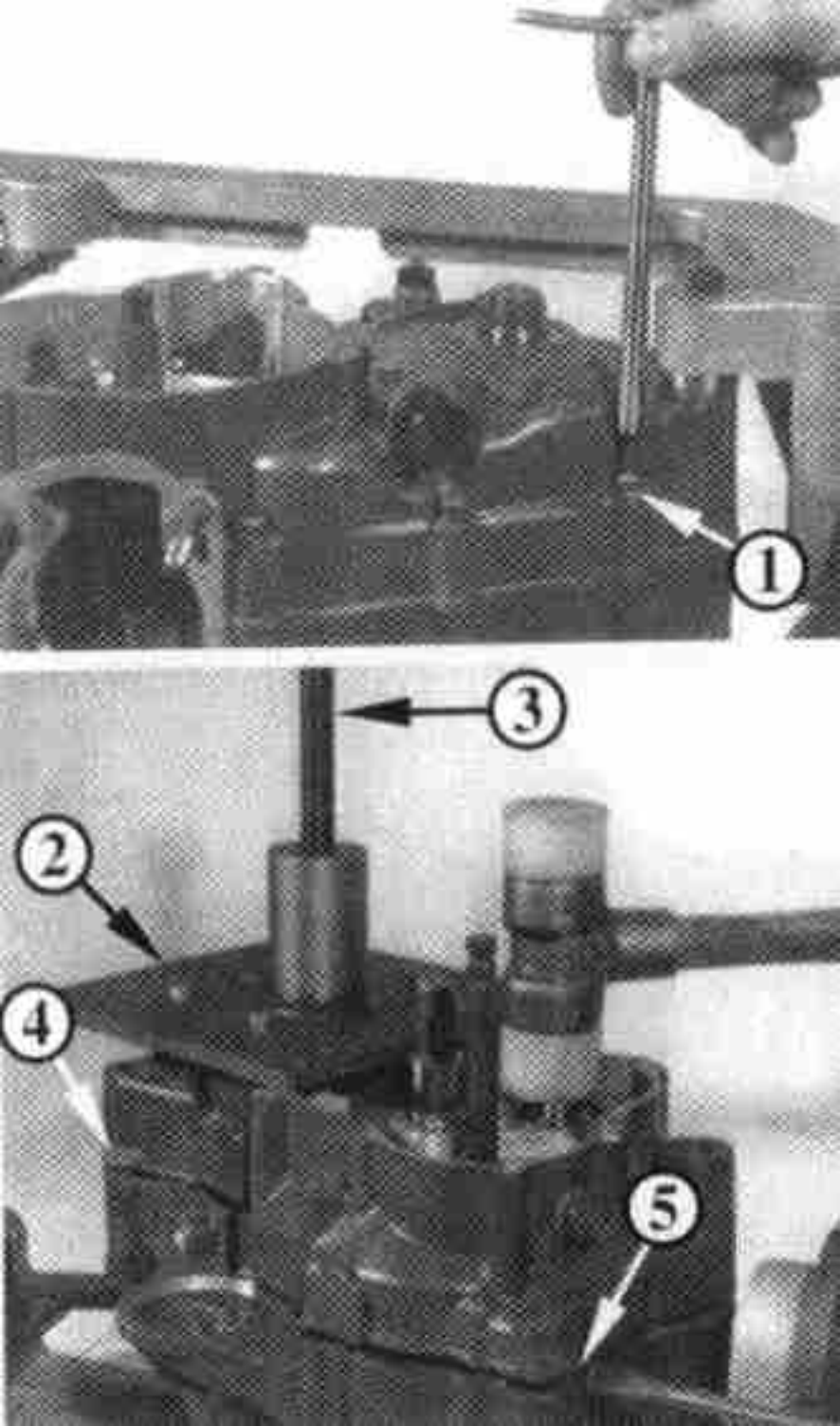
Separating crankcase halves:

Turn engine on trestle, magneto side upwards. Remove 13 Allen screws M6 ❶ and lockwashers with wrench S. Turn engine on trestle again, clutch side upwards. Fix puller plate ❷ with 4 Allen screws. Remove fixing screw from trestle.
Turn puller screw ❸ into puller plate until clutch side crankcase half ❹ lifts. Take care that the crankcase half lifts squarely.

While applying gentle pressure to the puller screw, gently knock clutch-, main- and gearshift shafts down with a mallet. Separation is facilitated by levering on the lugs ❺ with a screwdriver. Don't lever between the sealing surfaces!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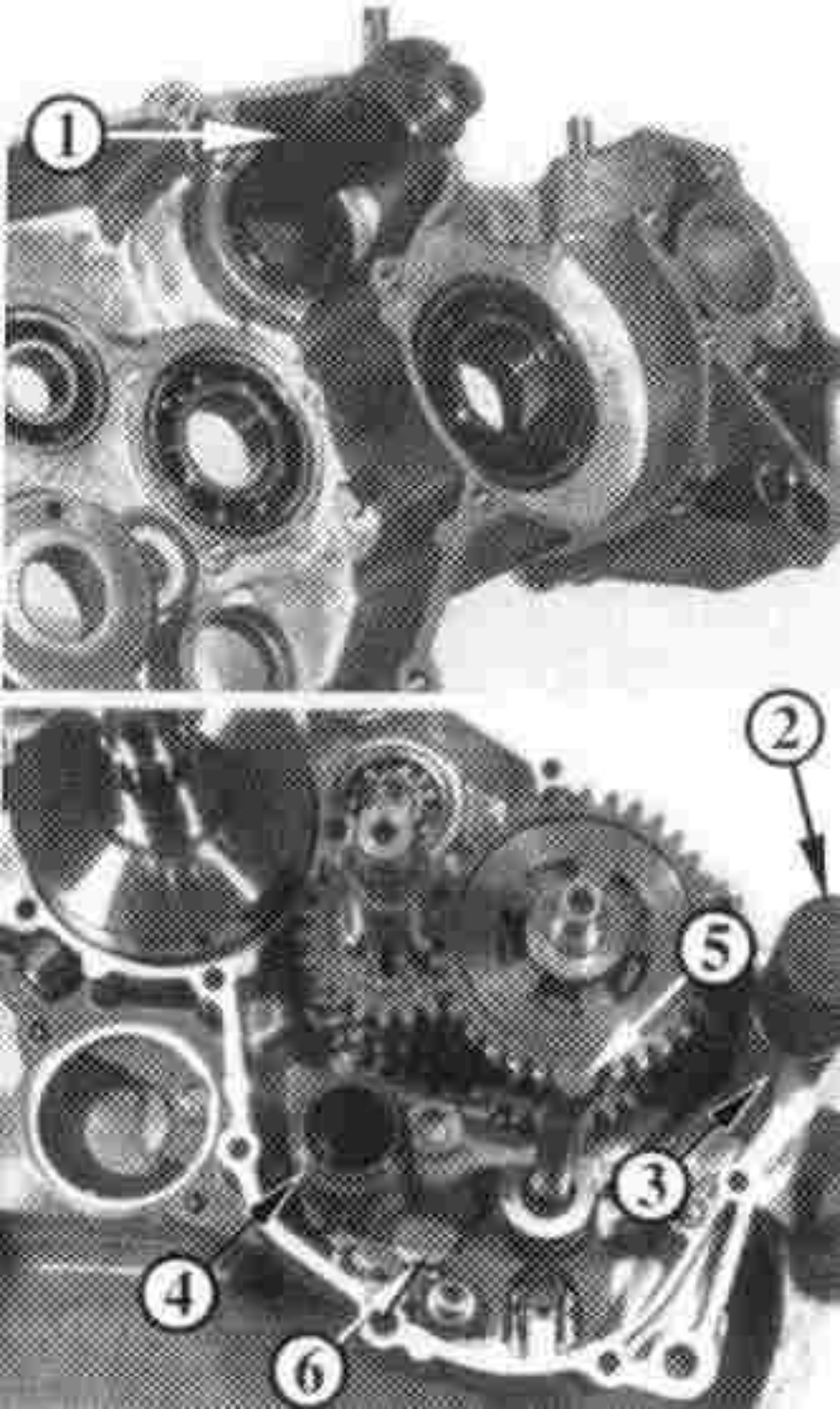
Lift clutch side crankcase half and detach puller plate. Take care of the thrust washer on mainshaft. It may remain stuck on the inside of the crankcase half.

When lifting off the crankcase half, the balance shaft ❶ may remain in the crankcase. Remove balance shaft. There are no spacer shims on balance shaft.

Gearshift and gearbox:

Remove crankcase centre joint gasket. Mount magneto side crankcase half with securing screw ❷ and spacer ❸ on trestle. Remove the shift fork spindle and 3 shift forks. Pull out shift drum ❹ with shift shaft ❺, index lever ❻, index spring and the shim underneath.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Turn crankcase half on trestle into vertical position.
Support both gearbox shafts by hand, and with a mallet
gently tap the sprocket end of the mainshaft which will
remove both shafts complete with gears from their bearing
seats.

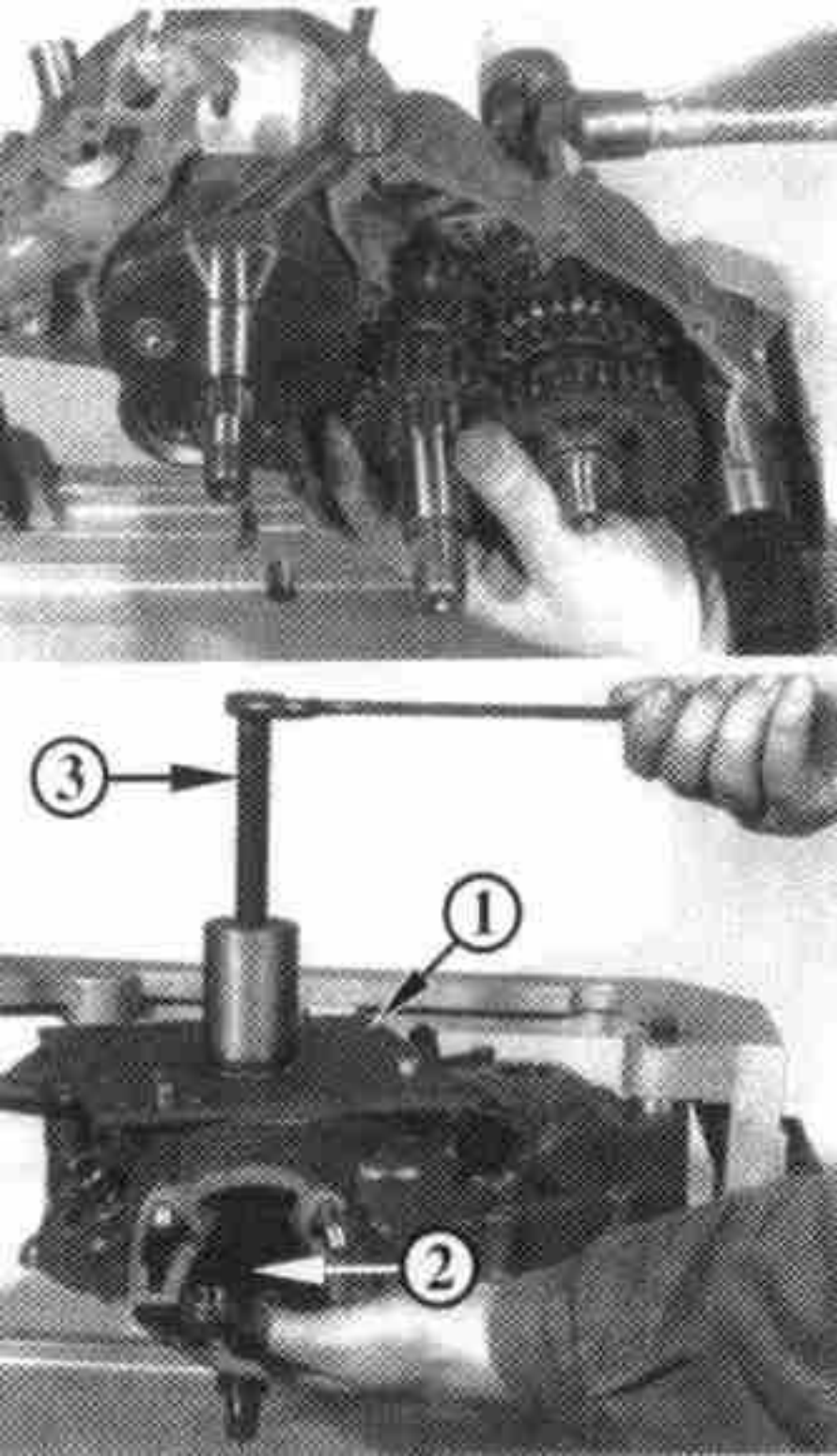
ATTENTION: Take care not to damage the mainshaft
oil seal.

Crankshaft:

Turn crankcase half on trestle, ignition side upwards.
Place protection cap *(276 790)* over crankshaft thread.
Attach puller plate ❶ to crankcase half and press out
crankshaft ❷ by turning the extractor screw ❸ clock-
wise.

ATTENTION: Support crankshaft by hand. Take care
not to damage the oil seal.

The spacer shims for adjustment of crankshaft axial play
are on magneto side, between crankblade and crankshaft
bearing.
Remove the extractor plate from crankcase half.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Individual component maintenance

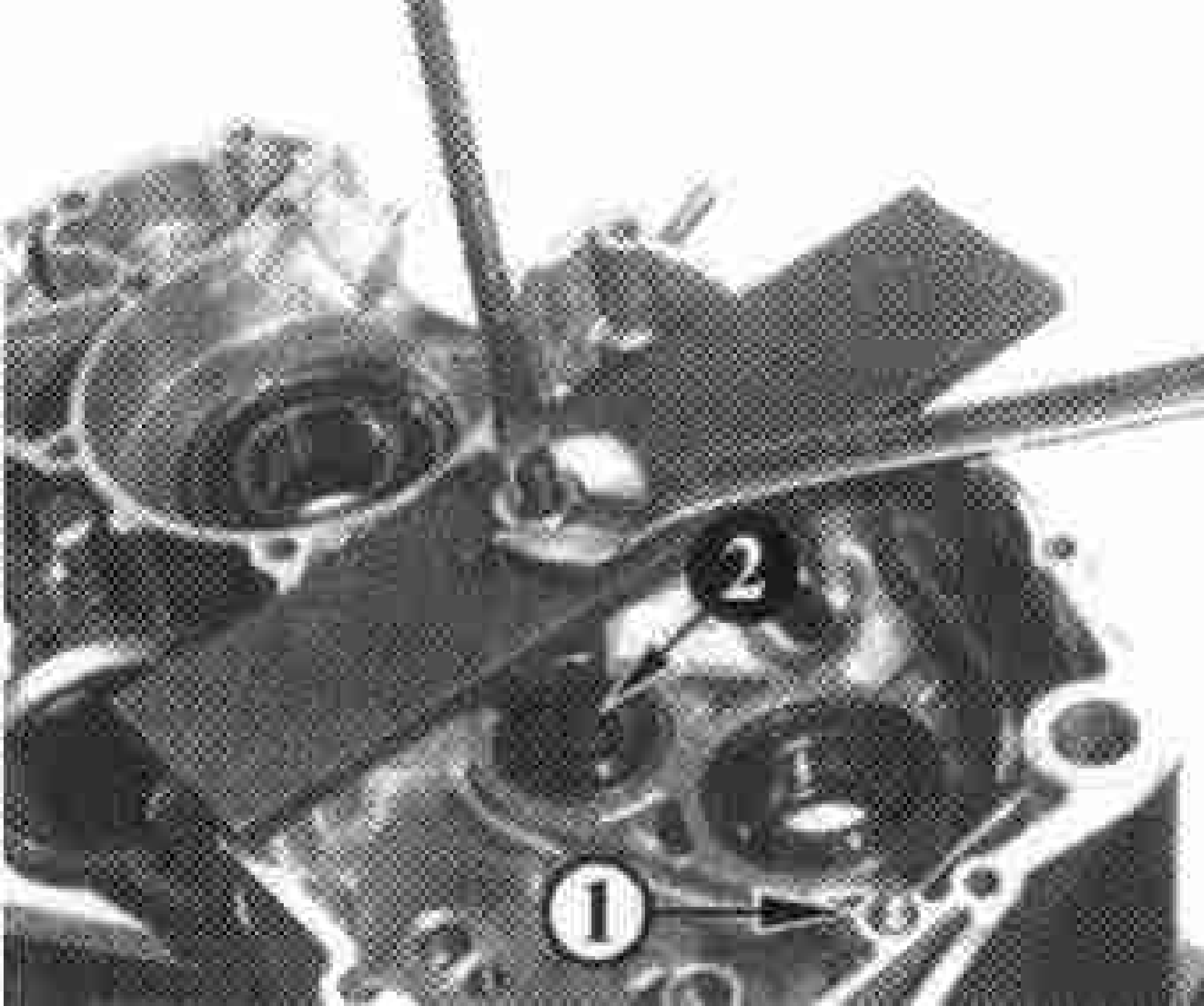
Crankcase:

Crankcase halves and ball bearings must be cleaned with gasoline or kerosene only, not with degreasing or cold cleaning agent.

Magneto side crankcase half:

To remove the ball bearings, heat crankcase to 60 ÷ 80 degrees C and remove the 2 dowels ❶. Place crankcase half on a flat surface with rubber mat to avoid damage to the sealing surfaces.

To remove the clutch shaft ball bearing, extract it with puller ❷ *(276 360)*, and the balance shaft ball bearing with puller *276 362*.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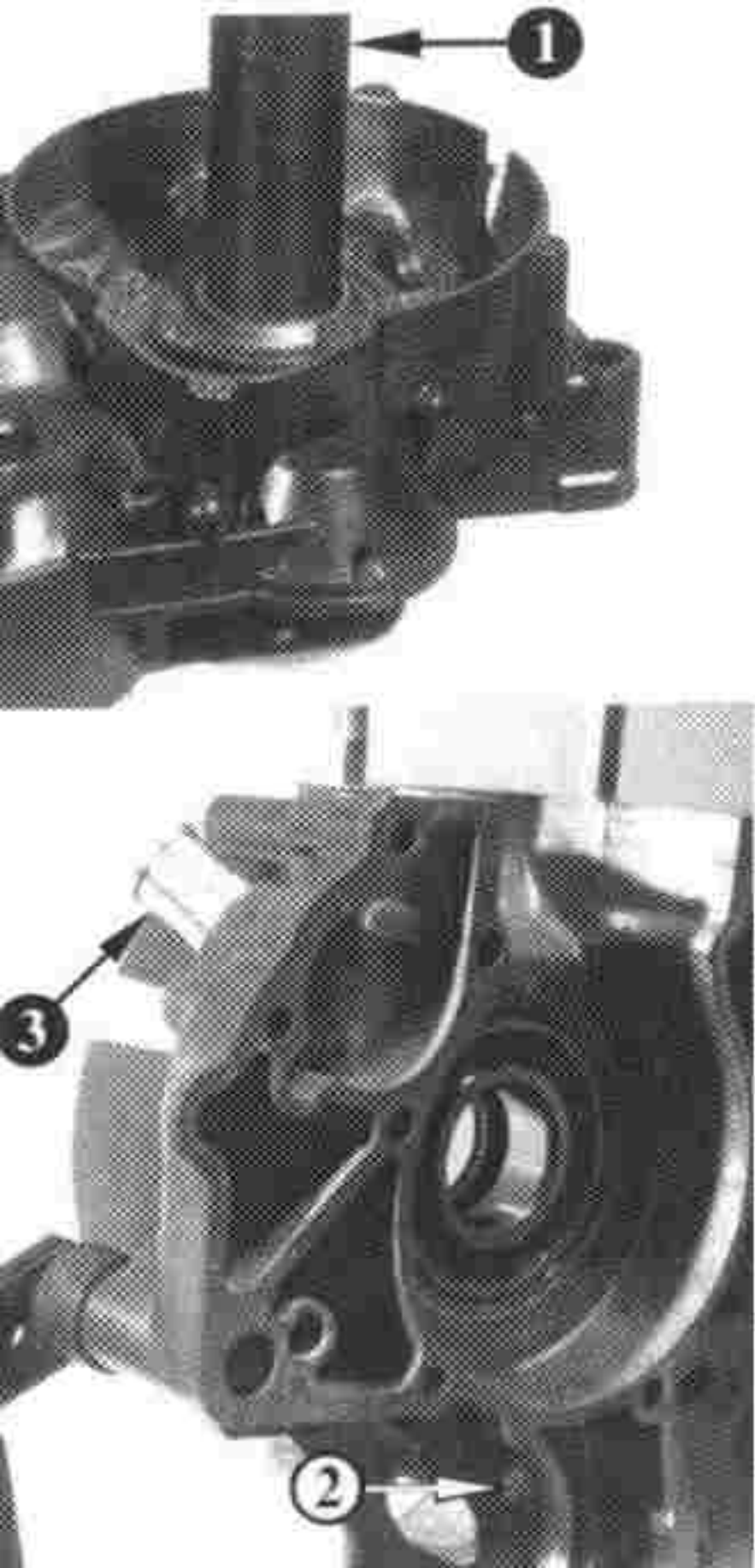
Mainshaft bearing, and if necessary also crankshaft bearing (usually remains on the crankshaft) should be driven from the outside inwards with an appropriate punch ❶ after removal of the oil seals. Clean crankcase half.

The same procedure applies to the needle bearing ❷ of the electric starter drive. Check all bearing seats and sealing surfaces.

The crankshaft bearings are an interference fit in the crankcase. The maximum interference is 0,05 mm with a new crankcase (bearing larger than housing). Wear limit 0,01 mm. Replace the oil seals of crankshaft and mainshaft.

If the water tube ❸ has to be replaced, seal and secure it in position with LOCTITE 648.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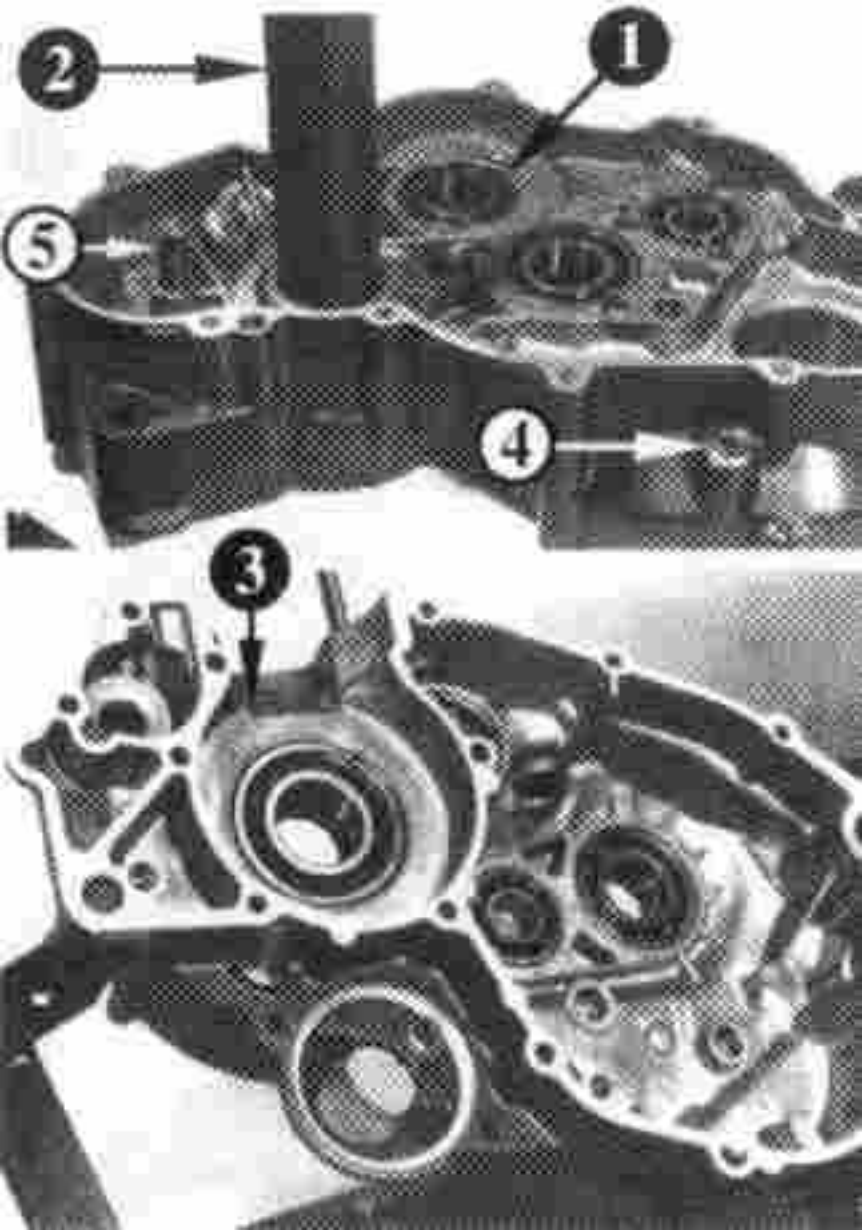
Clutch side crankcase half:

Heat crankcase half to 60 ÷ 80 degrees C and pull out dowels with pliers.Place crankcase half on flat surface with rubber mat. Knock out ball bearing ❶ for balance shaft from i n s i d e outwards, and the other ball bearings from o u t s i d e inwards. Always replace the crankshaft oil seal.

ATTENTION: Check lubrication bore ❷ for crankshaft bearing in both crankcase halves for free passage.

Check all bearing seats and sealing surfaces. Remove magnetic screw ❸ and clean it. Check the bearing spindle ❹ for water pump drive gear for tight fit in crankcase.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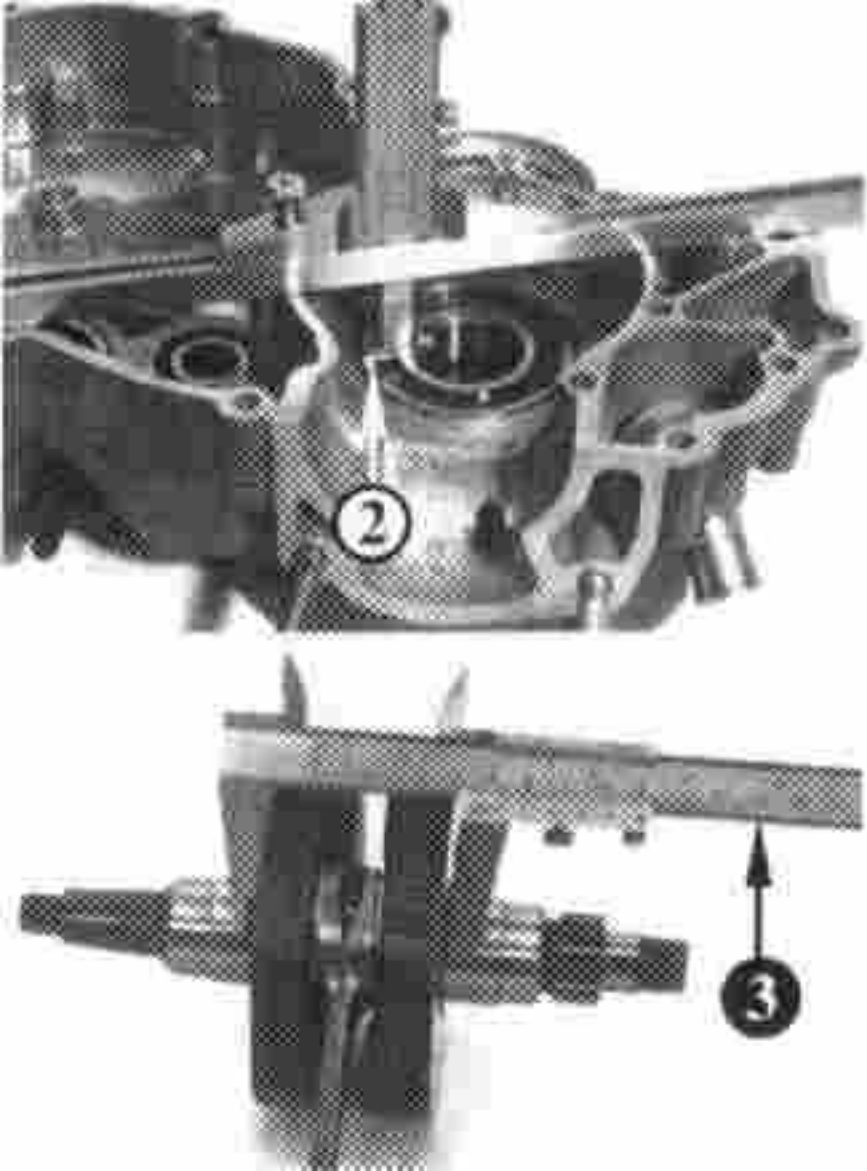
Measuring crankshaft axial play:

If crankcase or crankshaft are to be replaced, the crankshaft axial play (end-float) has to be measured. Heat the 2 crankcase halves to 90÷100 degrees C, insert the oil seals for crankshaft with punches 277 875.
Fit the ball bearings in the crankcase whilst still hot, tapping with a suitable punch on the outer bearing race. Be sure the bearings are pressed fully down in their housings.
ATTENTION: The closed side of the bearing cage ❶ must face towards crankblade to prevent the cage to jump out.
With a depth gauge measure the distances on each crankcase half between crankcase joint surface and the outer bearing race ❷. Add these 2 values plus crankcase gasket together.
Place the radius ring on crankshaft, magneto side. Then

measure the overall width of the crankblades (including radius ring).
Deduct crankshaft value from that of crankcase. The resulting figure is the axial play and should be 0,2 +0,4 mm. If it is more, fit shims as required between radius ring and ball bearing, but only on magneto side.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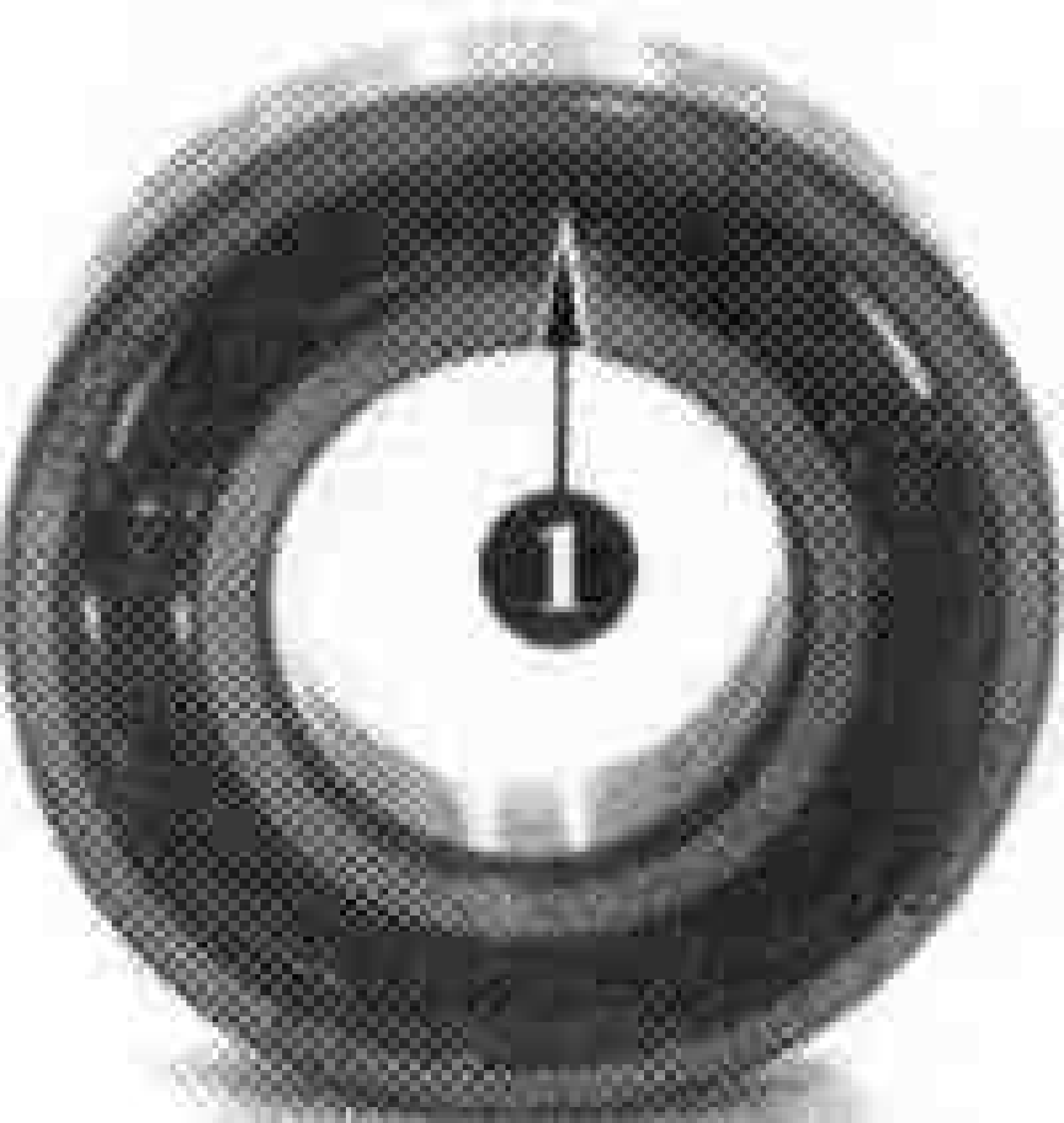
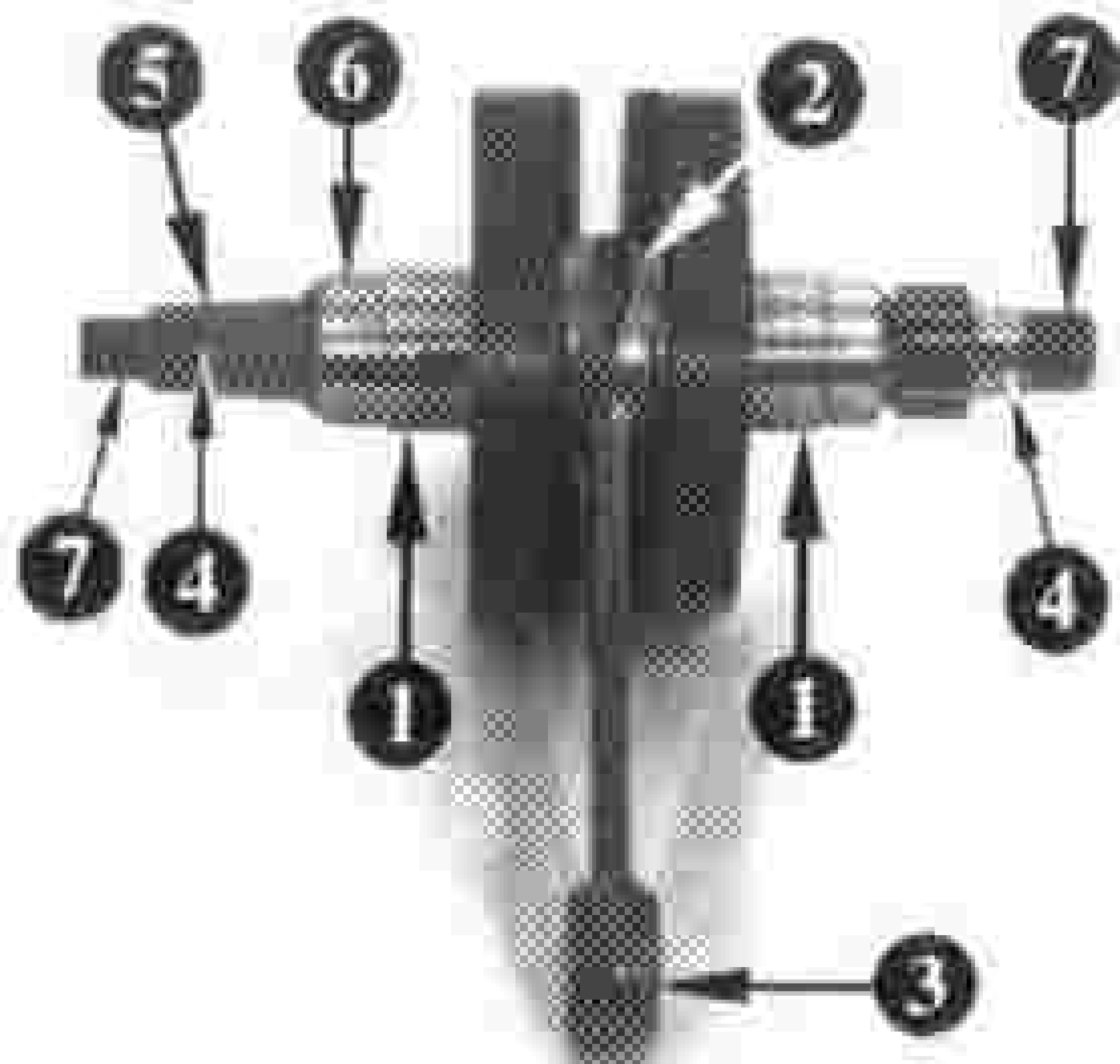


Check the following points on crankshaft:

- crankshaft between centres for eccentricity (max. 0,03 mm), measure on bearing seats ❶
- radial play in con rod bearing ❷ (0,015 to 0,026 mm, max. 0,05 mm)
- con rod axial play (0,590 to 0,937 mm, max. 1,3 mm)
- piston pin bore in con rod ❸ (max. play 0,03 mm)
- grooves ❹ for Woodruff keys
- taper surface ❺
- bearing seats ❶ and surfaces ❻ for oil seals
- threads ❼ on the 2 crankshaft ends.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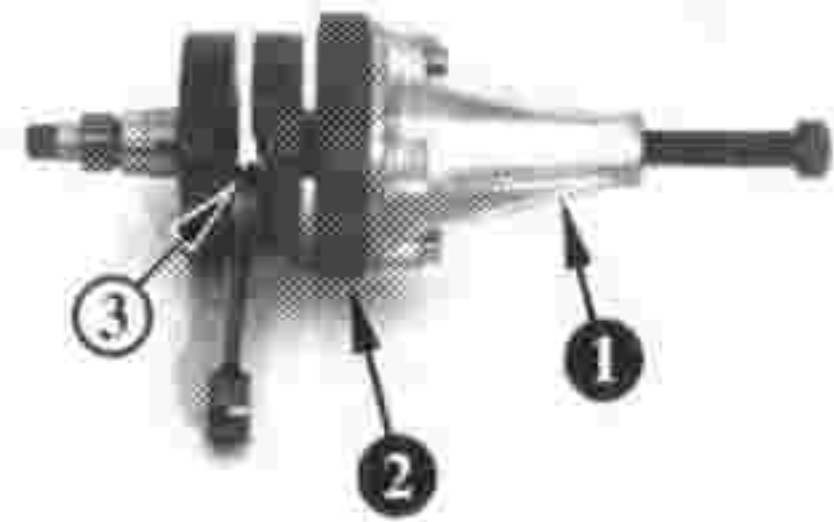
When pressing out the crankshaft, the magneto side ball bearing may remain on the crankshaft. It may be removed with bearing puller ❶ *876 298*, ring halves *276 025* and ring ❷ *977490*. On clutch side the crankshaft is a sliding fit.
If the con rod bearing ❸ is defective, use crankshaft repair kit consisting of con rod, crank pin, needle bearing and thrust washers. These parts are matched together and must only be replaced as a kit. Special equipment is required to press the crankshaft assembly apart, and this work must be entrusted to specialists.

Balance shaft, balance drive gears:

Check the 2 bearing seats ❹ and the circlip groove ❺. The balance shaft need not be measured axially. Check the 2 balance shaft drive gears for cracks and the inside and outside teeth ❻. Replace these gears every 15.000 km.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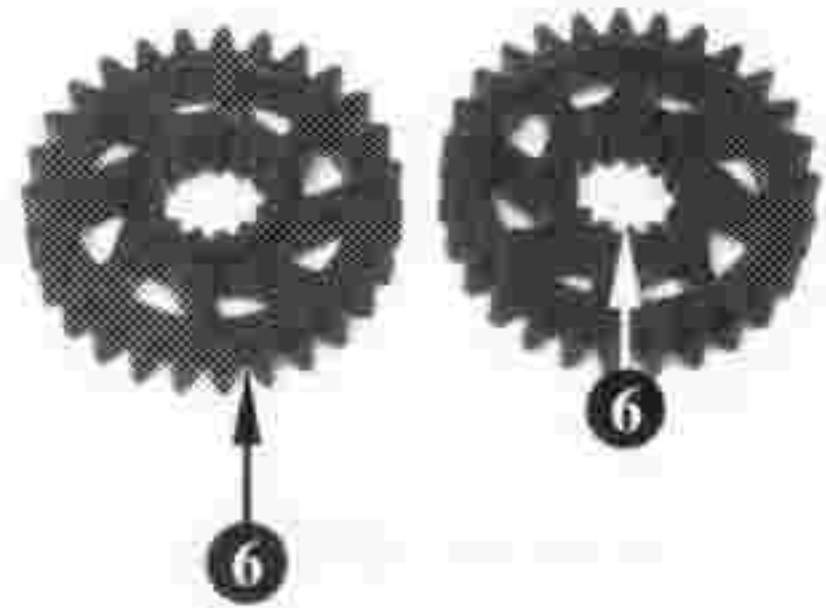
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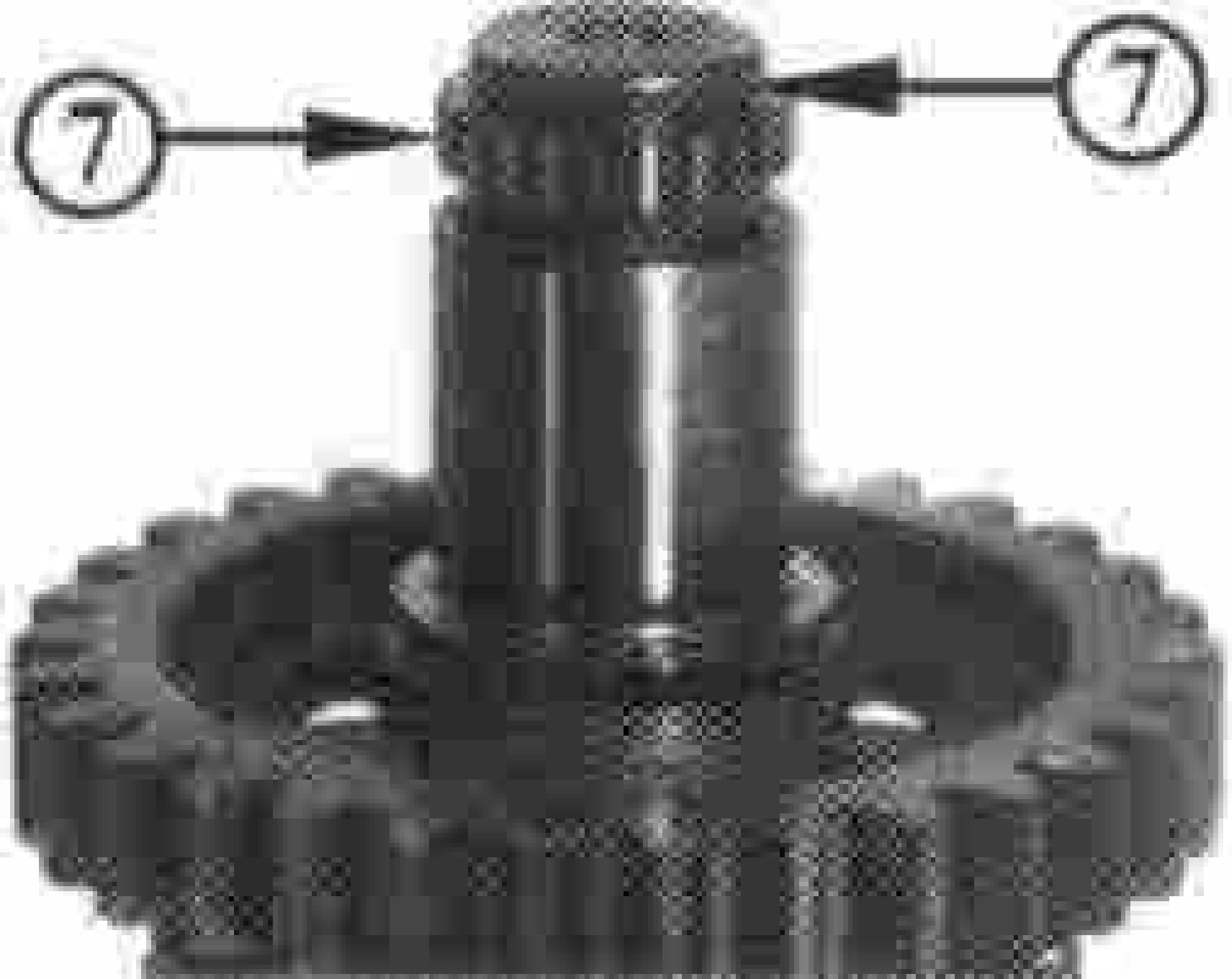
Transmission:

Fix mainshaft (resp. clutch shaft) in a vice using protective jaws. Remove gears, and observe the following points:

1. Check needle bearings for wear.
2. Check bearing seats on both shafts.
3. Check gear dogs for wear.
4. Check tooth flanks of all gears for wear.
5. Check tooth profile of clutch shaft and mainshaft as well as their matching gears for wear.
6. Check all sliding gears for easy movement along their splines.
7. tooth profile for sprocket and groove for circlip

Carefully clean all components, replacing any damaged parts. Gears should always be replaced in pairs. Check clutch shaft and mainshaft for truth between centres.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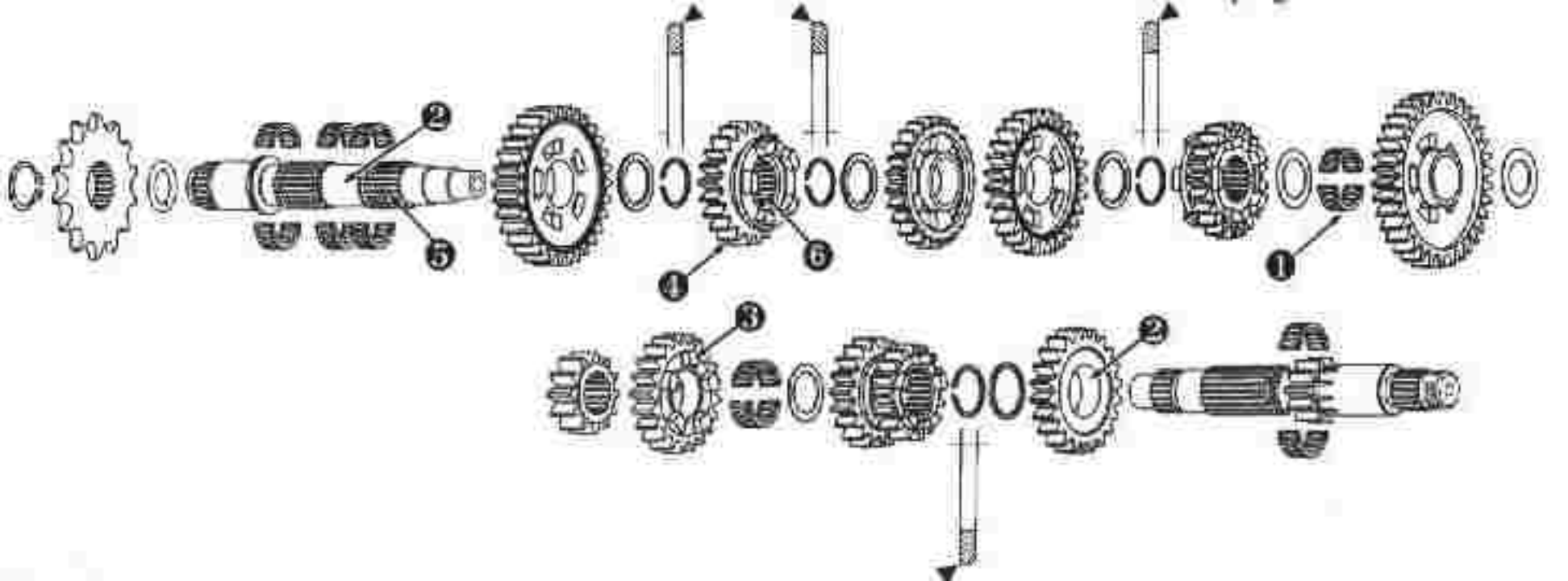
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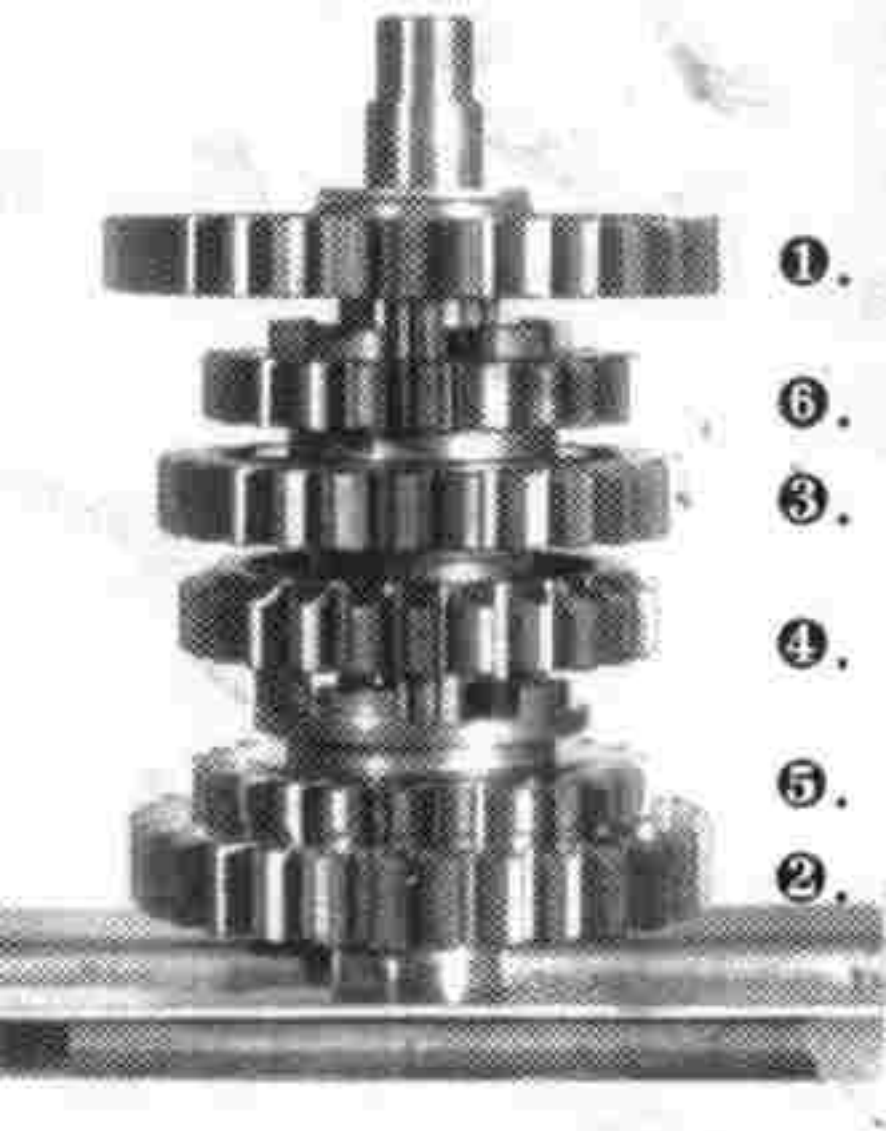
Mainshaft assembly (Enduro, Custom, Strada, Rally):

Fix mainshaft in vice using protective jaws with splines for chain sprocket downwards. Lubricate the split needle bearing (10 mm wide), fit it on shaft, slide ❷nd gear free pinion, collar downwards, over the bearing and fix it with thrust washer and snap-ring (sharp edge facing upwards).
Push on ❸rd gear with slot for shift fork upwards, mount snap-ring with sharp edge downwards, slide angular ring with recess downwards over the splines of mainshaft.

Lubricate and fit the split needle bearing (10 mm wide) on the shaft, and fit ❶st gear free pinion with collar upwards.



Lubricate and fit the split needle bearing (10 mm wide) on the shaft, and fit ❸(c) gear free pinion with collar downwards, and fix with thrust washer and snap-ring (sharp edge upwards).

Assemble ❻th gear with slot for shift fork facing downwards, fit thrust washer, needle cage 10 mm and ❶st gear free pinion with collar upwards, and fit thrust washer.

Clutch shaft assembly (Enduro, Custom and Rally):

Fix clutch shaft in vice using protective jaws with threaded end downwards. Lubricate the split needle bearing (10 mm wide), fit it on shaft, slide ❻th gear free pinion, dogs upwards, over the bearing and fix it with thrust washer and snap-ring (sharp edge upwards).
Push on ❽th/❹th gear pinion with ❸rd gear (smaller din. gear) downwards, fit thrust washer, lubricated needle bearing and ❺th gear free pinion with dogs downwards. Then fit ❷nd gear pinion (symmetrical).

Main- and clutch shafts for AF1 (Strada):

Assembly is same as for Enduro. Only the pinions of ❺th and ❻th gears are different.

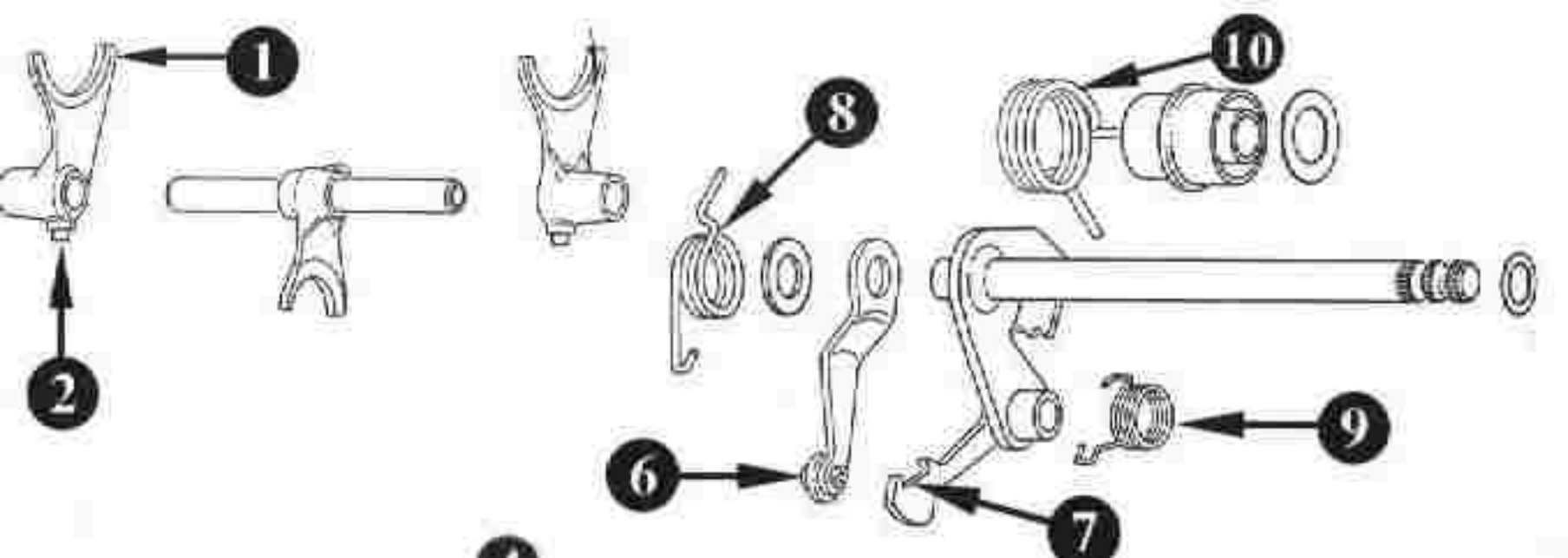
	5th gear	6th gear
Enduro	21 : 23	22 : 21
Strada	21 : 24	22 : 23

Gearshift mechanism:

- Check shift forks for wear on their blades ❶ and engagement pegs ❷.
- Examine tracks ❹ on shift drum ❸ for wear and make sure that index profile disk ❺ is securely fastened to the shift drum body.
- The index lever roller ❻ must turn freely.
- Check pawl ❼ of shiftshaft for wear.
- Examine index spring ❽, pawl spring ❾ and hairpin spring ❿ carefully for cracks and tension.
- Check shift shaft for eccentricity.

Gearshift drum:

⓫ = Peg for neutral gear indication
⓬ = Check blanking shim
⓭ = Neutral position of index disk (between 1st and 2nd gear).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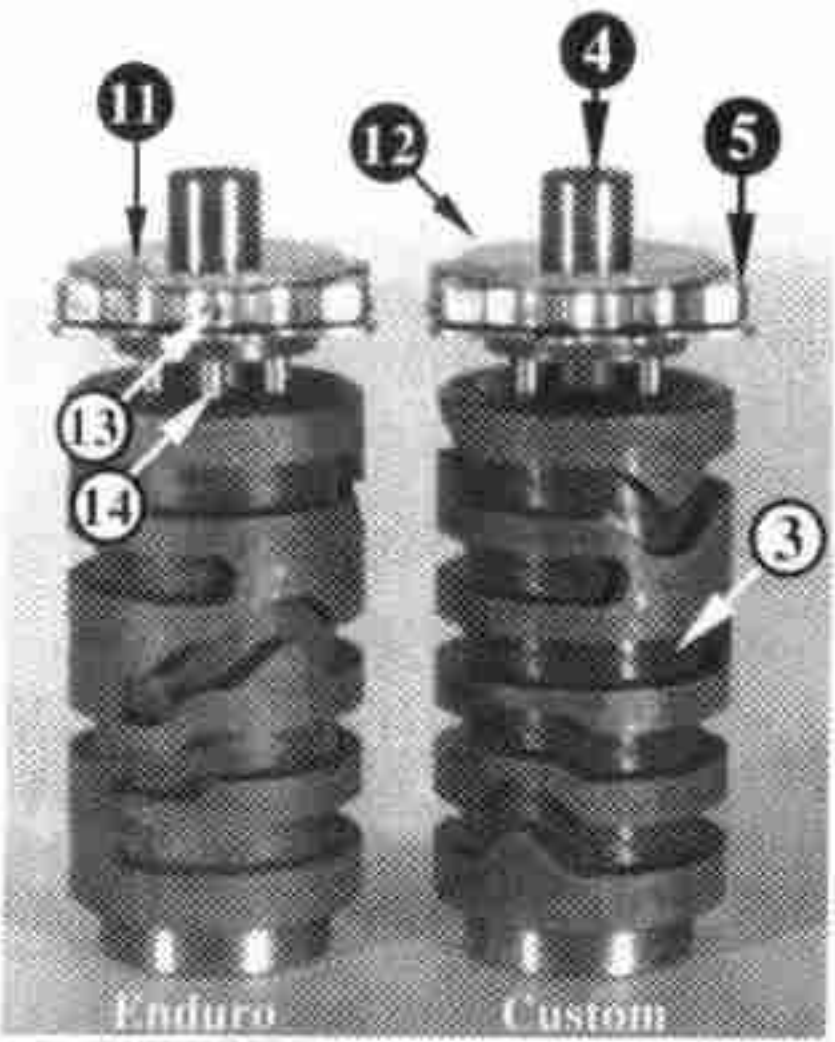
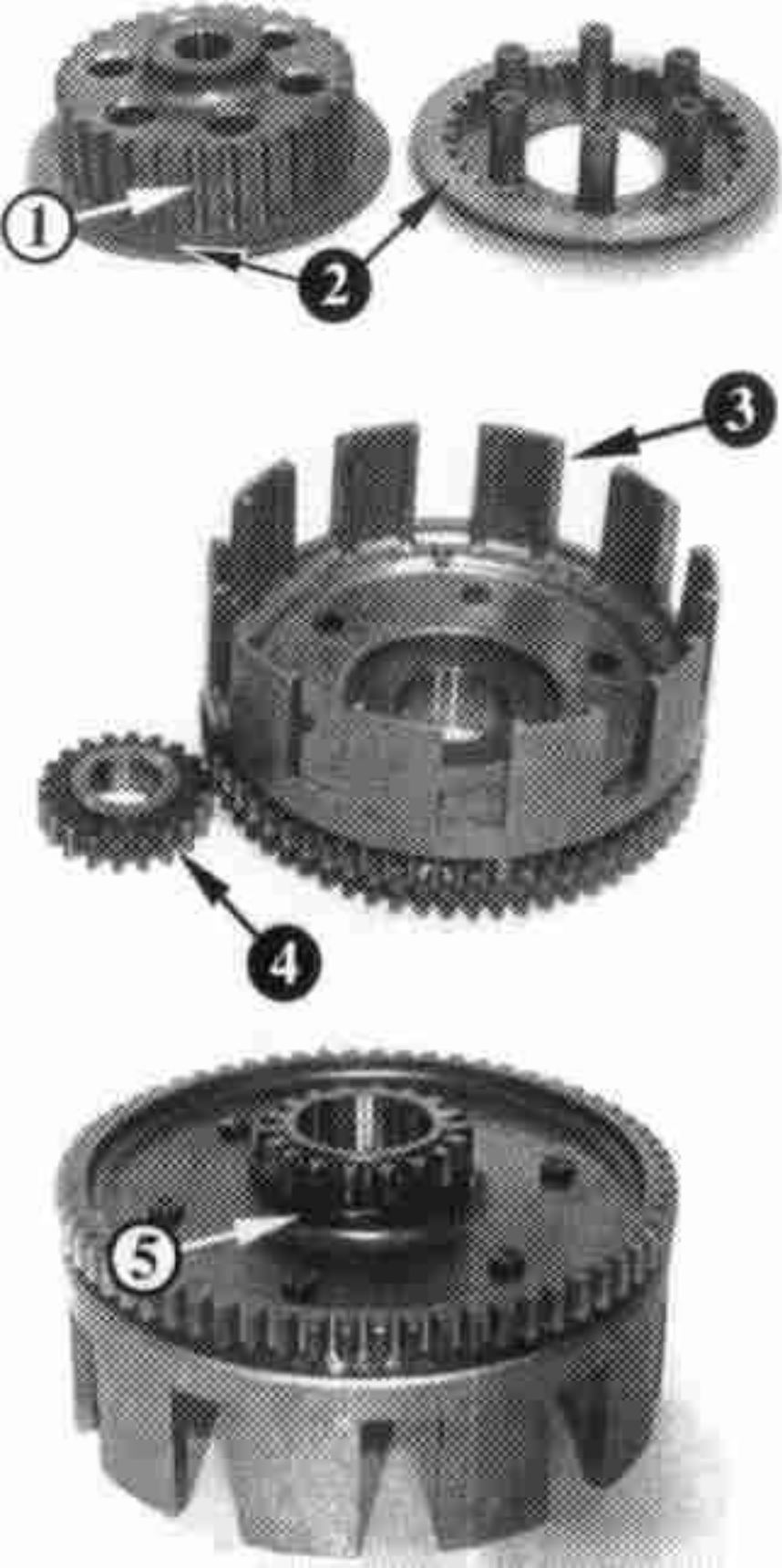


ATTENTION: On engine type 123 Custom with reversed gearshifting sequence there is no pin (13) under the neutral position (13)

Clutch:

Check needle bearings, friction and steel clutch plates, and retaining plate for wear. All steel and friction plates must be perfectly flat, otherwise the clutch will drag.
Check threads M5 and the friction surface ❷ of the inner pressure plate for flatness.
Check the clutch hub splines ❶ and the flat surface ❷ for wear.
Check the friction plate slots ❸ of the clutch drum for wear.
Check teeth and tooth flanks of primary drive gears ❹ for wear. Replace O-ring ❺.

ATTENTION: Clutch drum assy. with gear and crankshaft drive gear are a matched pair and must not be replaced individually.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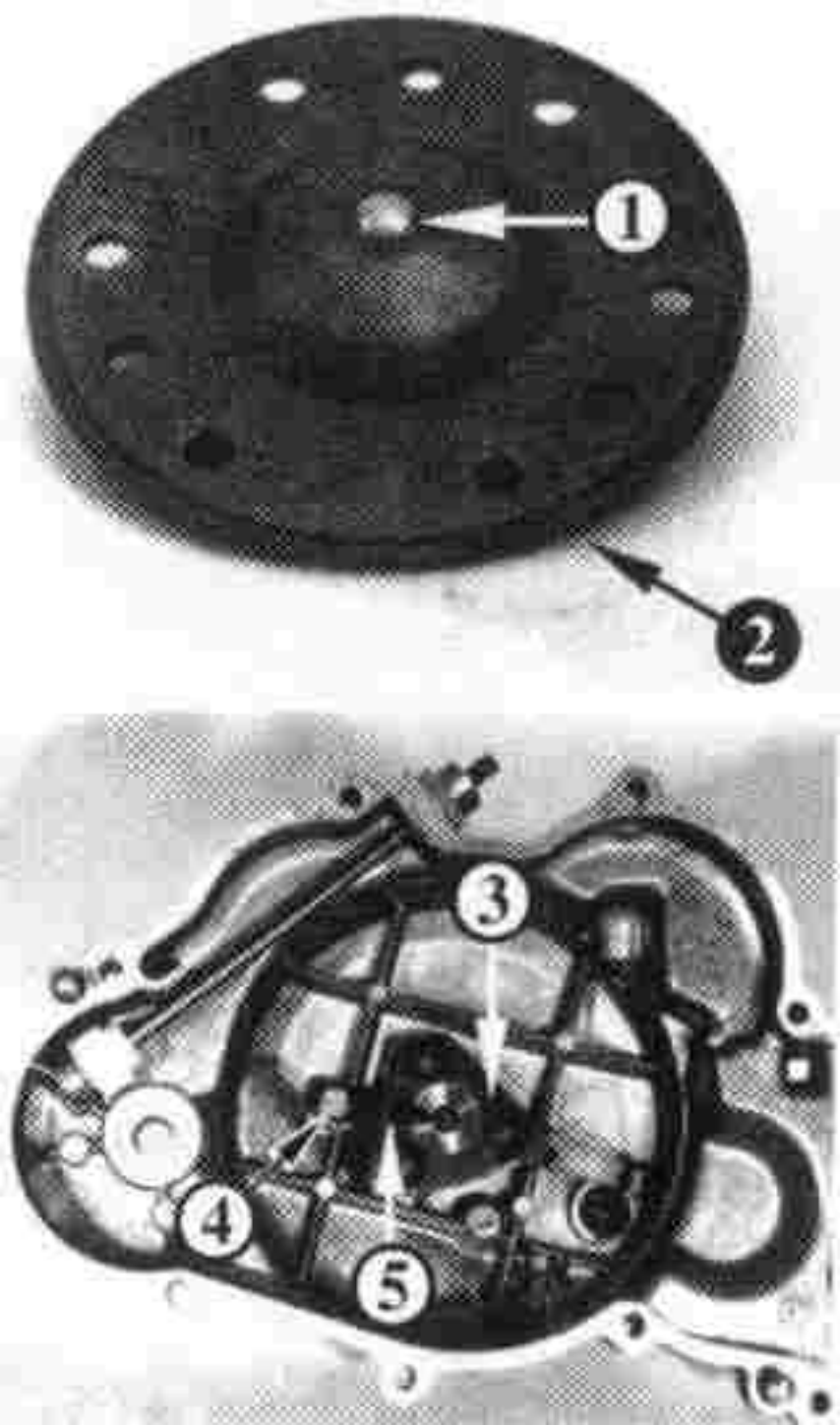
Clutch release:

Normally the clutch release mechanism ❺ is not subject to wear. If however necessary, remove the Taptite screw M5 ❹ with socket wrench 8, then the leaf spring ❻ and release plate ❸ and check the ball ramps for wear. If necessary, replace and reassemble.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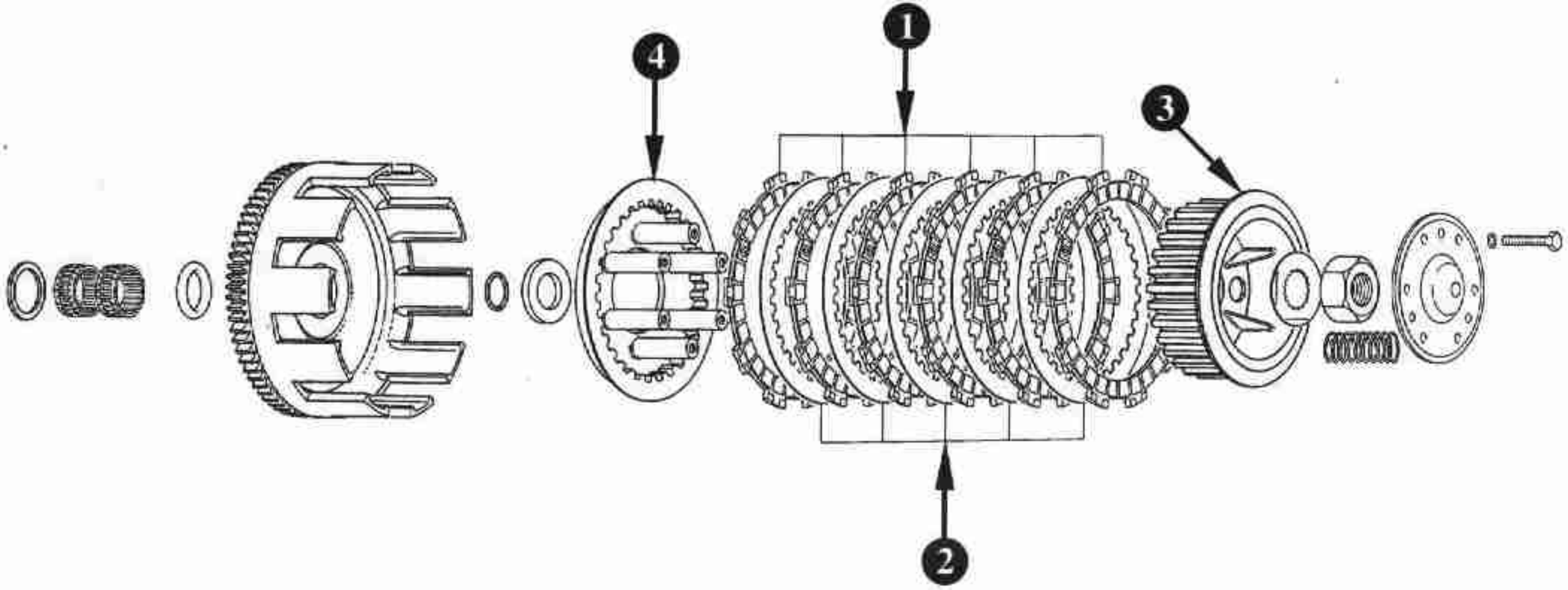
Clutch assembly:

Place clutch plates on clutch hub ❸ starting with a friction plate ❶ (3.0 mm thick) and then alternately 5 steel plates ❷ (1 mm thick) and 5 friction plates ❶ (3.0 mm thick).
Then fit the inner pressure plate ❹. The plate package (6 friction plates and 5 steel plates) should measure 23 mm thickness.
Wear limit: 21.2 mm.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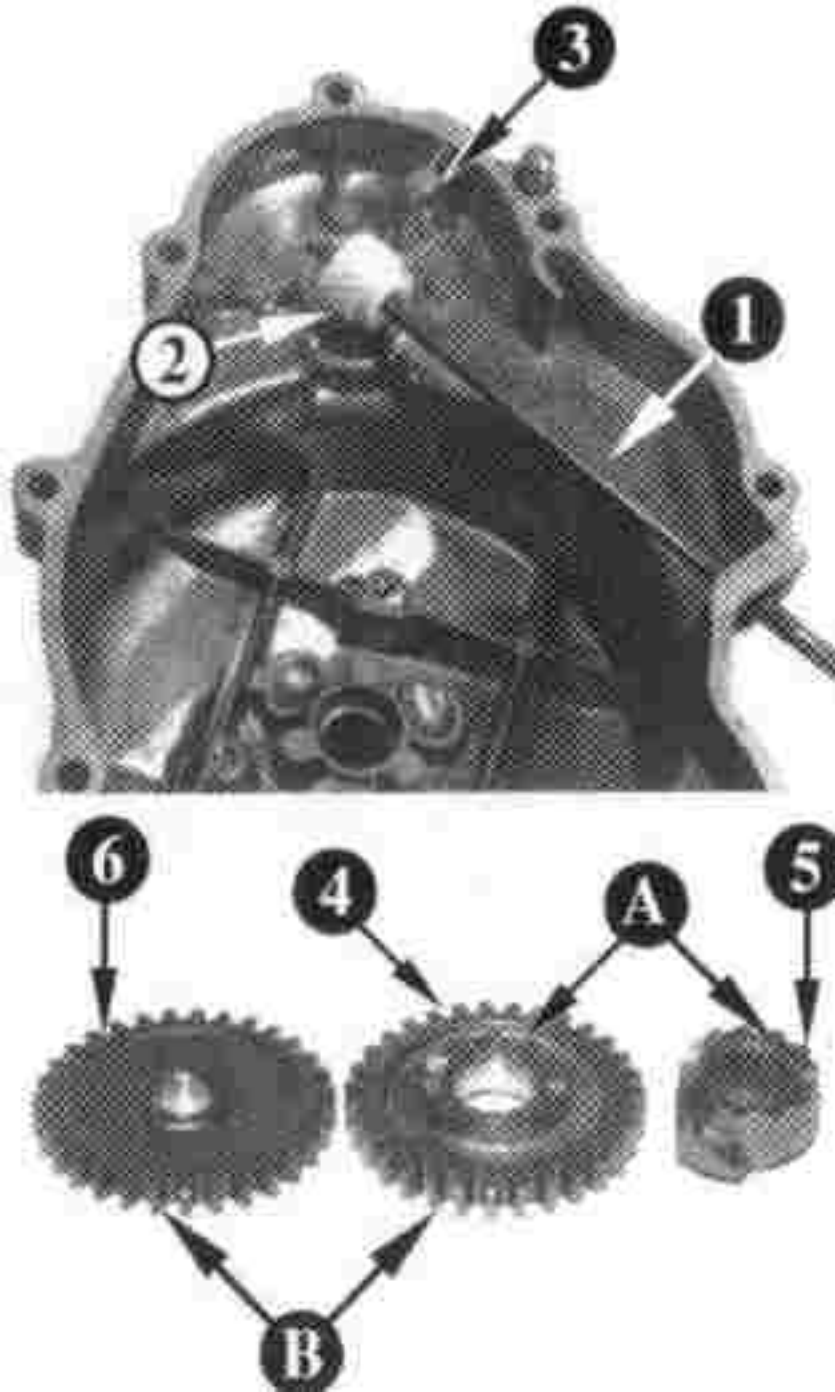
Rev. counter drive (not on Rally):

To dismantle the rev. counter drive, unscrew the hollow shoulder screw, lift the cable drive shaft ❶ with worm gear ❷ off its seat ❸. Then pull the complete shaft down. In the hollow collar screw there is an oil seal. Replace if necessary. Reassemble in reverse sequence.

Kickstart drive:

Check the teeth A on starter gear ❹ and ratchet gear ❺ as well as the tooth flanks B of the starter gear ❹, and the idler gear ❻. Examine all bronze bushings in the gears. Check kickstart spring and the splines of kickstart shaft. Replace O-ring on kickstart shaft. On engines with electric starter the kick start drive can be omitted. On engines without kickstart, the rev. counter drive is via plastic gears.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A
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B

Piston:

Remove combustion residues from piston crown ❶, check piston for cracks. Check piston skirt surface ❷ for signs of seizure. Replace if necessary.
Clean piston ring grooves and blast with compressed air. The piston rings must be able to move freely in their grooves.
Piston ring groove/piston ring clearance must not exceed 0,2 mm max. Check piston ring locating pegs for security.

ATTENTION: Combustion residues must not be removed with piston still installed.

Piston/cylinder clearance:

123 Enduro, Custom, Strada, Rally: 0,02 ÷ 0,032 mm
Inversion "SVIZZERA" (=Switzerland) 0,03 ÷ 0,042 mm


1
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Piston dimensions:

Standard red 53,98 mm, green 53,99 mm, Oversize 54,00 mm and 54,01 mm. For version "SVIZZERA": 53,97 mm (black dot ❶).
To determine the piston/cylinder clearance, take piston diameter as stamped on piston top (❷ = nominal dia.)

Piston wear limit:

Difference between maximum skirt dimension and cylinder diameter must not be greater than 0,11 mm. Replace if necessary.


2
1
3

Piston rings:

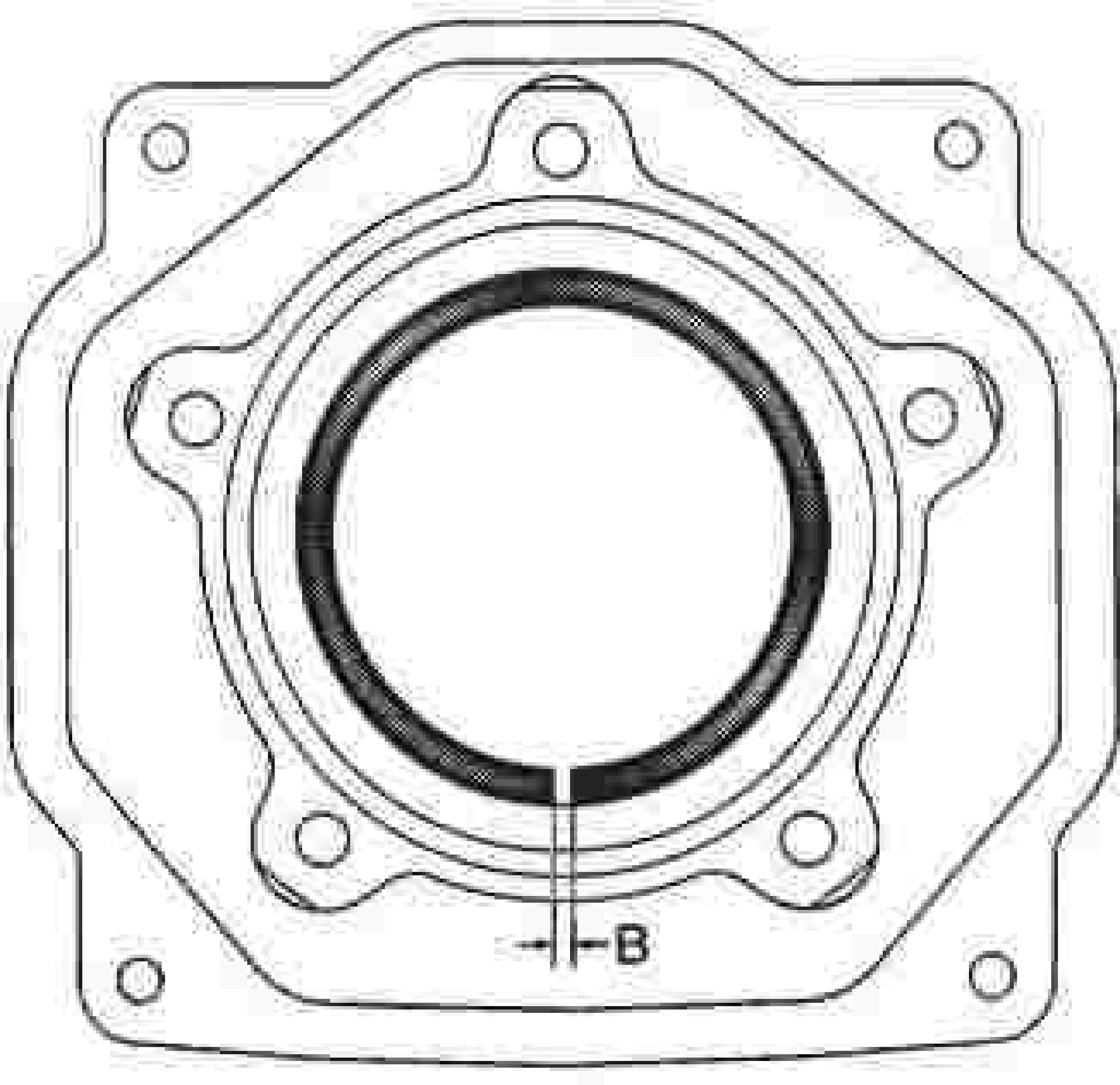
Check piston rings ❽ for clean working surfaces. Ring end gap 0,15 + 0,3 mm. Max. permissible ring end gap 0.8 mm. Replace piston rings if necessary.

Measuring of piston ring end gap:

Insert piston ring squarely into cylinder using the bare piston. The gap **B** should not exceed max. 0,8 mm and can be checked with a feeler guuge. If the gap is greater, check piston and cylinder for wear.
If piston and cylinder wear are within tolerance limits, replace the piston rings only.

Piston pin:

The max. play of piston pin in con rod small end bearing must not exceed 0,03 mm.
Check piston pin needle cage for pittings, cracks and discolouration (blueing) indicating lack of lubrication and/or overheating.
There must be no detectable play between the piston pin and bore in piston.


B

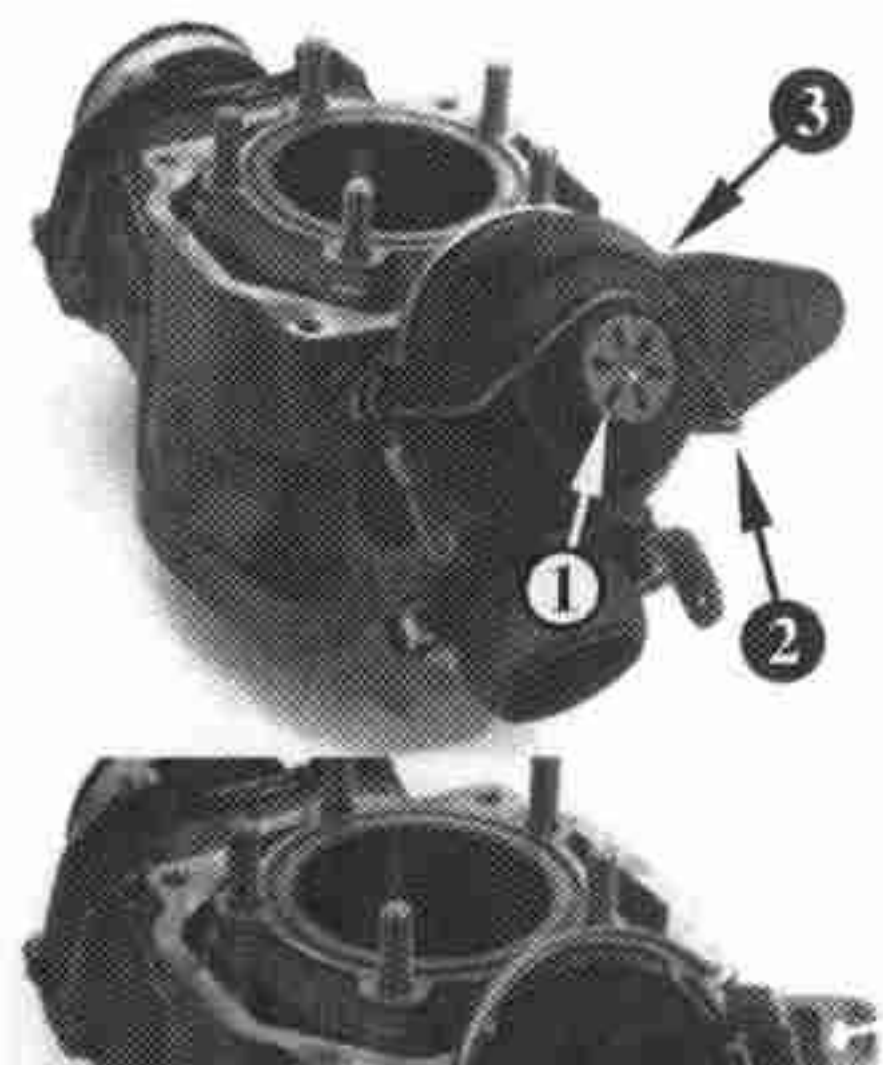
Exhaust valve RAVE II (pneumatic):

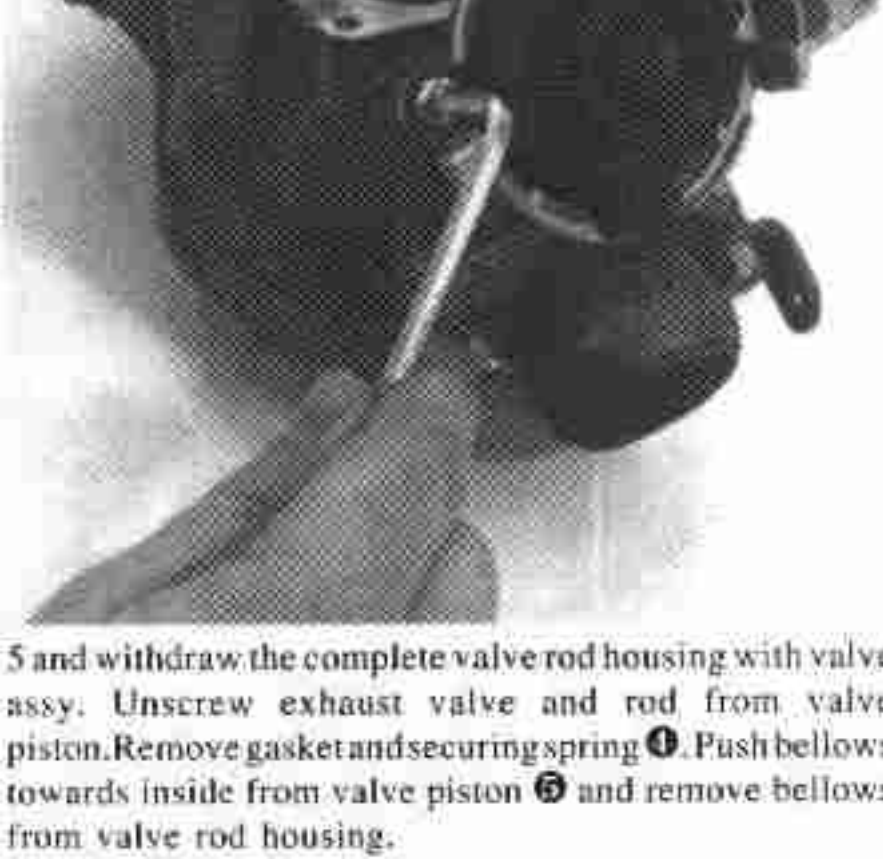
The height of the exhaust port can be varied by the exhaust valve, which is driven by pressure of exhaust gases. Pressure passes from the exhaust port to the exhaust valve mechanism via a small bore. The optimum r.p.m. switching point for actuation of the valve is controlled by pre-tension of the pressure spring. On type **AF1** there are 2 additional shims under the valve spring.

Fine adjustment with the red adjustment screw ❶ in the valve cover. Self-cleaning system via cable to footbrake.

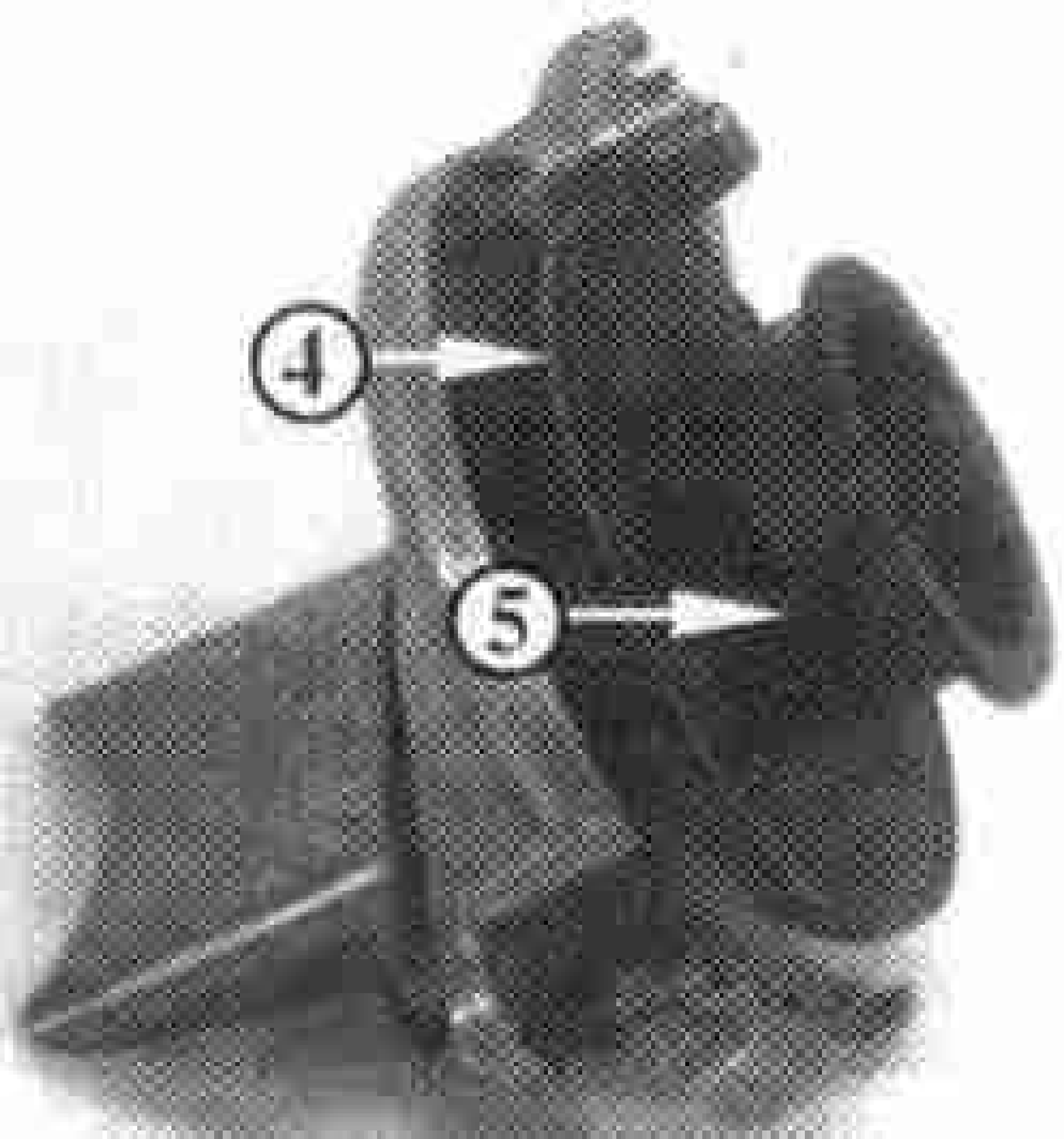
Disassembly of RAVE II:

Remove spring clip ❷, valve cover ❸ with adjustment screw ❶, pressure spring and distance shims (if any) underneath. Remove valve lever with leaf spring. Check for tightness. Remove the 2 Allen screws and spring washers with wrench





5 and withdraw the complete valve rod housing with valve assy. Unscrew exhaust valve and rod from valve piston. Remove gasket and securing spring ❹. Push bellows towards inside from valve piston ❺ and remove bellows from valve rod housing.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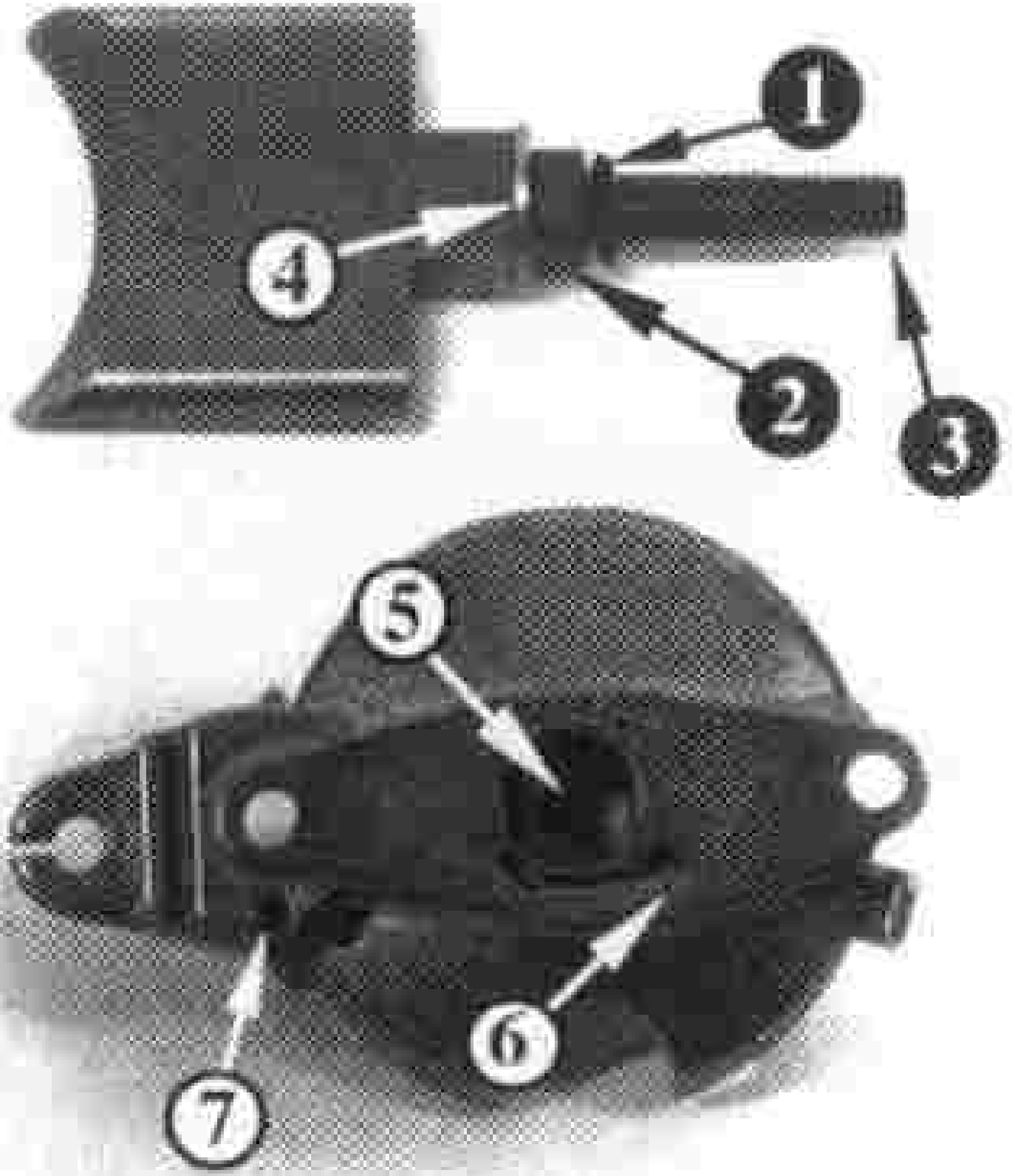
Check O-ring ❶ on valve rod, replace if necessary. This O-ring serves for shock absorption. Loosen hex. nut ❷ and unscrew valve rod ❸ with shim ❹ from exhaust valve. Clean and check all parts.

Clean exhaust valve and valve port in the cylinder from combustion residues. Check bore ❺ of valve rod housing for wear. Check bore ❻ for exhaust valve actuation for free passage. Clean if necessary.

Check bellows for cracks and porosity and replace if necessary.

❼ = attachment for spring clip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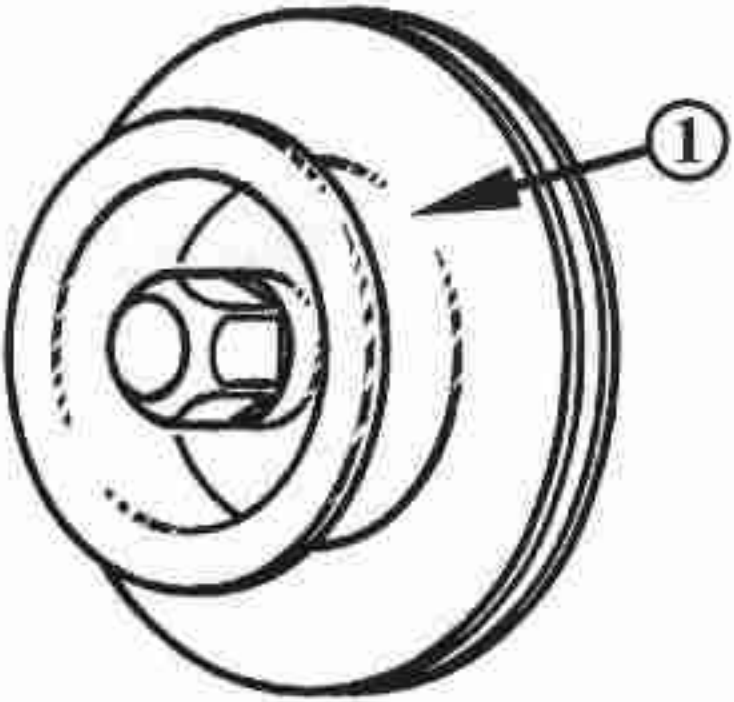
Check valve piston ❶ for cracks due to excessive tightening and deformation by overheating. The pressure spring is responsible for correct function of the system.

Pressure spring	Enduro/AF1	Rally
Free length mm	48,5	42,5
spring pressure at 14 mm spring length	8,8 N	7,3 N

As the exhaust valve is dependant upon exhaust gas pressure, a leaking ball joint ❷ will affect its efficient operation. Check this joint carefully, and replace if necessary.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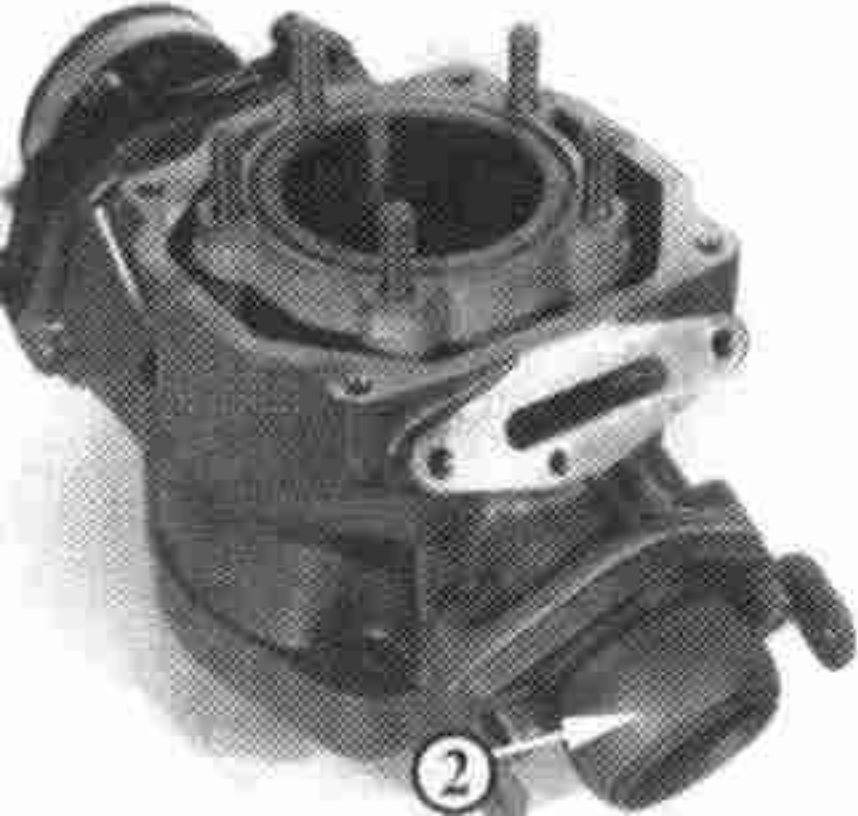
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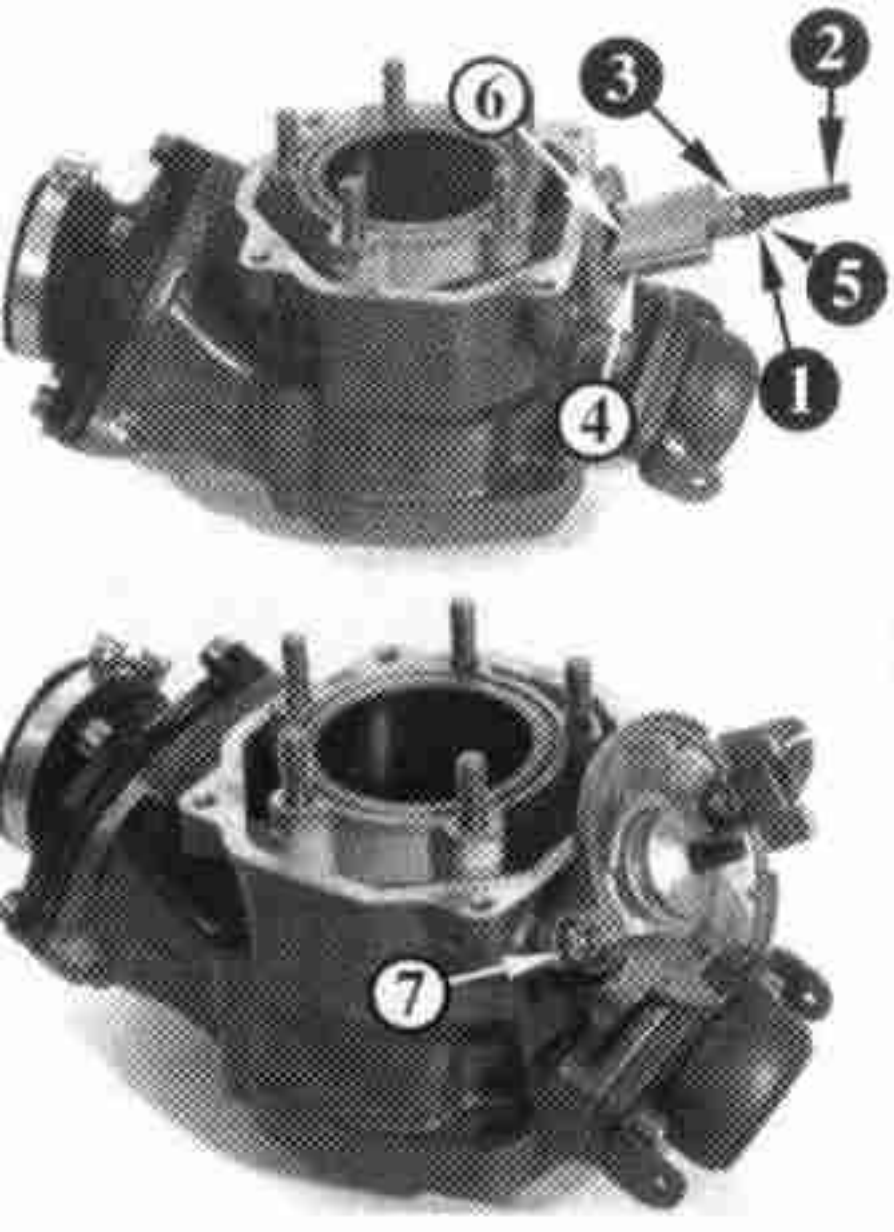
Reassembly of RAVE II:

Screw hex. nut M6 ❶ to the longer thread of the valve rod ❷. Screw valve rod with shim ❸ completely into the exhaust valve ❹ and lock with hex. nut.

On type 123 Rally the shim ❸ and hex. nut ❶ are different.

ATTENTION: Secure hex. nut M6, valve and valve rod with LOCTITE 648 (strong). If this nut loosens, the valve will cause severe engine damage.

Fit O-ring ❺ and push exhaust valve with sharp edge ❻ upwards into the cylinder. Place gasket correctly and fit valve rod housing with 2 Allen screws ❼ and spring washers.
Check valve rod for free movement. If necessary, loosen the 2 Allen screws and reposition housing.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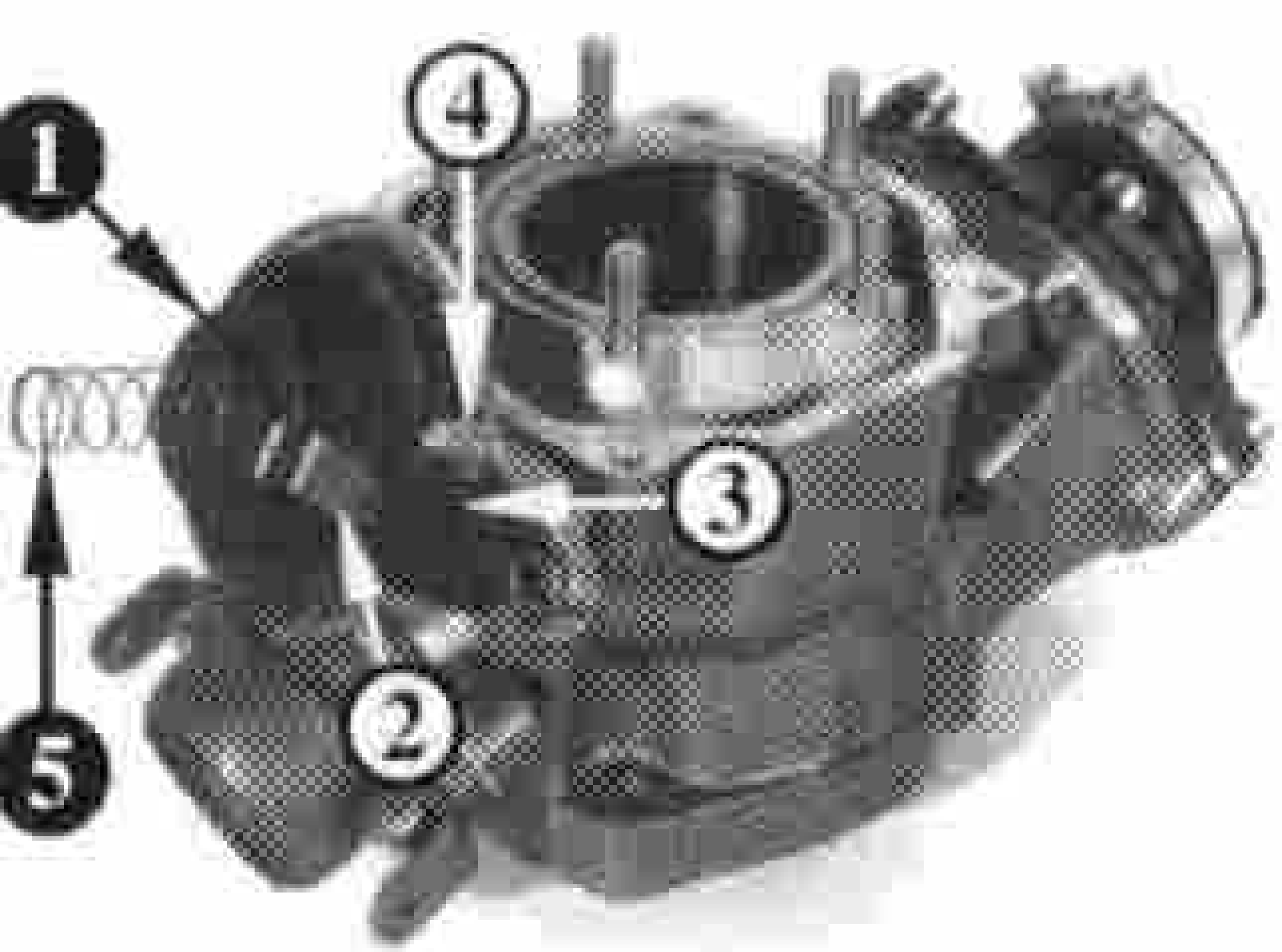
Push bellows onto valve rod housing (rim must be well seated in the groove). Screw valve piston ❶ carefully by hand onto the valve rod taking care not to damage it by overtightening. Fit bellows very carefully using a blunt tool, and secure bellows with the spring fastener. Insert leaf-spring ❷ into valve lever ❸, position lever in the valve piston and mount it on the 2 supports ❹ on the valve rod housing. Fit distance shim (if there was one when dismantled) and pressure spring ❺ on valve piston. Fit valve cover with adjustment screws, then fit spring clip and fix valve cover.
Tighten red adjustment screw until level with cover.

ATTENTION: Check exhaust valve for free movement. It must on no account protrude into the cylinder bore. Check adequate clearance between edge of valve and piston when fully closed (min. 0,4 mm). Check with an engineer's ruler ❻ (see ill.) and a 0,4 mm dia wire.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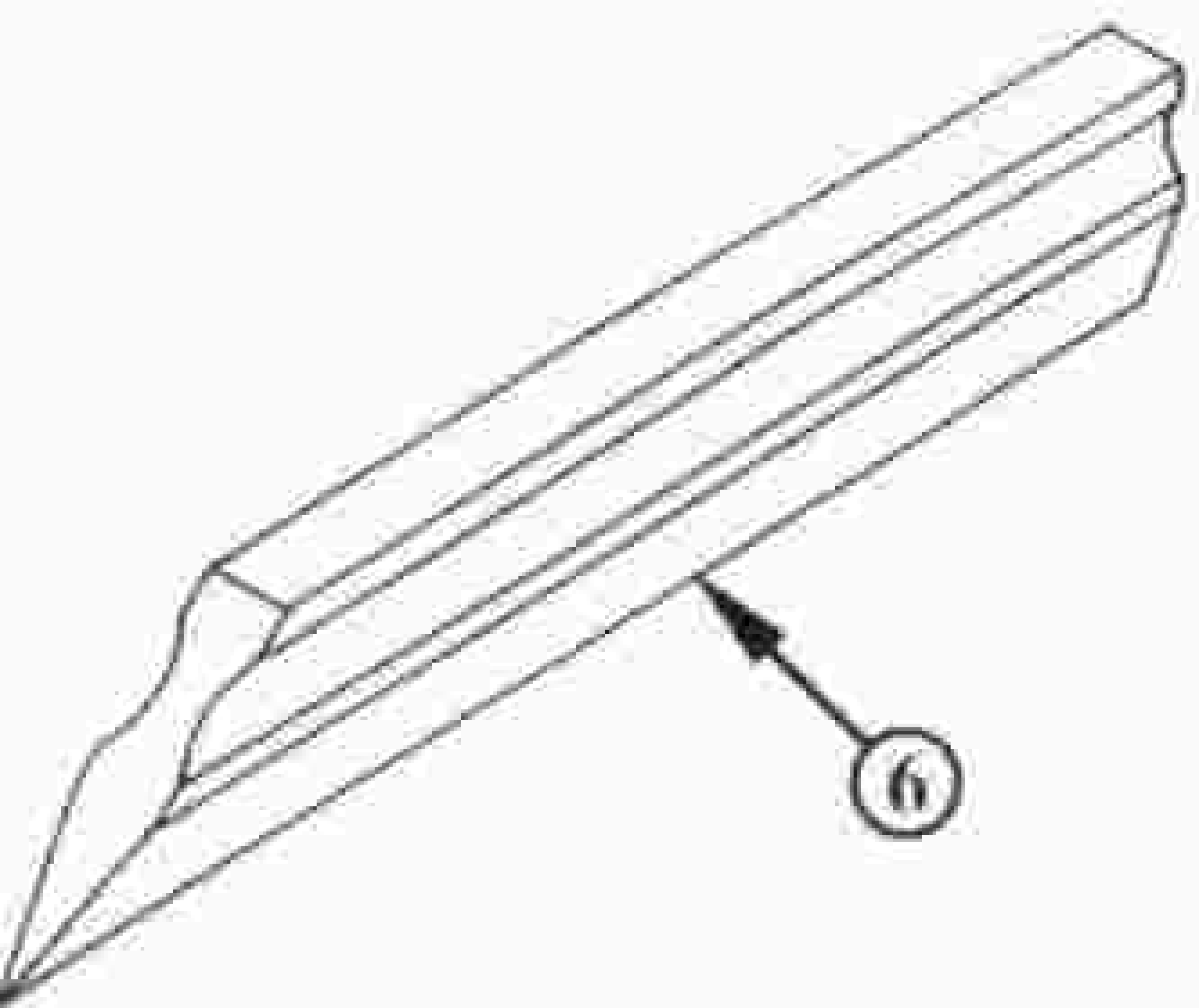
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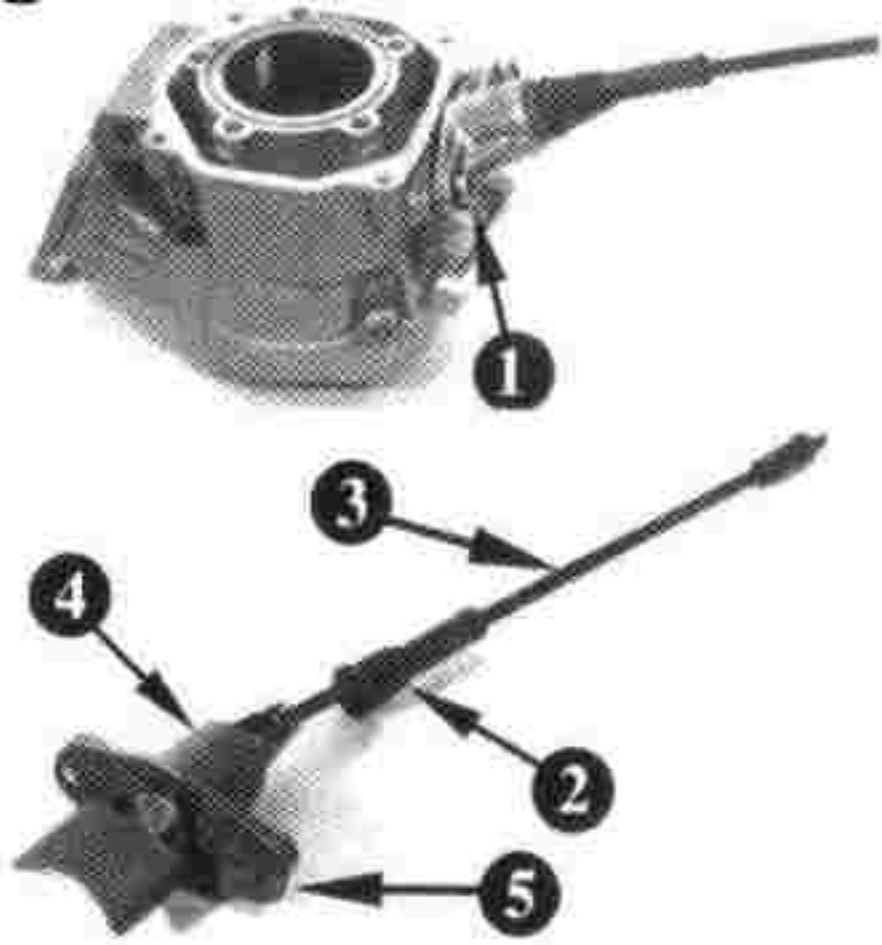
Exhaust valve RAVE-E (electronic):

In this case the exhaust valve is operated by an electro-magnetic servo, via Bowden cable. The servo is controlled by an electronic box which reads engine RPM from the low-voltage side of the ignition circuit. For check and setting procedures see page 82.

Disassembly of RAVE-E:

Remove the 2 Allen screws ❶ with lockwashers and withdraw



the complete valve assembly with gasket. Push protection cap ❷ back, pull the cable ❸ back until it can be removed from the valve rod.

Remove the exhaust valve with rod, gasket and spring. In the valve rod housing ❶ there is an O-ring and a shaft gasket. Check and replace if necessary. If necessary, unscrew valve rod from valve. Clean valve and valve port in the cylinder from combustion residues and make a visual check. The bore in the cylinder for pneumatic valve control must be blocked. Free length of exhaust valve spring: 36,3 mm. Spring pressure at 18 mm spring length: 7,3 N. Reassembly with new gasket ❺ in reverse sequence.

ATTENTION: The threads on valve rod and lock-nut must be secured by means of LOCTITE 648 green (strong). If this nut loosens, the valve will cause severe damage.

ATTENTION: Check exhaust valve for free movement. It must on no account protrude into the cylinder bore. Check adequate clearance between edge of valve and piston when fully closed (min. 0,4 mm). Check with an engineer's ruler and a 0,4 mm dia. wire.

Cylinder:

Check cylinder bore working surface for wear. The cylinder diameter must not exceed the nominal dia. (= 54,03 mm) by more than 0,07 mm. Ovality and taper tolerance: 0,02 mm
Clean the bore ❶ for exhaust valve actuation. Remove combustion residues from exhaust port. Clean O-ring grooves and check them.

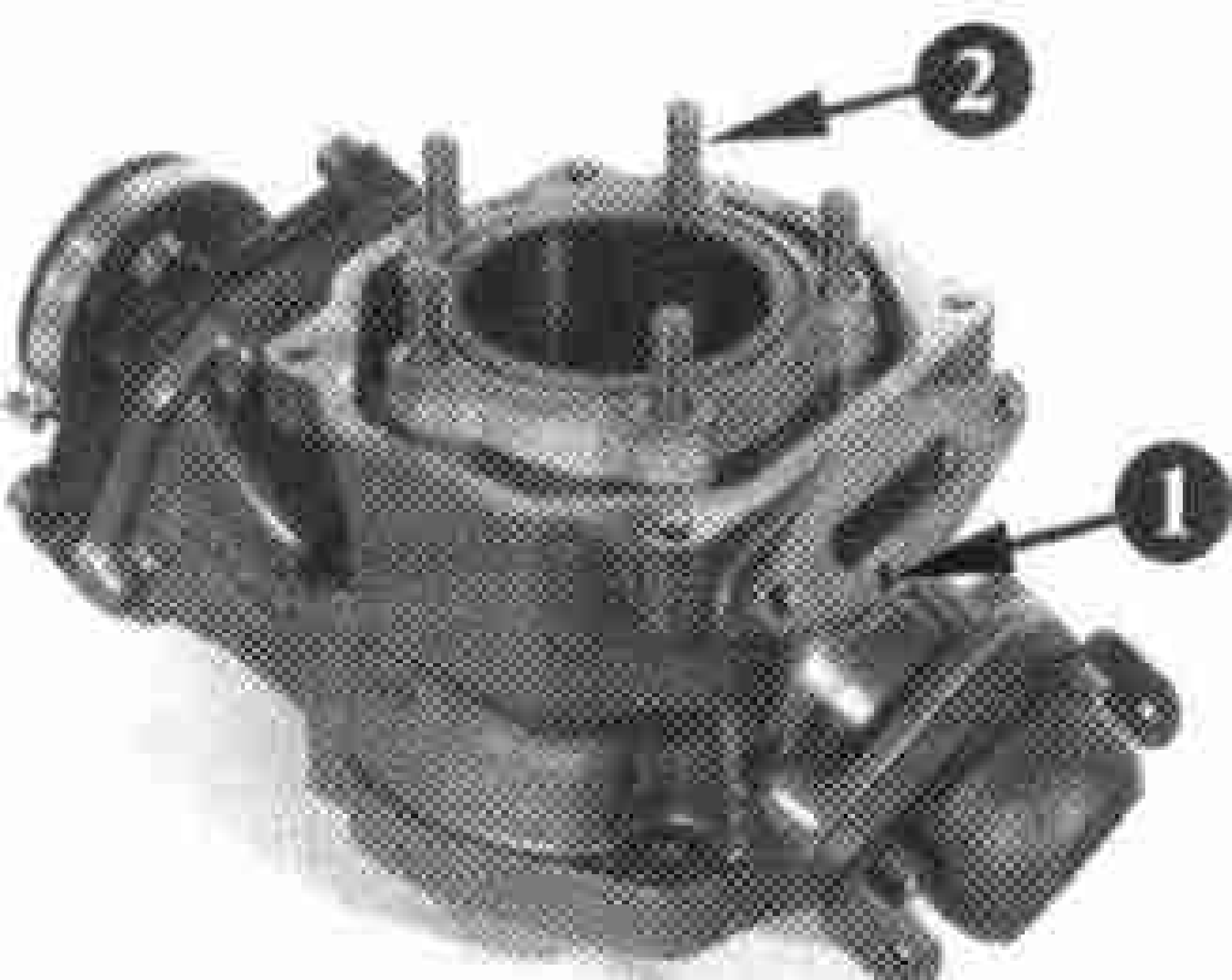
All sealing surfaces must be perfectly flat. Check threads for studs ❷.

Cylinder diameters (for all versions 123):

Cylinder 'A' (red) = 54,00 - 54,012 mm
Cylinder 'B' (green) = 54,012 - 54,024 mm

Cylinder/piston clearance:

See chapter "Piston".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Combustion chamber insert:

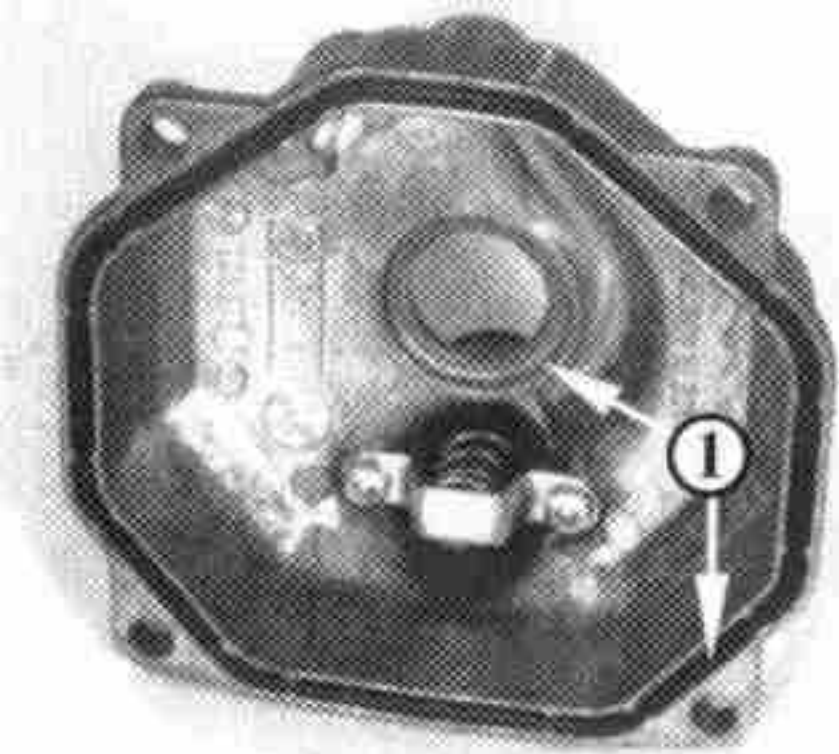
Check sealing surfaces to be clean and flat. Clean combustion residues from combustion chamber and check for cracks. Check spark plug threads.

Cylinder head jacket:

In the cylinder head jacket is the thermostat and threads for temperature sensor. Check for clean O-ring sealing surfaces ❶.

Checking of thermostat:

Place thermostat ❷ into a pan of water and gently heat it. With a thermometer note thatat approx. 55 + 60 °C the thermostat must be completely open.
The plunger ❸ only moves approx. 4 mm. If necessary, replace the thermostat. Check spring ❹ and thermostat holder ❺.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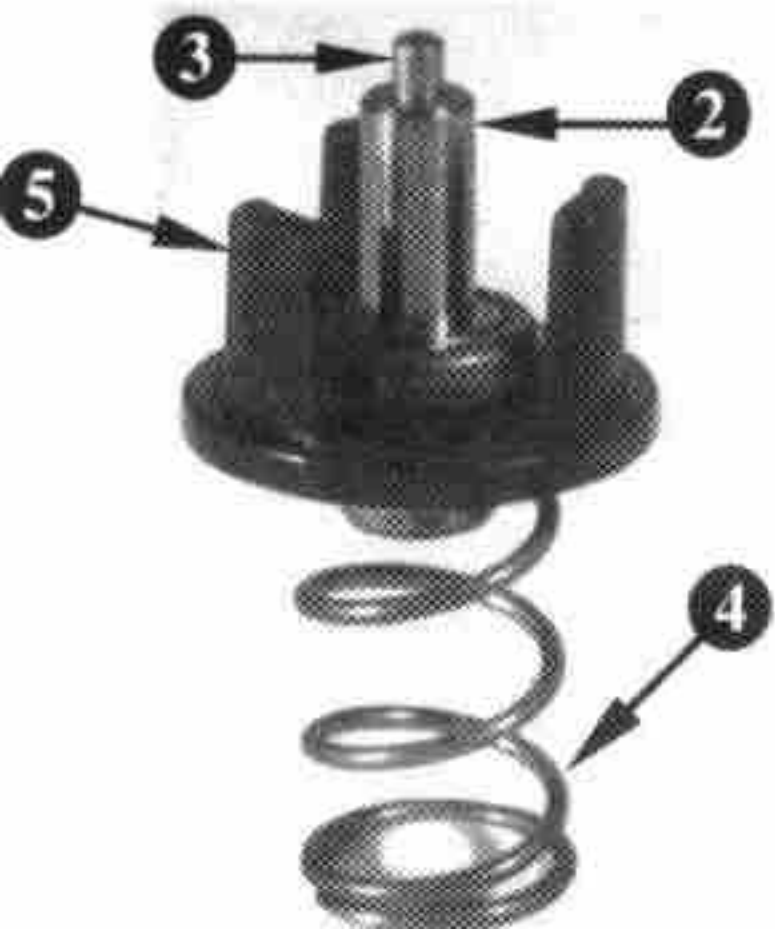
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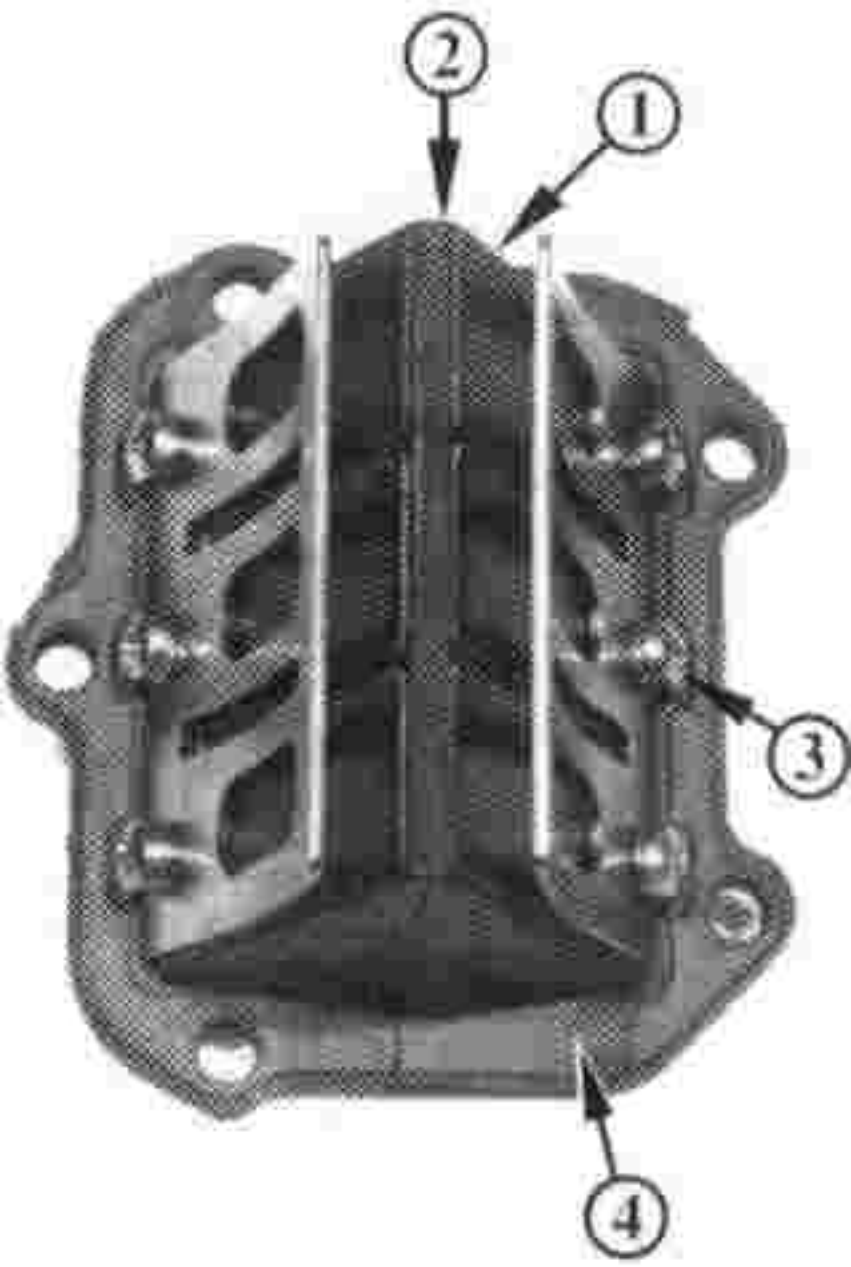
Reed valve assy.:

Check reed valve petals ❶ for cracks or other defects. The petals must lie completely flat against the valve body ❷. To check, hold against light. Check perfect condition of rubber coating on reed valve body, and valve petal fixing screws M4 ❸ for tightness. If reed petals have to be replaced, secure Allen screws M4 with LOCTITE 648 (strong).

In case of a reed valve body without rubber coating in the area of sealing surface ❹, a paper gasket 250 520 must be used.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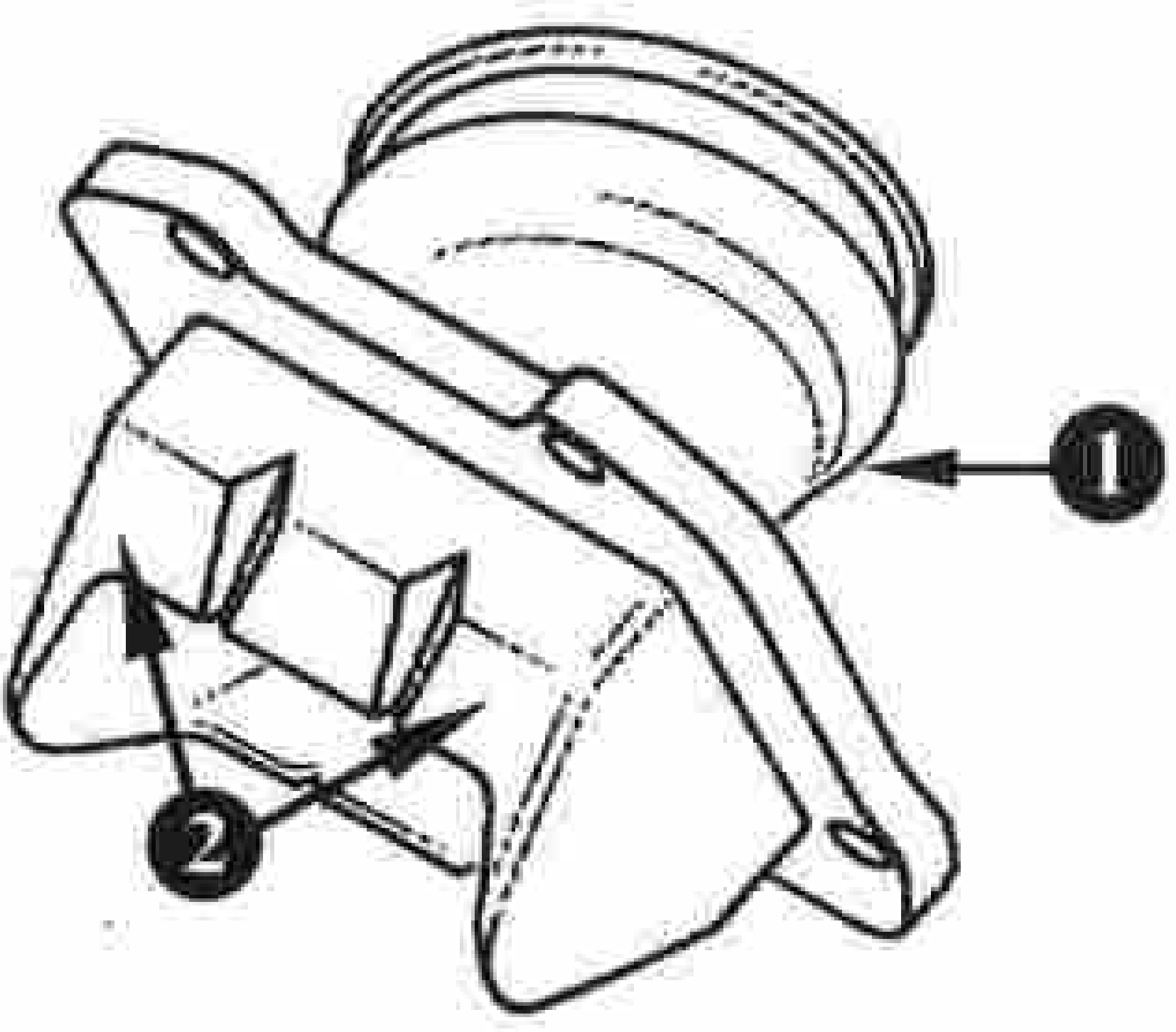
Carburetor flange:

Check for cracks and possible porosity of rubber coating. In case of the angular carburetor flange ❶, it is an advantage to shorten it in the area ❷ to a min. 4 mm distance to the reed petals, to avoid blocking of reed petals due to swollen carburetor flange.

Exhaust socket:

Check the ball joint ❸ for damage and the bore for spring mounting brackets ❹.

An untight ball joint causes malfuction of the pneumatic exhaust valve.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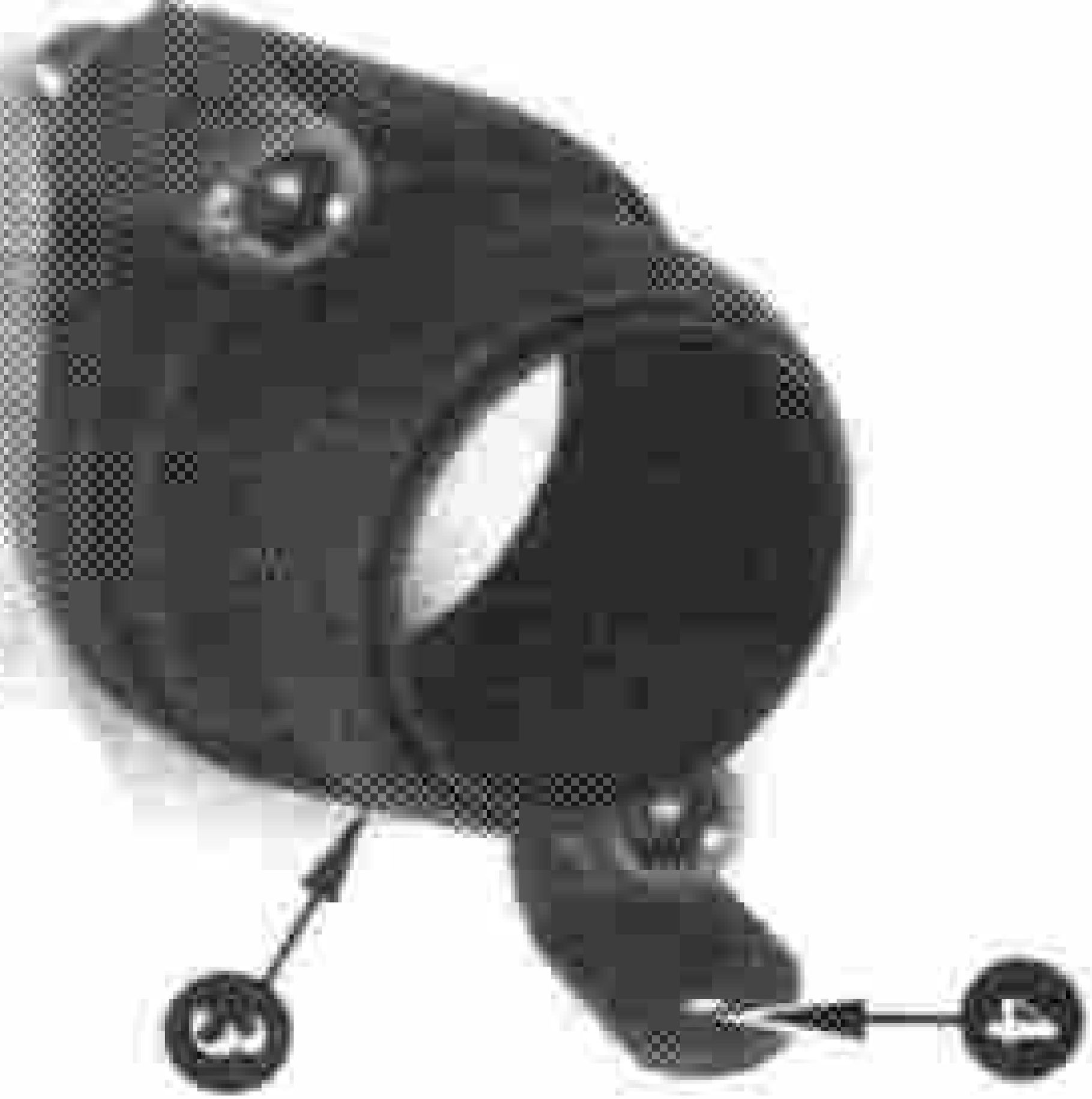
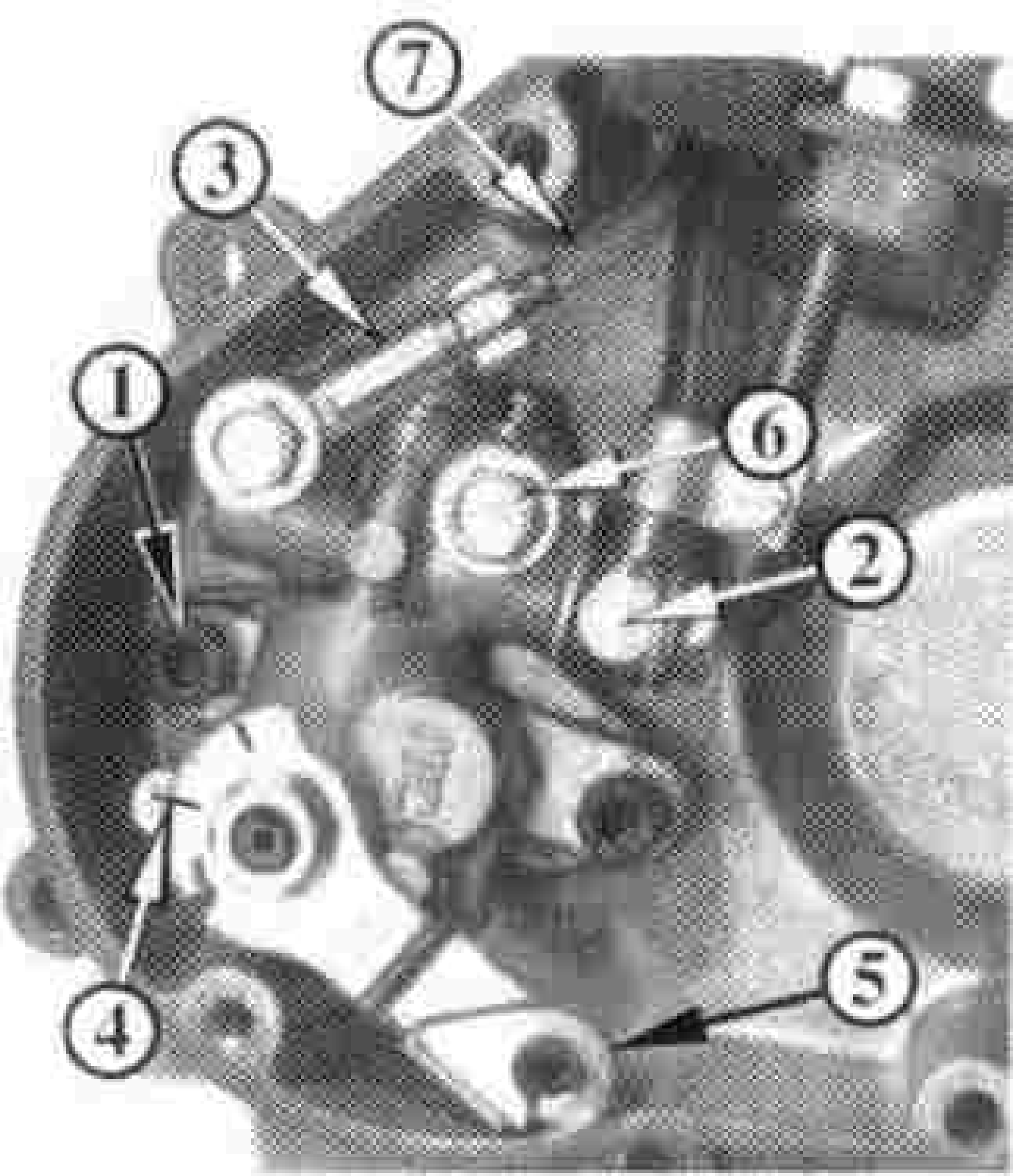


Oil pump:

Remove the 2 Allen screws ❶ with lock-washers and the oil pump. Remove banjo ❷ and check valve ❸, clean and check for free passage.
Carefully clean oil tank, oil filter and oil line. If the oil pump is leaking, the cover gaskets, O-ring, sealing ring and oil seal can be replaced, or a new oil pump may be fitted.

When connecting the oil pump control cable, the cable must be adjusted so that the marks ❹ on pump lever ❺ and pump housing are in alignment at carburetor idle position.
ATTENTION: The check valve must lock in direction towards oil pump.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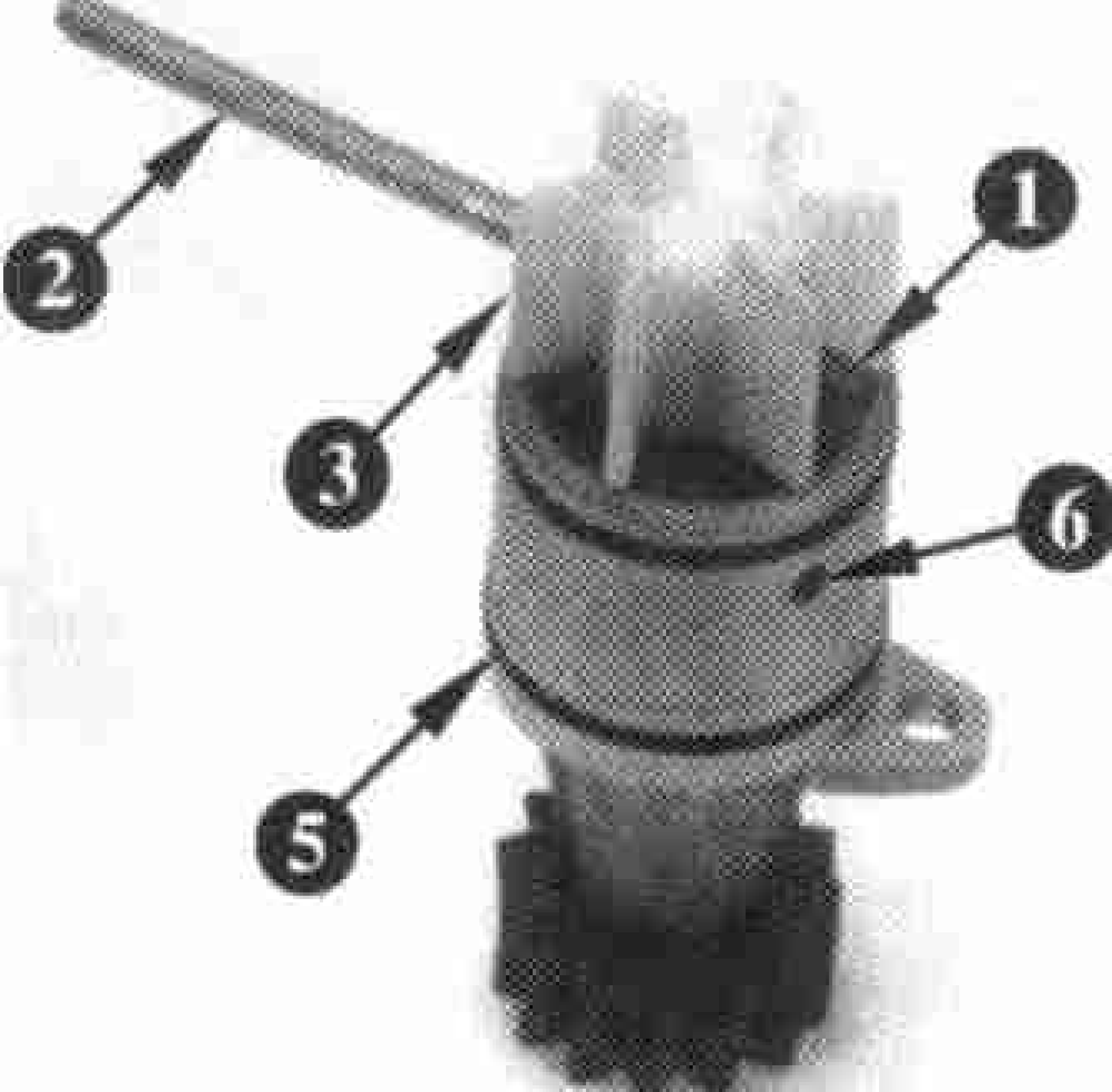
After connection of the oil lines, the oil pump has to be vented. Open the vent screw ❻ until oil without air bubbles comes out.
Also the oil feed line must be free of air bubbles.
Check function of oil pump on the pressure tube ❼, with engine running.
From engine serial no. 251833 the oil pump 293 197 is fitted. On type 123 Rally it was fitted from beginning of serial production.

Water pump:

Remove the slotted spring pin ❶ with a suitable punch ❷ and remove the impeller ❸ (take care not to damage the impeller). Withdraw pump shaft, pump gear and washer. Push pump gear inwards to remove it from shaft. Check parts and replace if necessary.

If the pump shaft housing is worn, replace water pump housing. If the water pump is leaking, replace the 2 oil seals ❹ and both O-rings ❺. Grease the inner oil seal, fit it with open side outwards, with punch 276 770 pressed fully down.
Grease the second oil seal and press it into the water pump housing to be level with the housing face. Check that water passage ❻ and lubrication bore for pump shaft are clear. Grease oil seals with water pump grease, e.g. MOLYKOTE 111. It is usually preferable to replace the complete pump if any parts are worn.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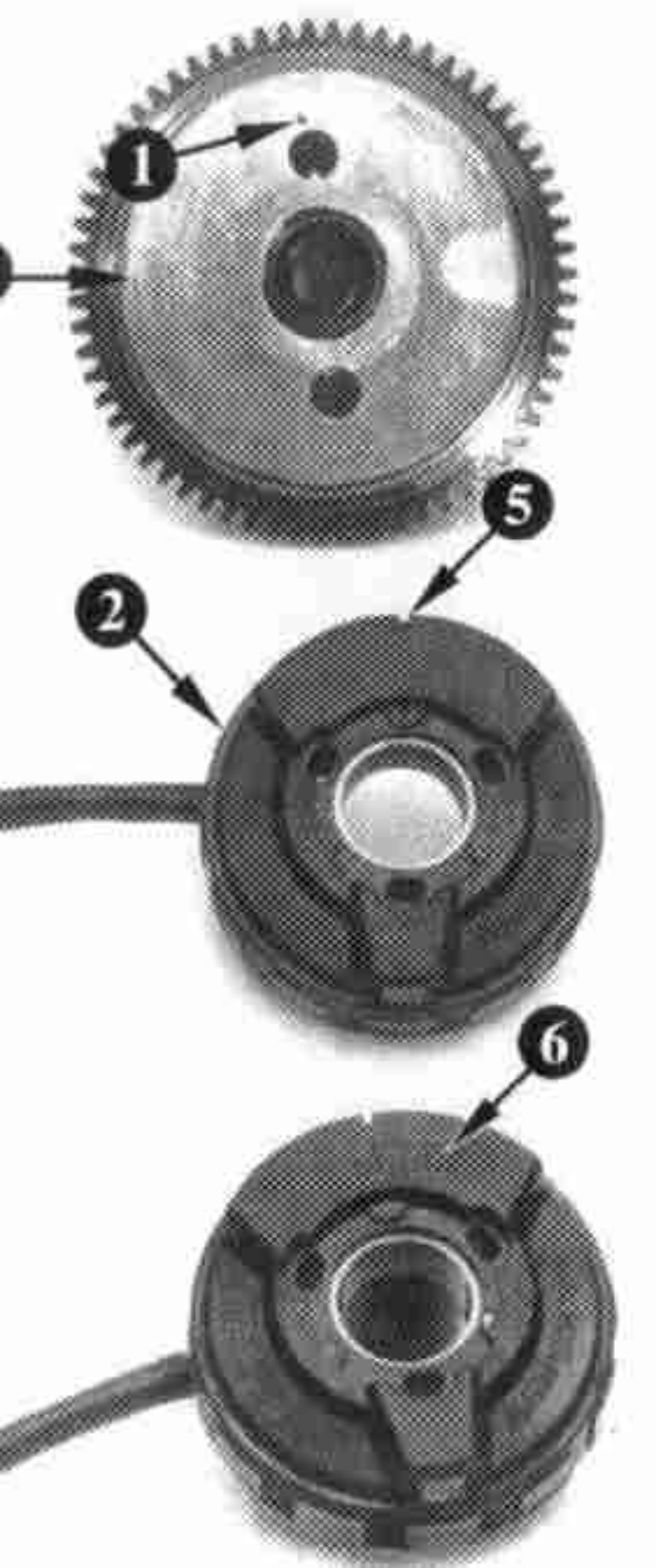
Ignition unit and generator SEM 123 Custom, Enduro, Strada, Rally:

Engine type 123 has an electronic (breakerless) SEM ignition unit with variable ignition timing and integral generator giving 12V 180W AC lighting output at 6000 r.p.m. This ignition unit has no wearing parts and requires no maintenance. Stator, magneto flywheel and ignition coil are n o t matched and can be replaced individually. Early production models of type 123 E-CUSTOM (frame no. 01101 to 01480) have an ignition unit without variable timing, and such units can be recognized by the absence of bore ❶ in the flywheel and black ignition coil. The components (stator ❷, flywheel ❸, ignition coil ❹) cannot be repaired successfully, and complete replacement is advised in the event of malfunction. On the stator 2 there is a slot ❺ necessary for ignition timing adjustment. For version without variable timing (Custom) the scale ❻ is relevant.

Ignition coil black: without variable timing.
Ignition coil blue: with variable timing.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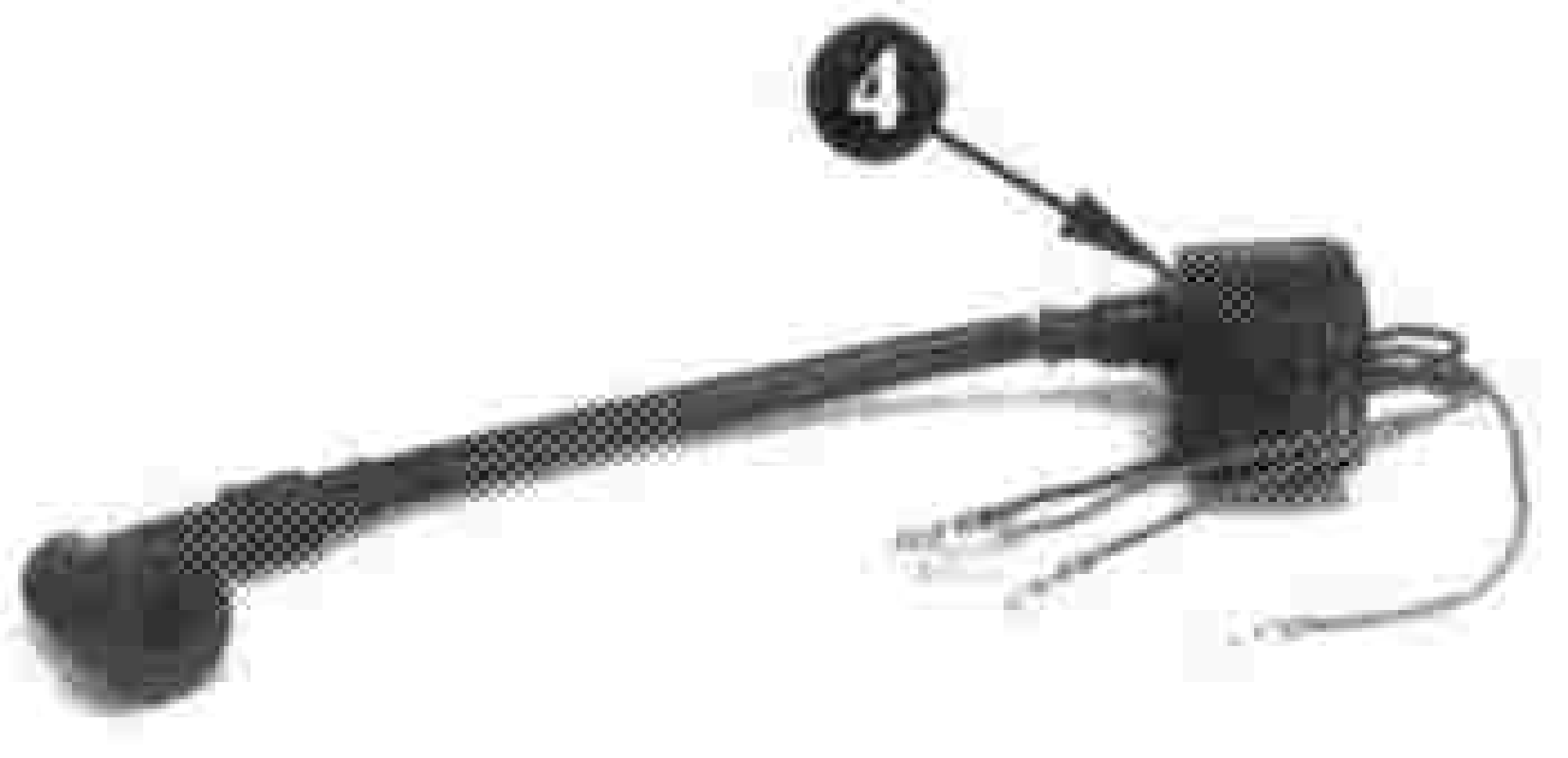
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SEM ignition unit with variable ignition timing
Checking values

Values for checking the stator

green	-	black	= 170 Ω ± 1%
black	-	stator mass	= < 0,5 Ω(responsible for function of orange shorting cable)
green	-	red	= in practice not measurable
red	-	black	= in practice not measurable
blue	-	blue	= 0,3Ω
blue	-	black	= ∞

Values for checking the ignition coil

red	-	orange	= < 0,5 Ω
red	-	black	= in practice not measurable
green	-	black	= in practice not measurable
orange	-	black	= in practice not measurable
black	-	ignition-cable	= 2,2 kΩ ± 20%

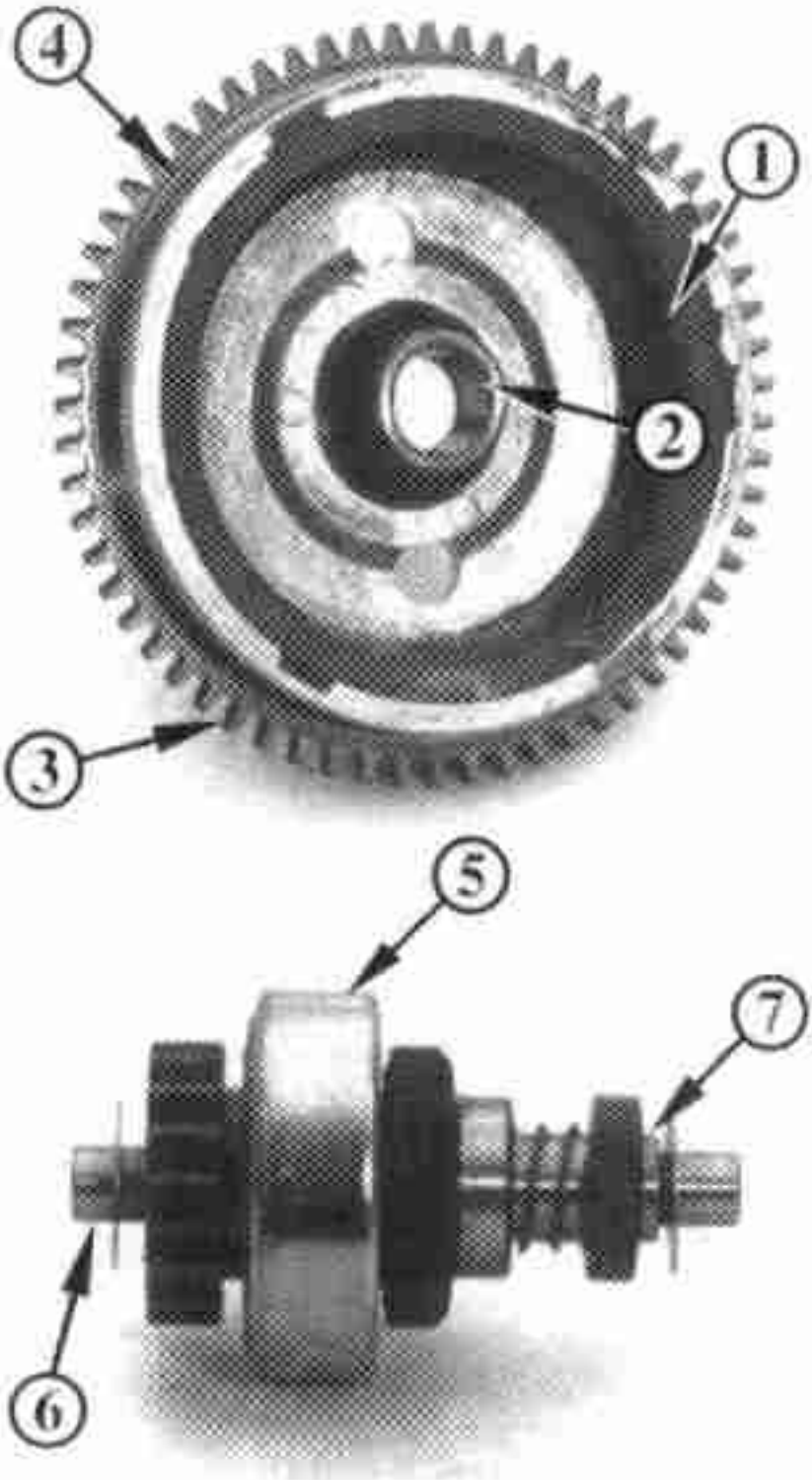
In case of doubt, test with new ignition coil.

Magneto flywheel with electric starter gear:

Check the magneto flywheel interior ❶ for damage (parts of magnets broken off), taper surface ❷ and keyway. Check the teeth ❸ of the starter gear.
If replacement of the sturter gear ❹ is necessary, it is recommended to replace the flywheel complete with starter gear.
ENDURO and RALLY models are produced both with and without electric starter. Non-electric start versions can be converted to electric starting - refer to spare parts list for necessary items. Secure the starter gear on magneto flywheel with LOCTITE 648.

Electric starter drive gear:

Check pinions and spring. The gear ❺ must lock firmly



in one direction. Check that the drive shaft ❻ tur
easily in the worm gear. Take care that the securi
circlip ❼ is well seated.

Electric starter:
After dismantling check the following parts:

❶ **Armature**:Check for out of round, inspect visually. If necessary, rework carefully on a lathe. Use a fine saw blade to trim back the insulation leaves between commutator segments (see ill. A). The insulation should be 0.5 mm deeper than the segments. Check armature at 24 Volts with test lamp between commutator and iron core for connection to earth. If the lamp lights up, indicating a short-circuit, the armature must be replaced. Check armature windings at 2 to 4 Volts and ammeter (measuring range 60 A) for open circuit (see ill.**B**). If the ammeter indicates big differences between the individual segments, the armature has to be replaced. Check the splines and radial play.

❷ **Needle bearing and bushing**: Replace if necessary.

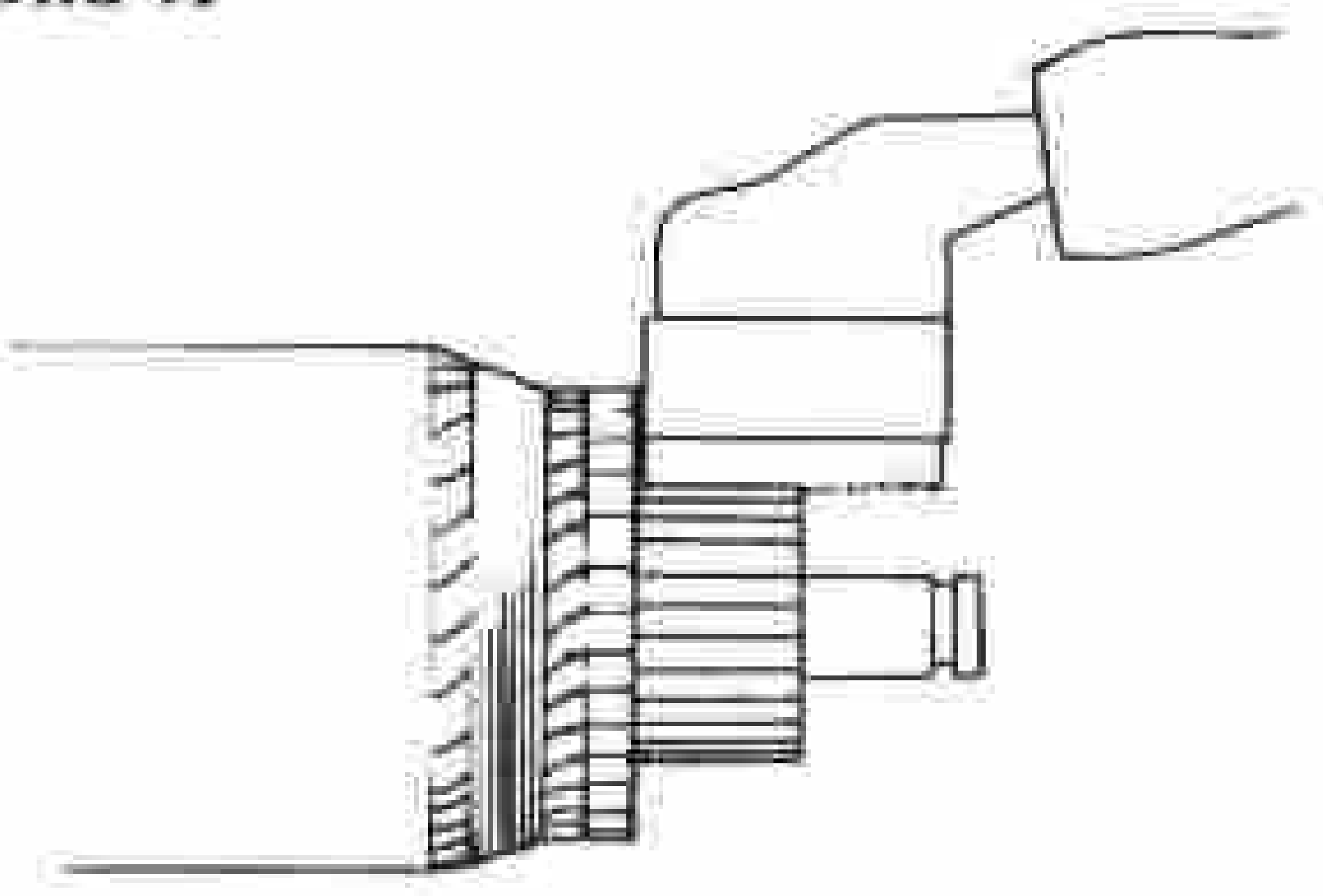
❸ **Check starter drive** for perfect function of free-wheel, check tooth flanks, replace if necessary.

❹ **Carbon brushes**: Must be able to move freely within their housings. Replace brushes that are worn to less than 8 mm. Check spring pressure.

❺ **Check starter coil** at 24 Volts with test lamp between connection of windings and housing for mass connection. If test lamp lights up, the windings are burned out. Replace starter housing. With an Ohmmeter check for interruption of windings.

❻ Replace O-ring.

Bild A



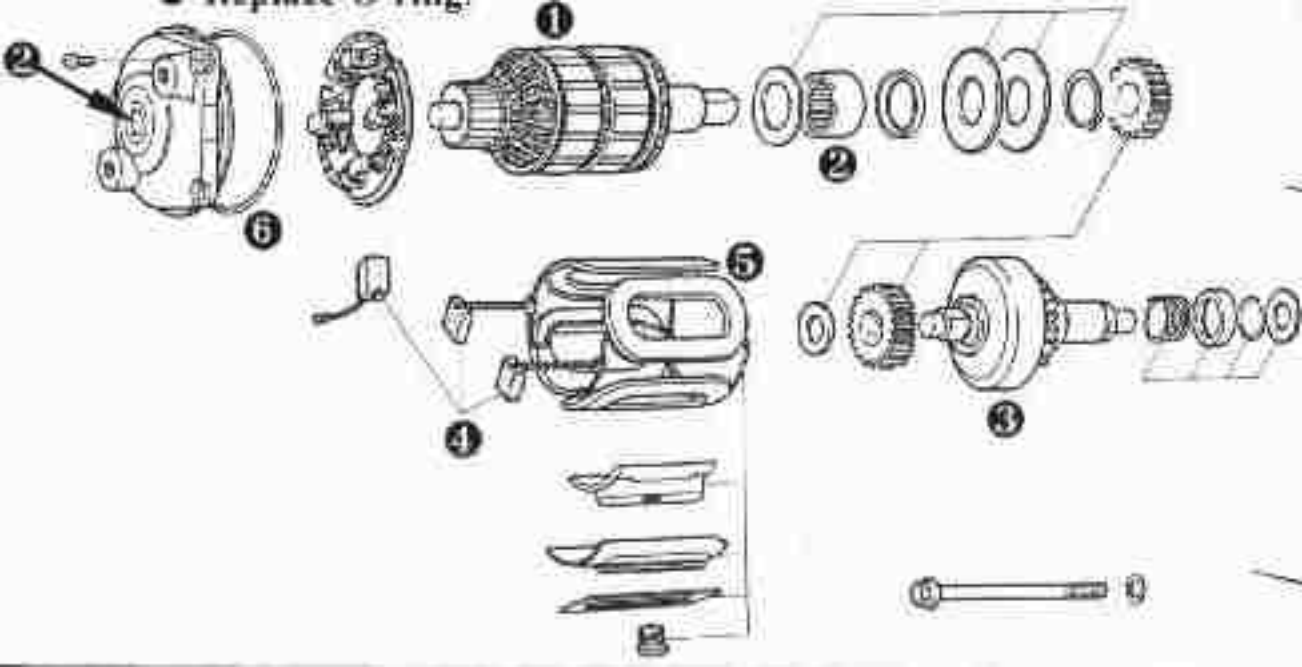

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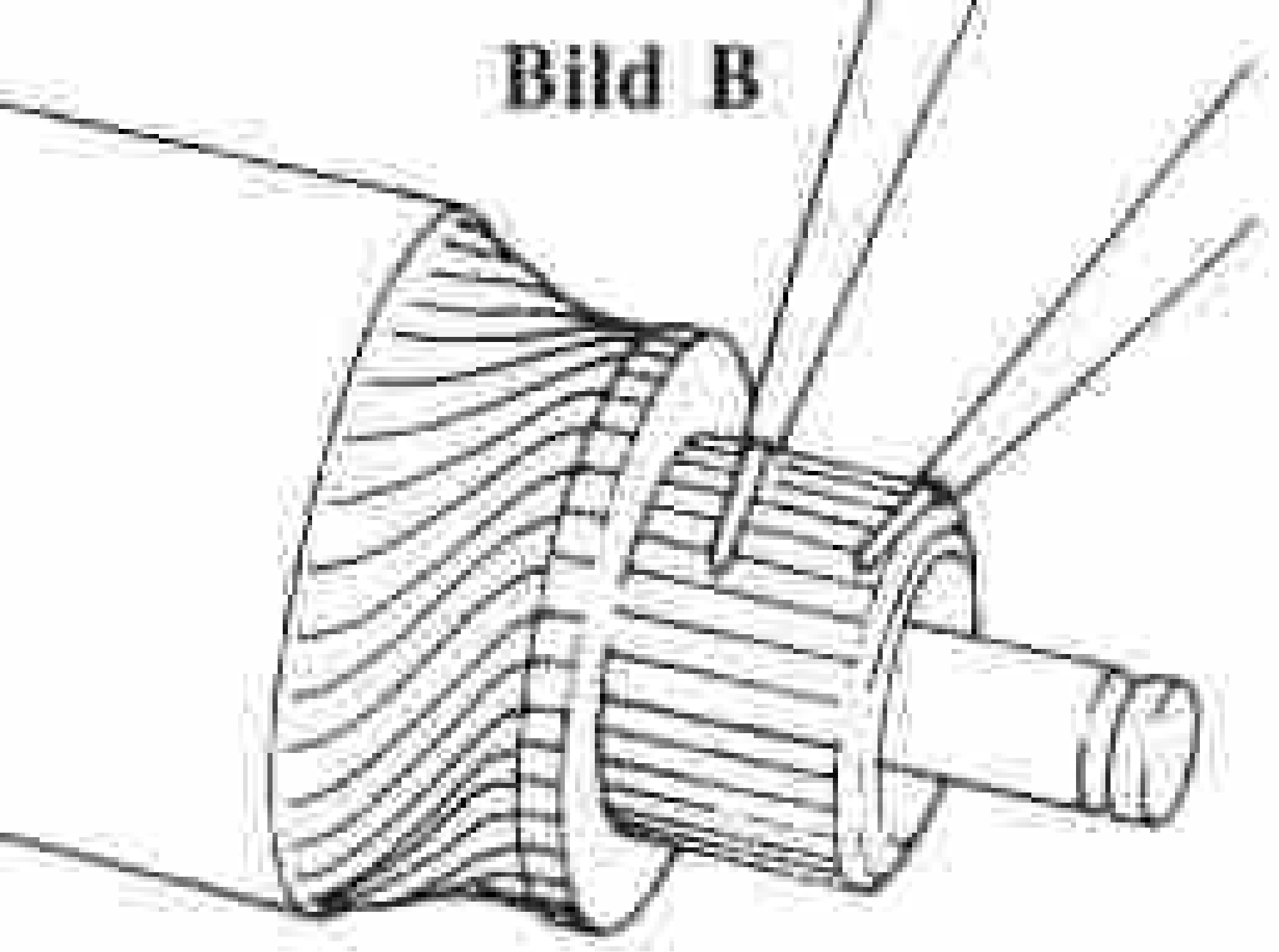
Bild B

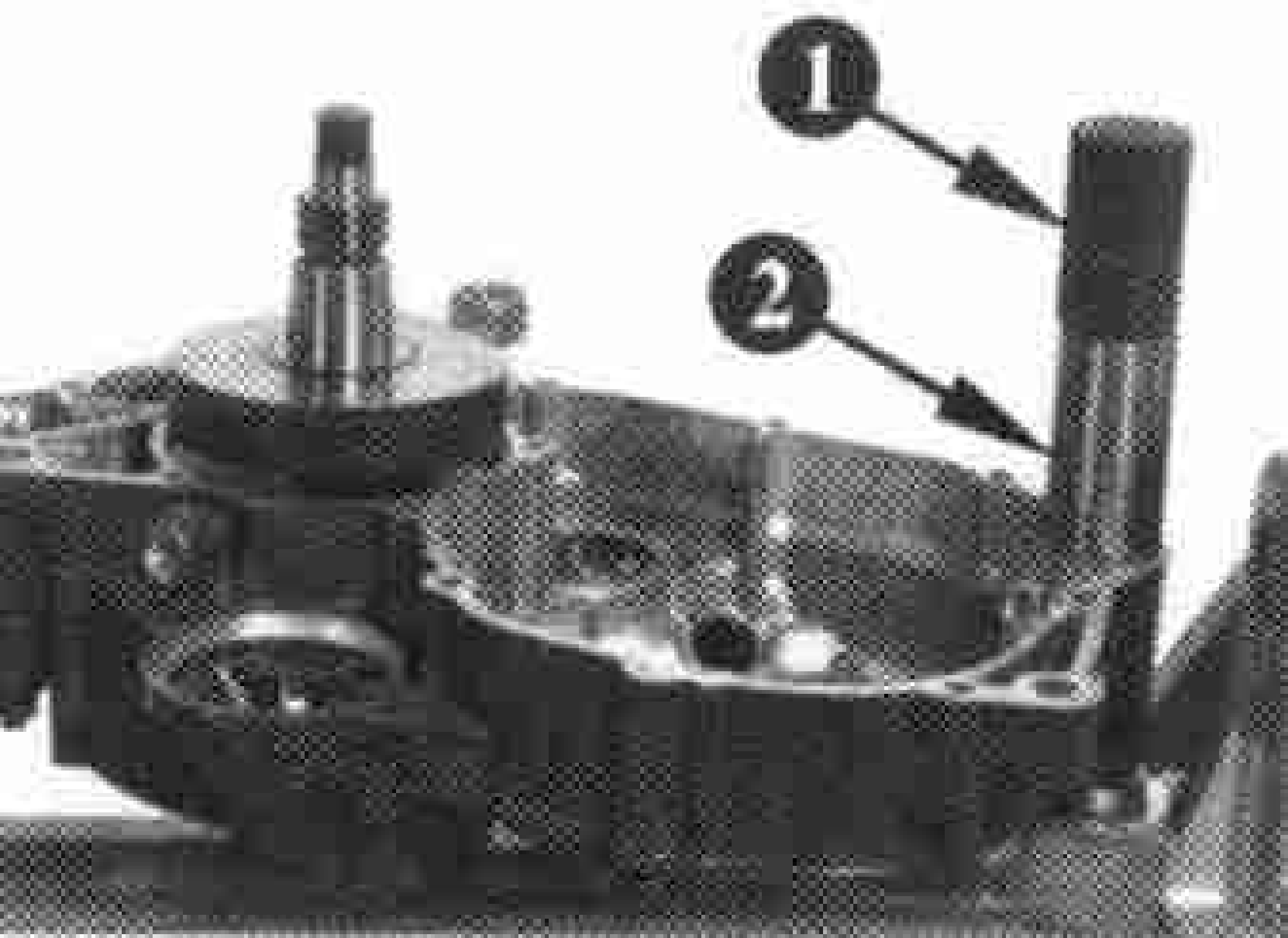


Engine reassembly

Installing the crankshaft:

Heat magneto side crankcase half to min. 90÷100 degrees C and fix it on trestle with screw ❶ and spacer ❷. Install new crankshaft- and mainshaft oil seals and crankcase ring using appropriate punches from inside (see also pages 23 and 24). Grease oil seals.

With the crankcase still hot (min. 90 degrees C) insert the crankshaft into its bearing. If necessary, tap gently on crankshaft with a mallet. Do not strike the crankshaft threads. Fit the oil seal for mainshaft with punch from inside.
Fit ball bearings for balance-, clutch- and mainshafts with an appropriate punch.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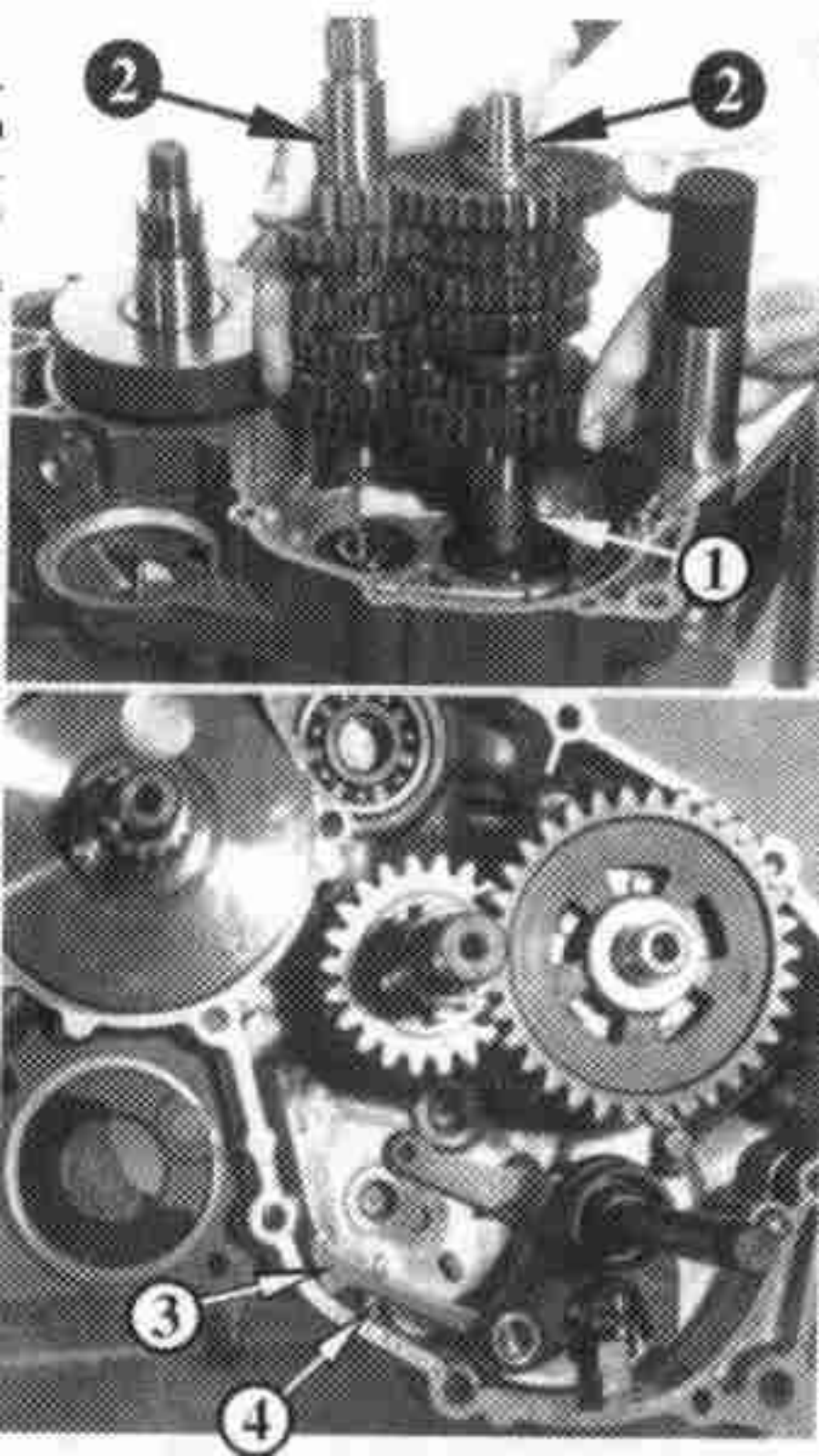
Gearbox assembly:

Fit oil seal guide sleeve ❶ on mainshaft. Insert mainshaft and clutch shaft together into the crankcase half, gently tapping with a mallet. Remove guide sleeve and check oil seal lip from outside.

ATTENTION: Apply slide paste (e.g. LOCTITE Antiseize) on the bearing seats ❷ to prevent metal galling.

Assembly of gearshift mechanism:

Place index spring in crankcase half, together with preassembled shift shaft, index lever (with bend facing downwards) and thrust washer. Initially, the shift shaft must not be pushed fully into position. Carefully insert it so that the lever arm ❸ rests upon the boss ❹.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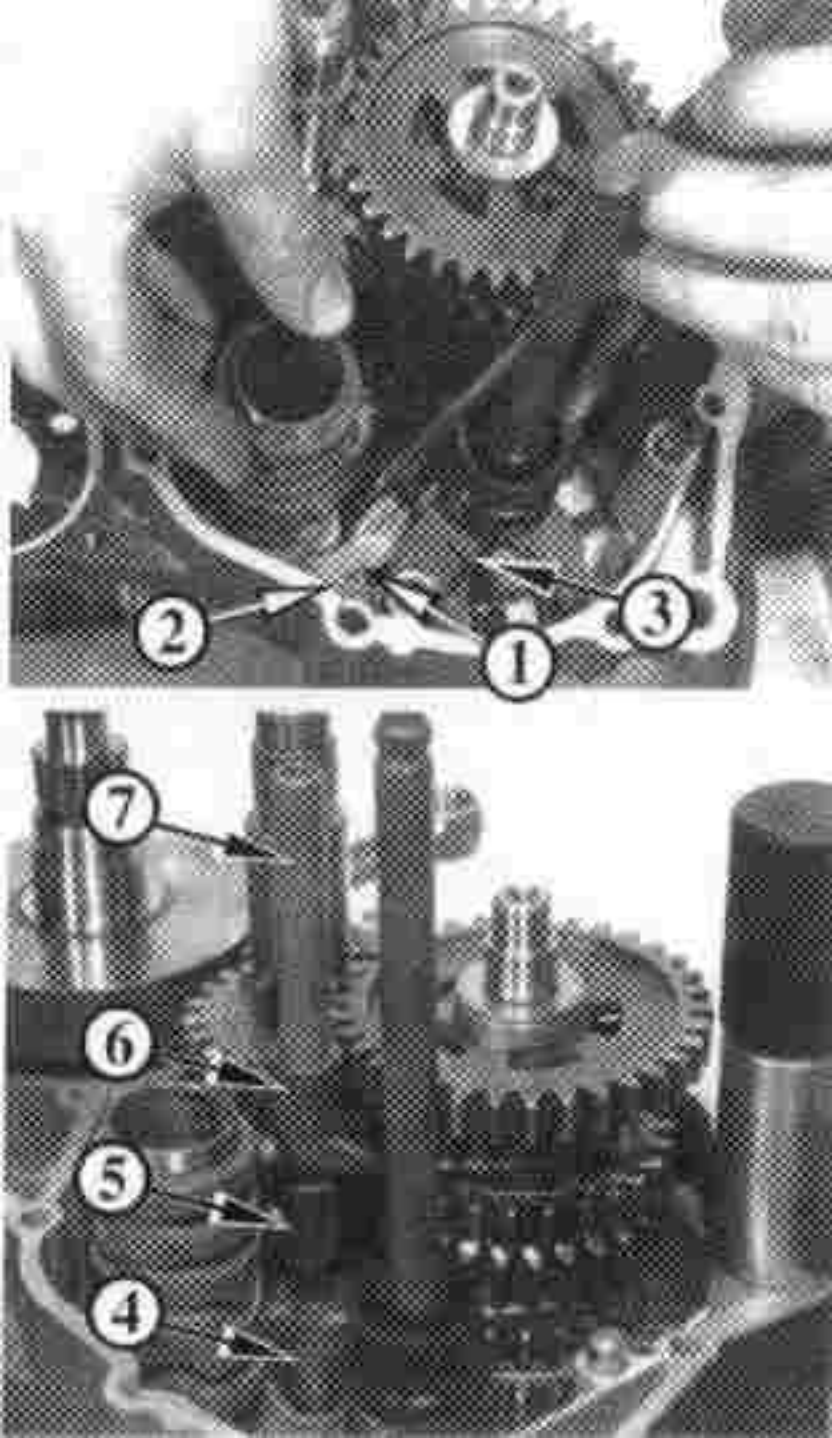
Locate spring in index lever. Press lever ❶ with a screwdriver outwards and insert shift drum. Release lever, push pawl ❷ inwards towards the shift drum.

Now press index lever with a screwdriver outwards and push the complete shiftshaft fully into the crankcase half.

ATTENTION: Be careful not to force the shift shaft into the crankcase to avoid bending the pawl.

Locate pawl spring ❸ and grease gearshift shaft. Engage shift fork for 2nd/4th gear ❹ (inscription upwards), shift fork for 5th/6th gear ❺, and shift fork for 1st/3rd gear ❻ (both with inscription downwards) in gears on mainshaft and clutch shaft and in shift drum.
Slide in shift fork shaft ❼.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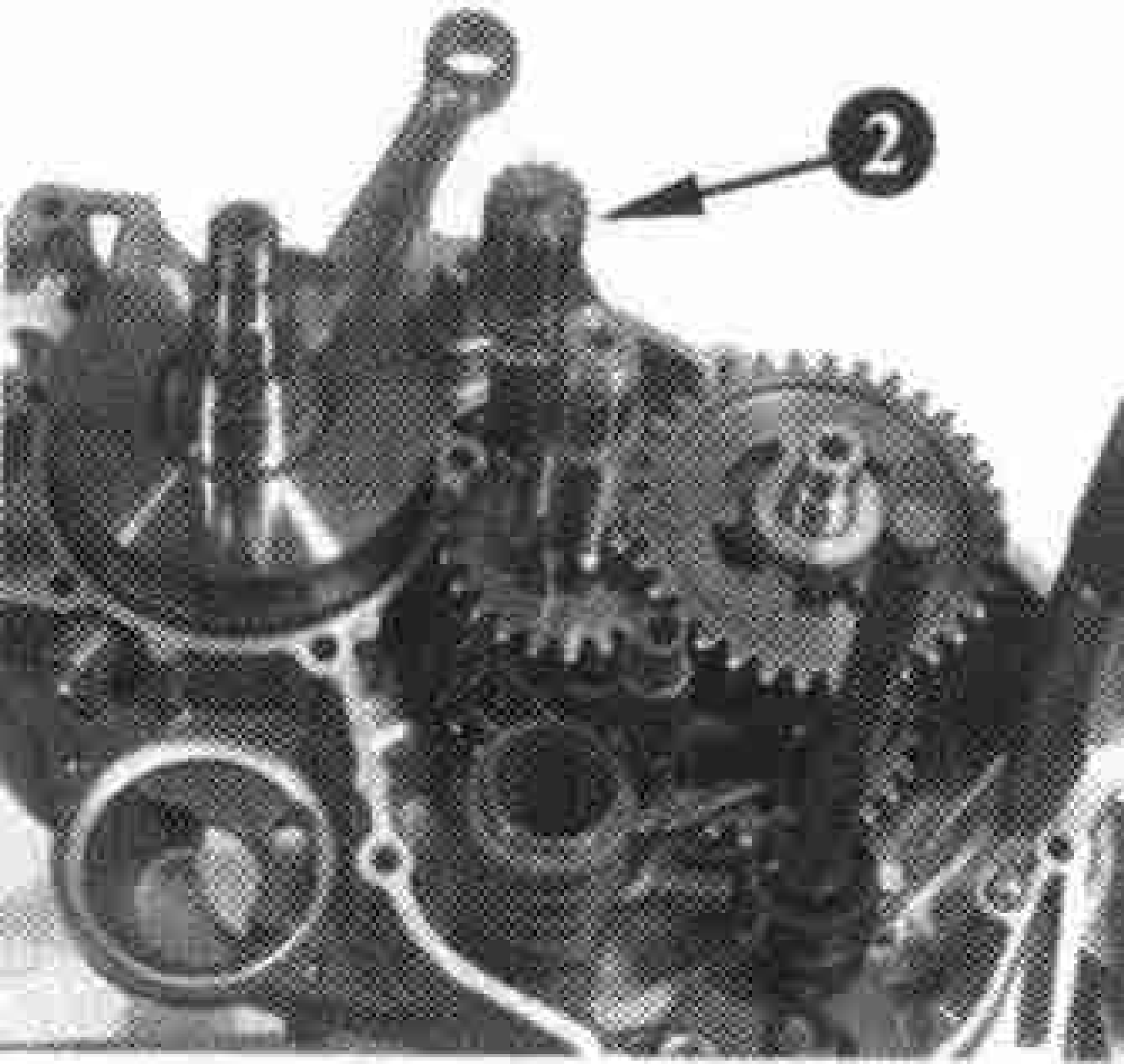
Checking of gearshift mechanism:

Clutch shaft, mainshaft, gearshift shaft, shift fork shaf
and shift drum must all be fully pressed into position
in their bearings.
Fit gearshift lever on shift shaft and shift all 6 gears
Check in each gear position that gears turn freely, and
that all shift forks are free, without sideways pressure
that could indicate that a shaft is not fully seated.

Turn shift shaft to left and right until stop. In this position,
the shift pawl must have some play which should be
equal in both directions. If not, check shift shaft, shift
pawl and shift drum and replace defective parts. The
play of the shiftshaft should be equal to left and right,
seen from its idle position.
Oil all moving parts of the gearshift mechanism.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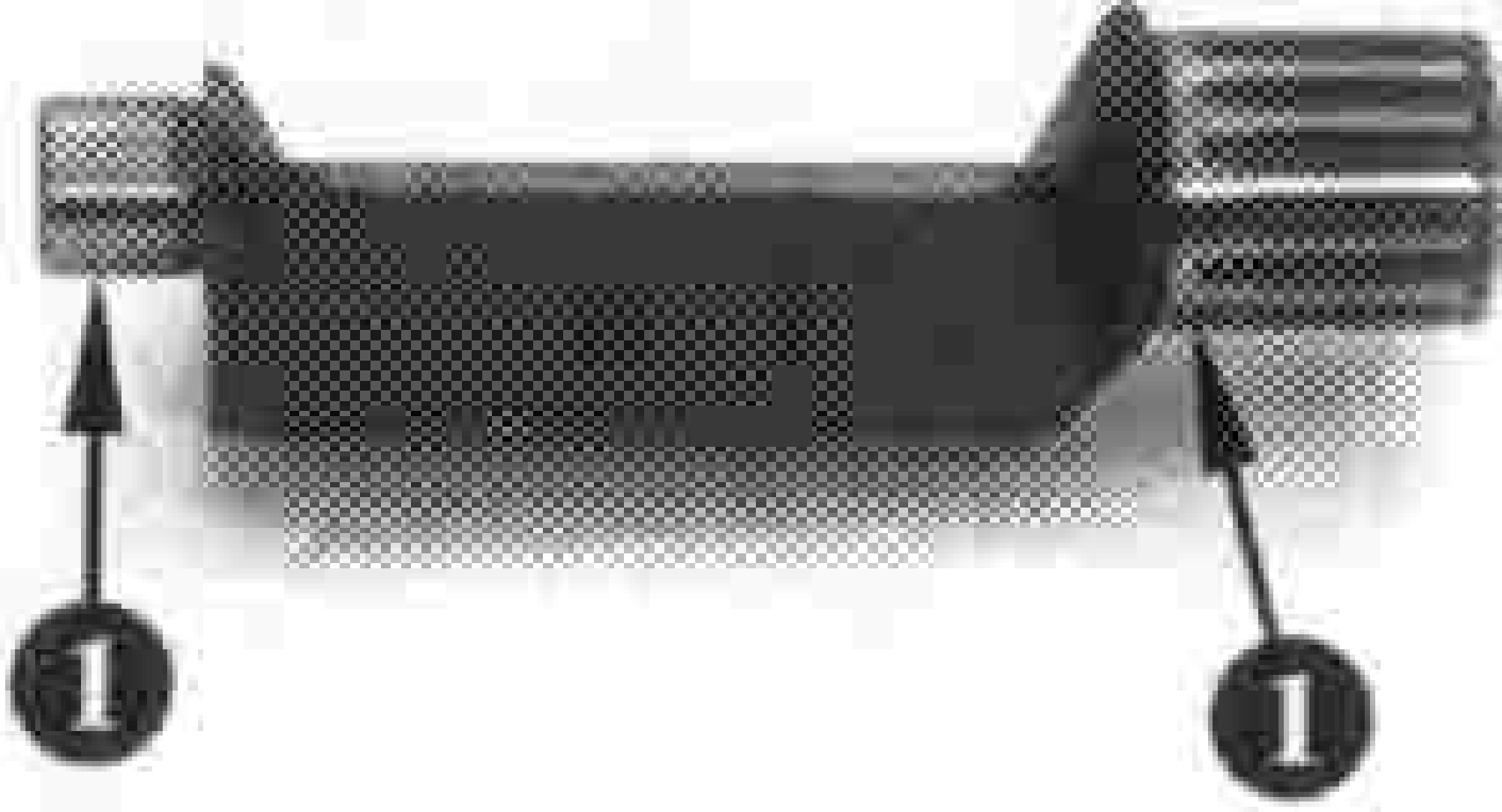
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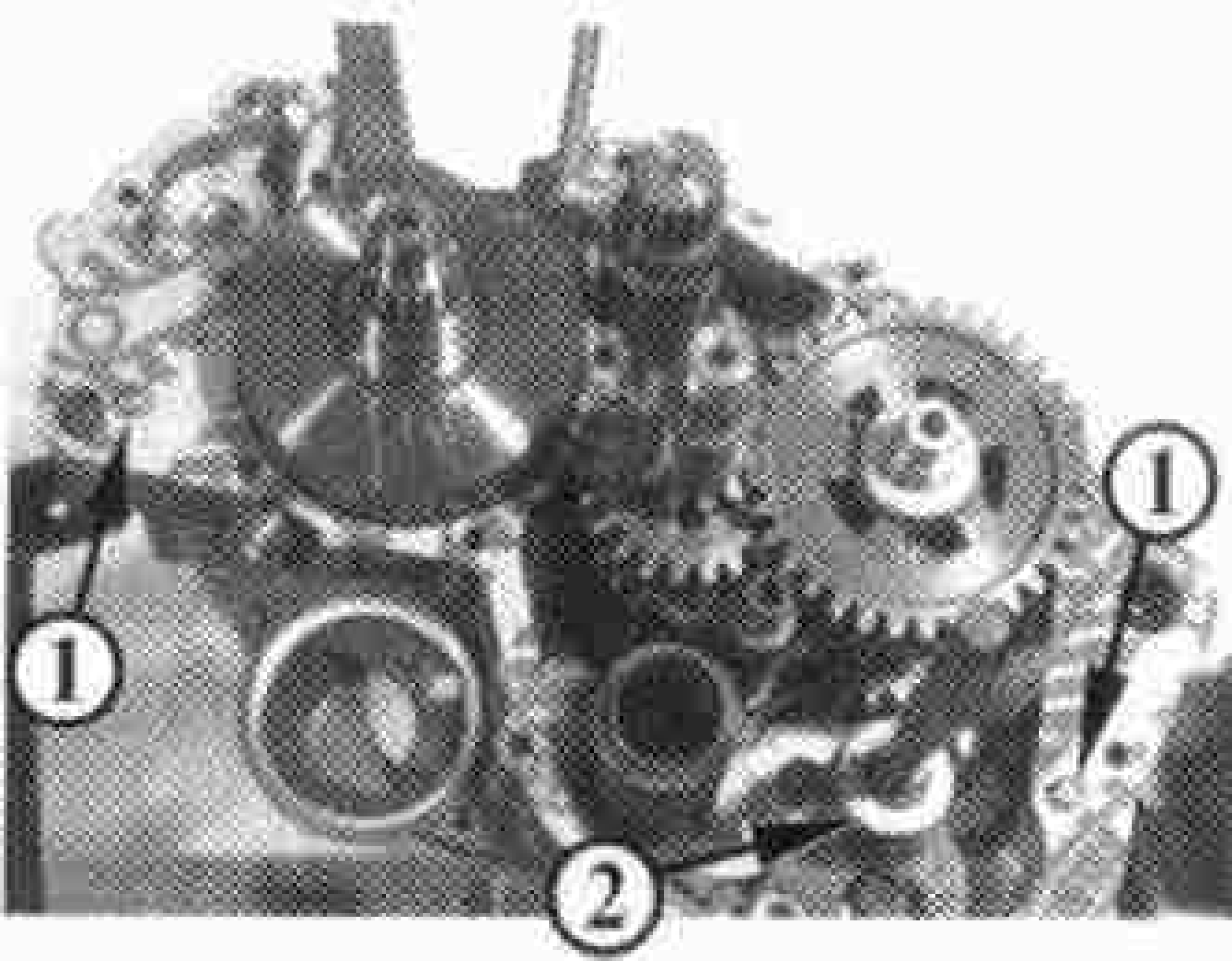
Balance shaft:

Apply LOCTITE Antiseize to both bearing seats ❶ and fit balance shaft ❷ (slide fit!). No spacer shims are fitted.

Crankcase assembly:

Remove fixing screw and spacer from trestle. Install the 2 dowels ❶ in the magneto side crankcase. Slide thrust washer ❷ for kickstart shaft on gearshift shaft.
Warm clutch side crankcase half to 70÷80 degrees C. Fit new oil seal, with sealing lip outwards, with an appropriate punch (see also page 24). Fill sealing lips with grease.
Fit cold ball bearing for crankshaft from inside into the crankcase half.

ATTENTION: The closed side of the bearing cage must face inwards (towards crankshaft).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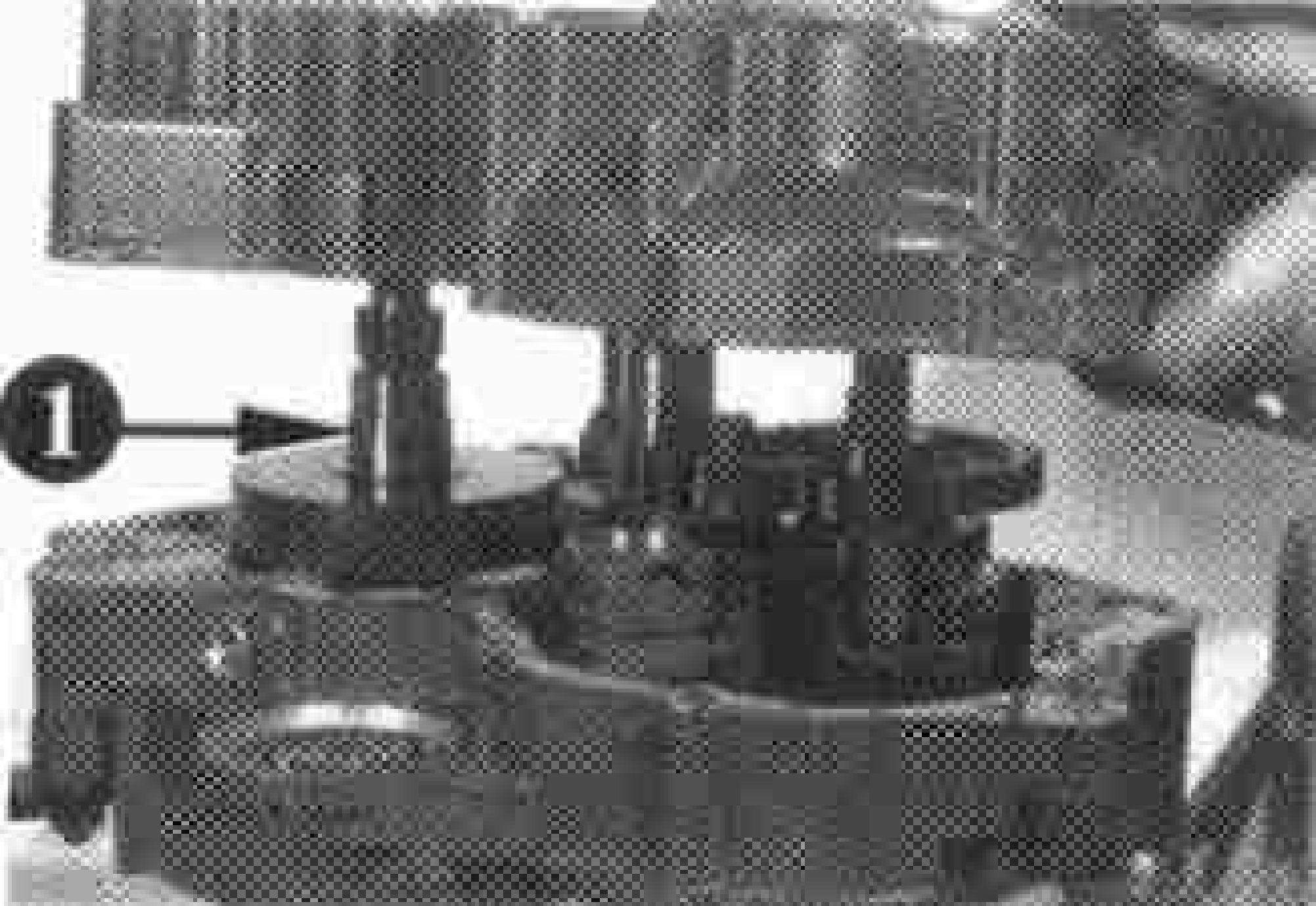
Apply LOCTITE Antiseize to the bearing seat ❶ for clutch side ball bearing. Place new gasket ❷ on crankcase half and trim excess gasket material from crankcase mouth ❸ (the gasket is made with a "bridge" at this point to be more durable in storage).

ATTENTION: The gasket may have shrunk during storage. If too small, dip it into water and position it on crankcase with some oil.

Check for correct position in areas ❶ to avoid loss of water or gear oil.

Mount crankcase half, if necessary tapping gently with a mallet on the engine mounting points (don't tap on sealing surfaces!).

ATTENTION: Be careful not to damage the oil seal!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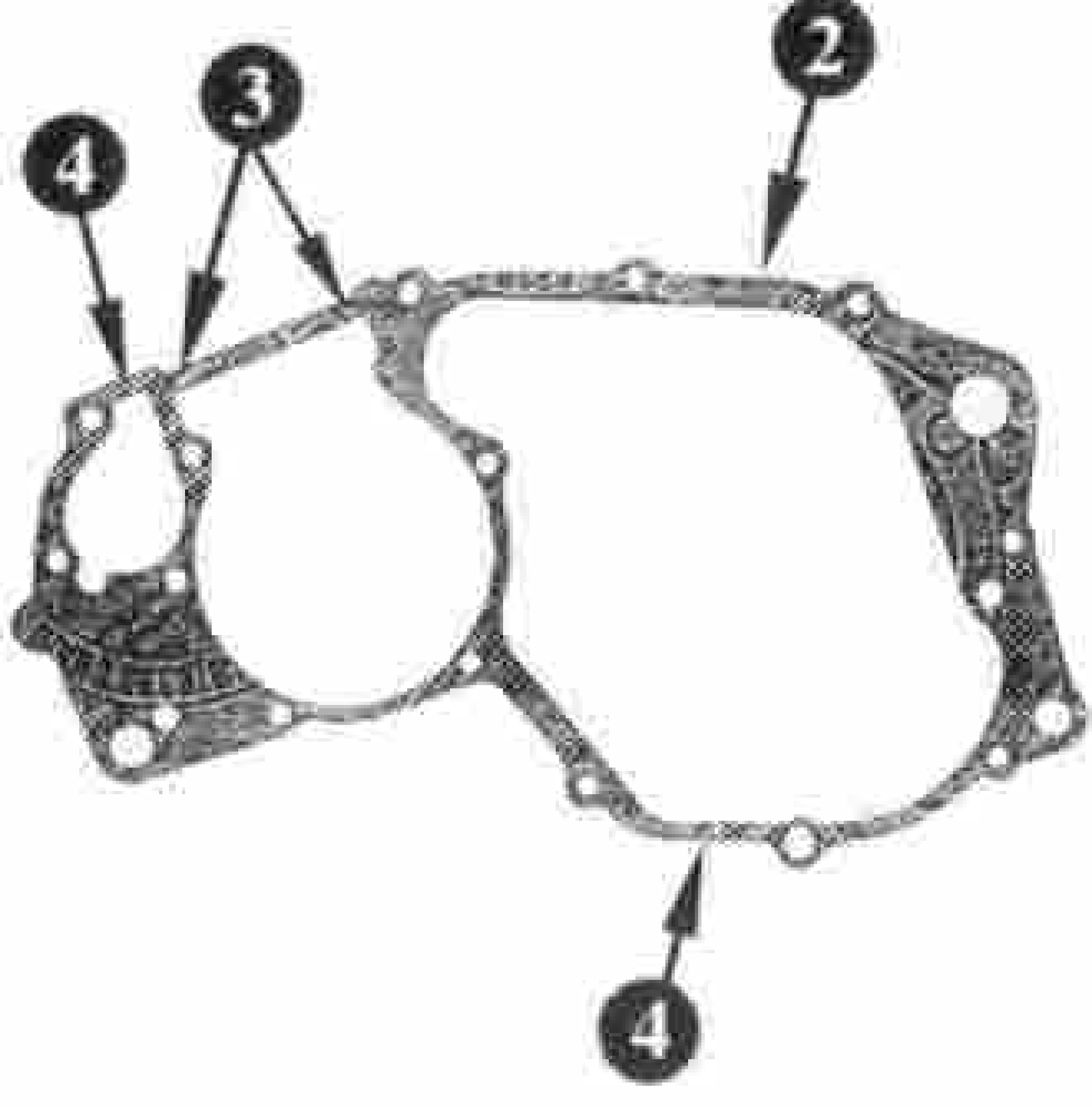
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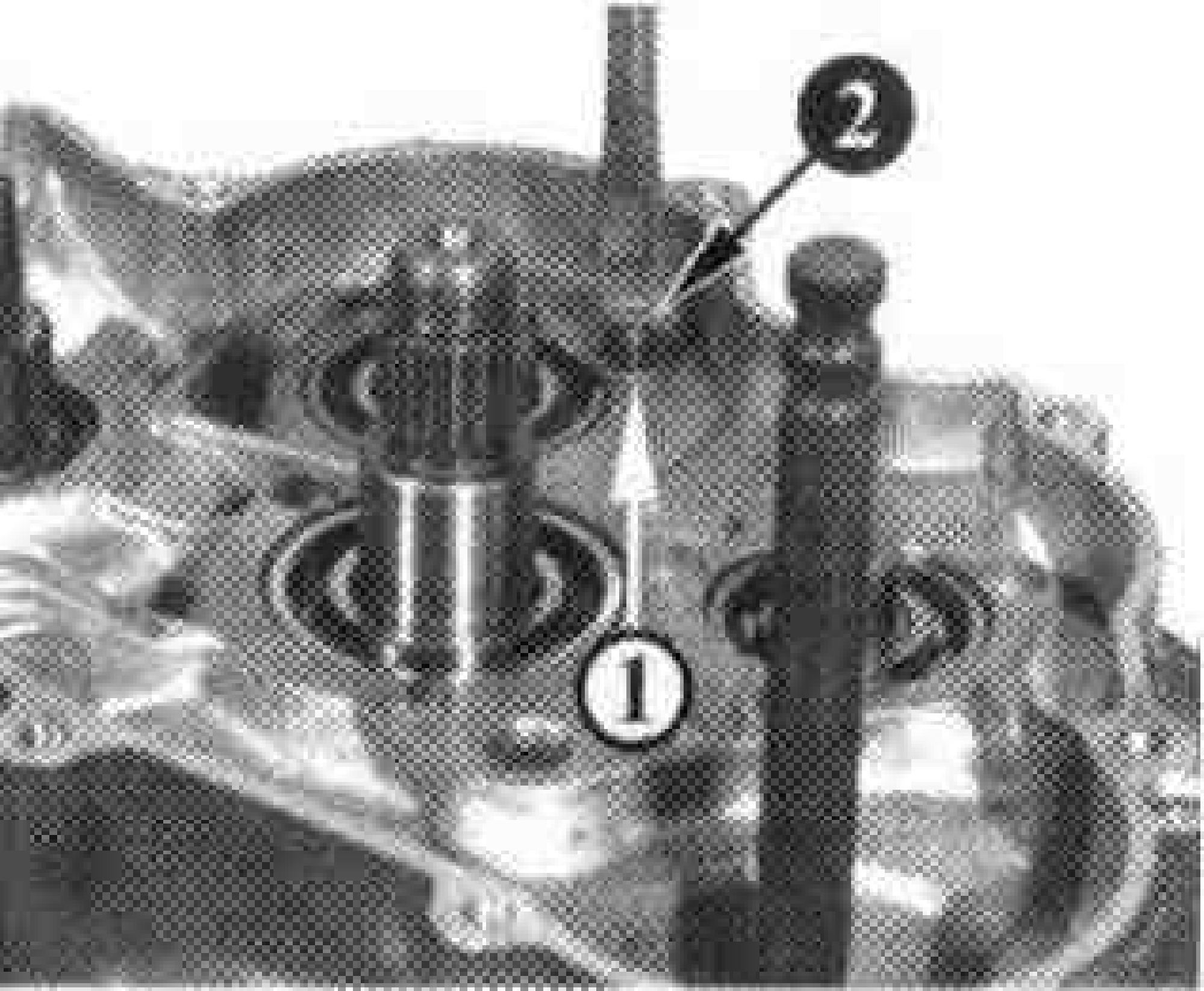
Mount the crankcase into the assembly trestle with fixation screws. Fit ball bearings for main- and clutchshafts with an appropriate punch in the crankcase still warm. Insert the ball bearing for balance shaft with punch (closed side of cage facing outwards). The ball bearing is retained by the plate ❶ and countersunk screw ❷. Use LOCTITE 221. Turn crankcase in assembly trestle ignition side upwards. Secure crankcase halves with 13 Allen screws M6 and lock washers and with 1 Allen screw M8 and sealing ring.

Turn crankcase on trestle clutchside upwards. Check that all shafts turn easily tapping gently on bearing inner races if necessary to free any end-loading resulting from assembly. Tap the ball bearings of clutch shaft and mainshaft firmly into position using a suitable punch.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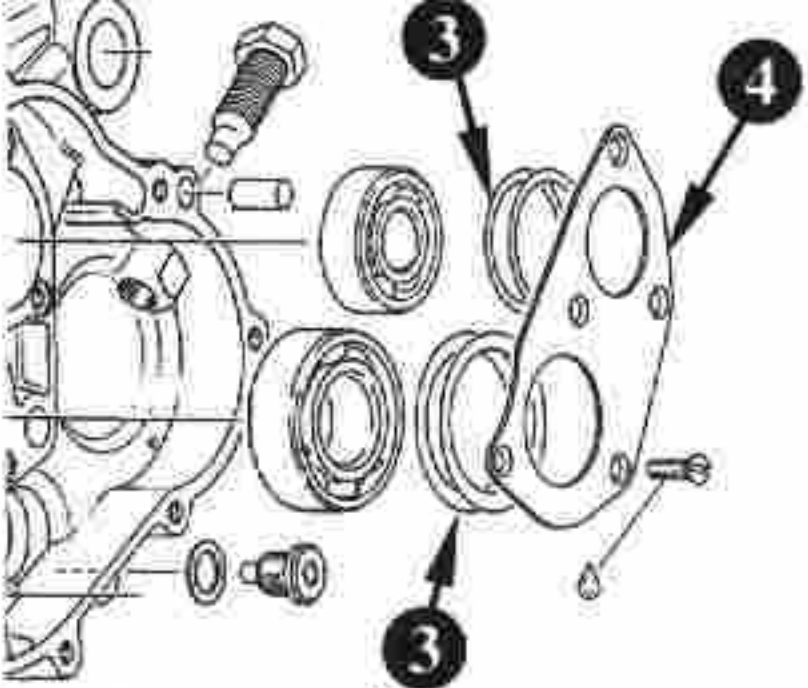


Place distance shims ❸ on bearings of clutch- and mainshafts (leaving 0,1+0,2 mm clearance to crankcase level). Fit bearing retaining plate ❹ applying LOCTITE 221 on 5 countersunk screws M5.

ATTENTION: Shims must not be displaced. If necessary, keep them in position with grease.

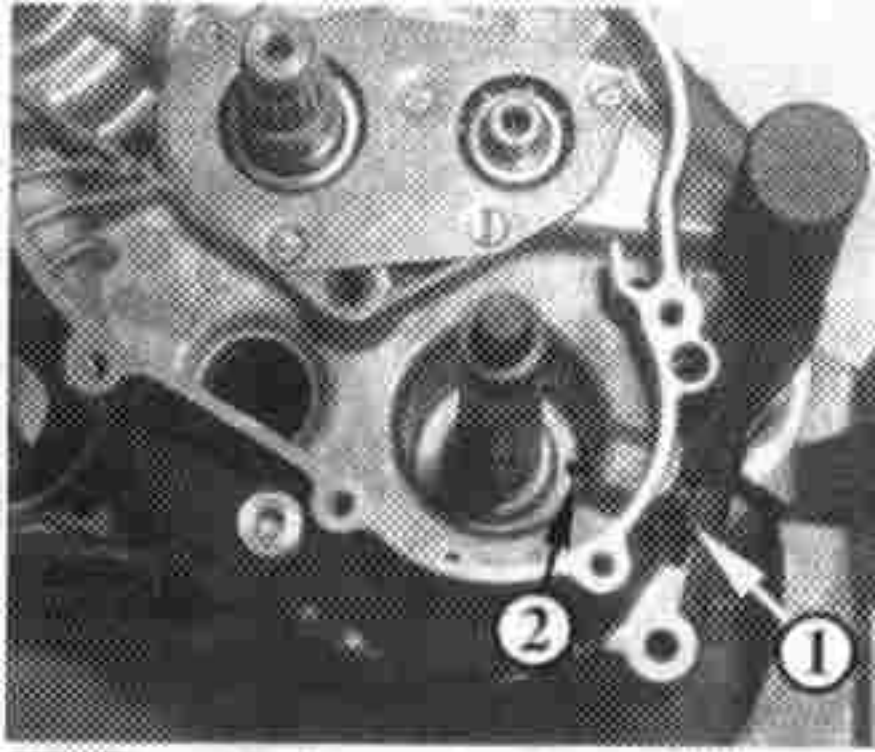
Fit gearshift lever and shift all 6 gears.

Kickstarter:

Slide O-ring and starter shaft on shift shaft. Turn release screw ❶ into crankcase by about 4 turns. Slide kick-starter spring with large dia. end over starter shaft and engage the inner spring peg in the bore ❷ of crankcase.

Slide oiled ratchet gear ❸ onto starter shaft with ratchet teeth upwards, and hook in kickstarter spring. Depress ratchet gear with screwdriver on the splines of starter shaft ❹ and keep it in this position.

With kickstart lever ❺ fitted, turn starter shaft clock-wise until the stop screw ❻ can be fully installed thus locking the ratchet gear. Turn starter shaft slowly back until ratchet gear is locked on its stop ❼. Tighten stop screw at 75 Nm.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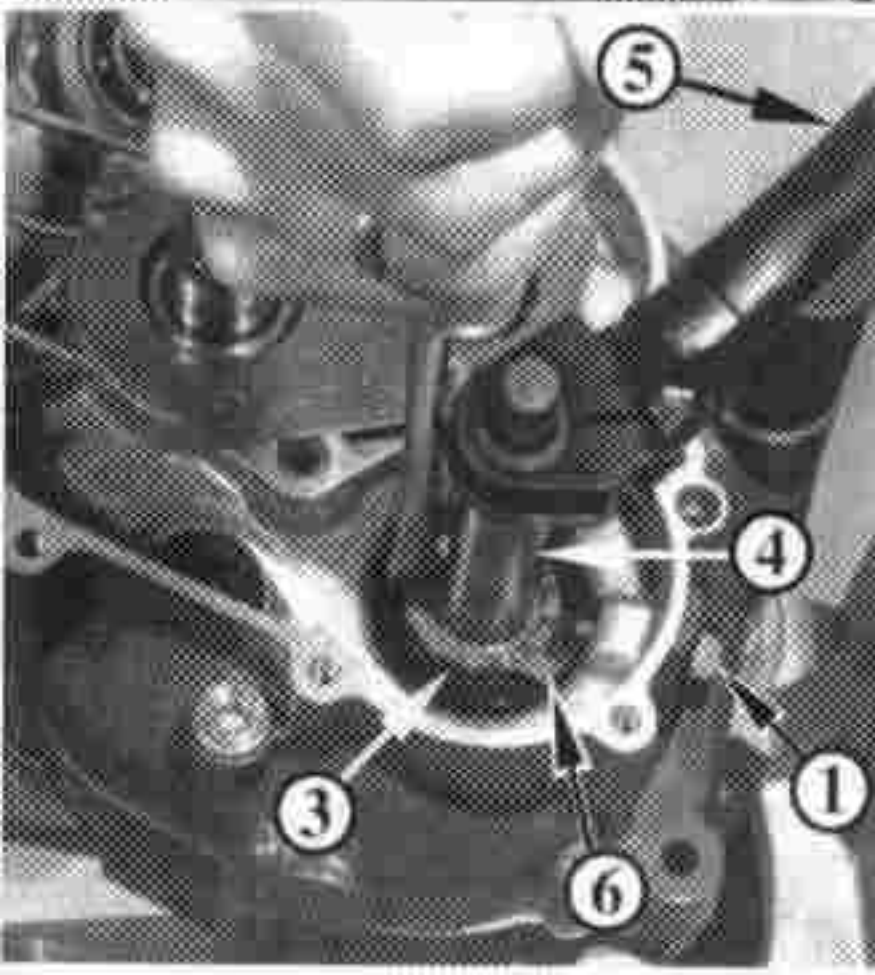
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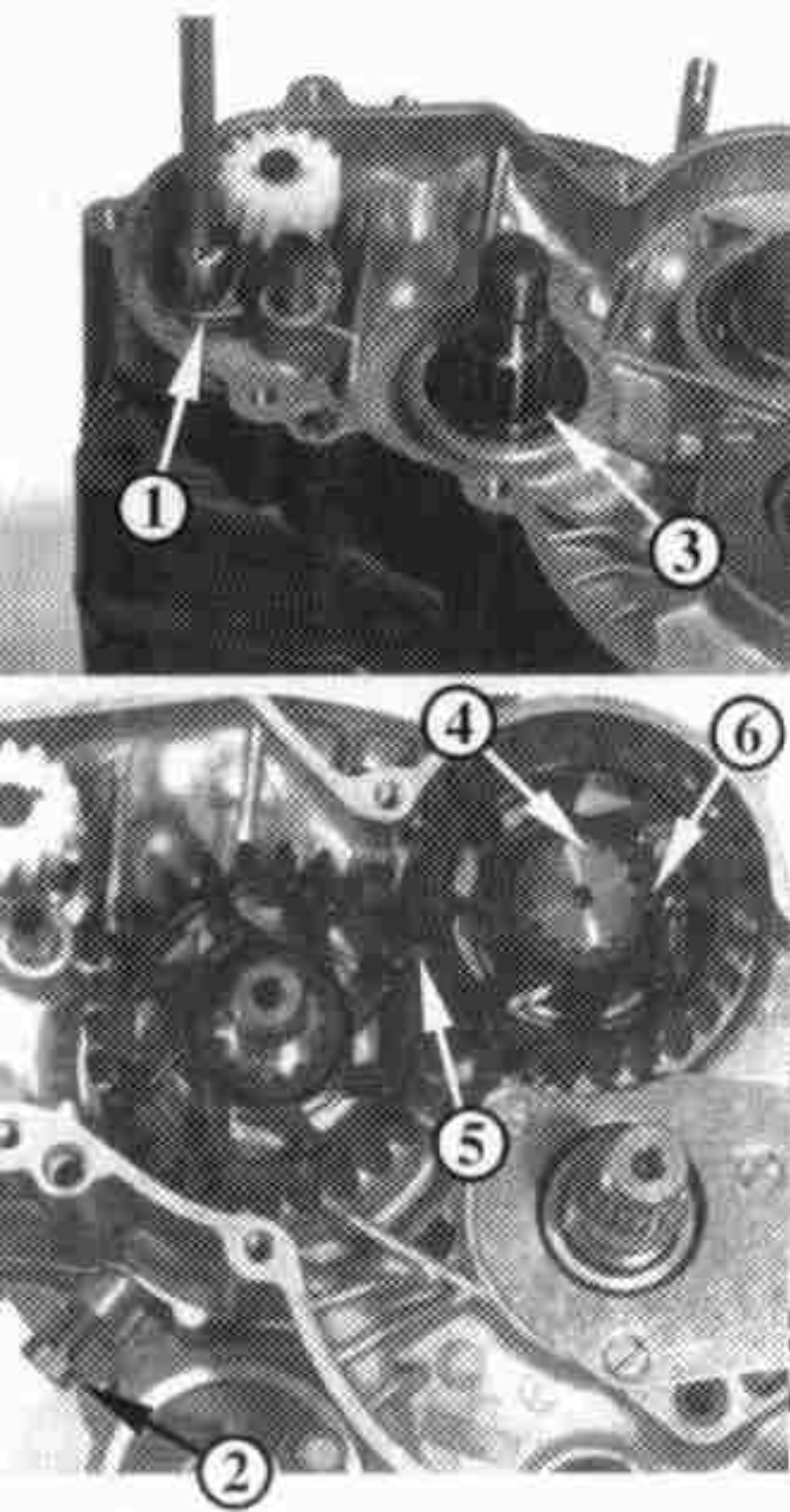
Water pump:

Coat the O-rings of the pre-assembled water pump ❶ with some grease, slide the pump into the crankcase and fix it with Taptite screw M5.

Balance shaft drive:

Insert Woodruff key into keyway on crankshaft. Screw in crankshaft locking screw ❷ by hand and fix crankshaft at top dead centre. The crankshaft locating screw has to engage firmly in the bore on crankblade.
Put O-ring 18x3,5 ❸ into the groove on crankshaft. Place balance gear onto spline on balance shaft so that marks ❹ correspond with the mark on balance shaft. Slide 2nd balance gear onto the crankshaft so that the marks ❺ correspond. Fit circlip ❻.
ATTENTION: The 2 balance gears are identical. It is an advantage to warm them slightly before assembly.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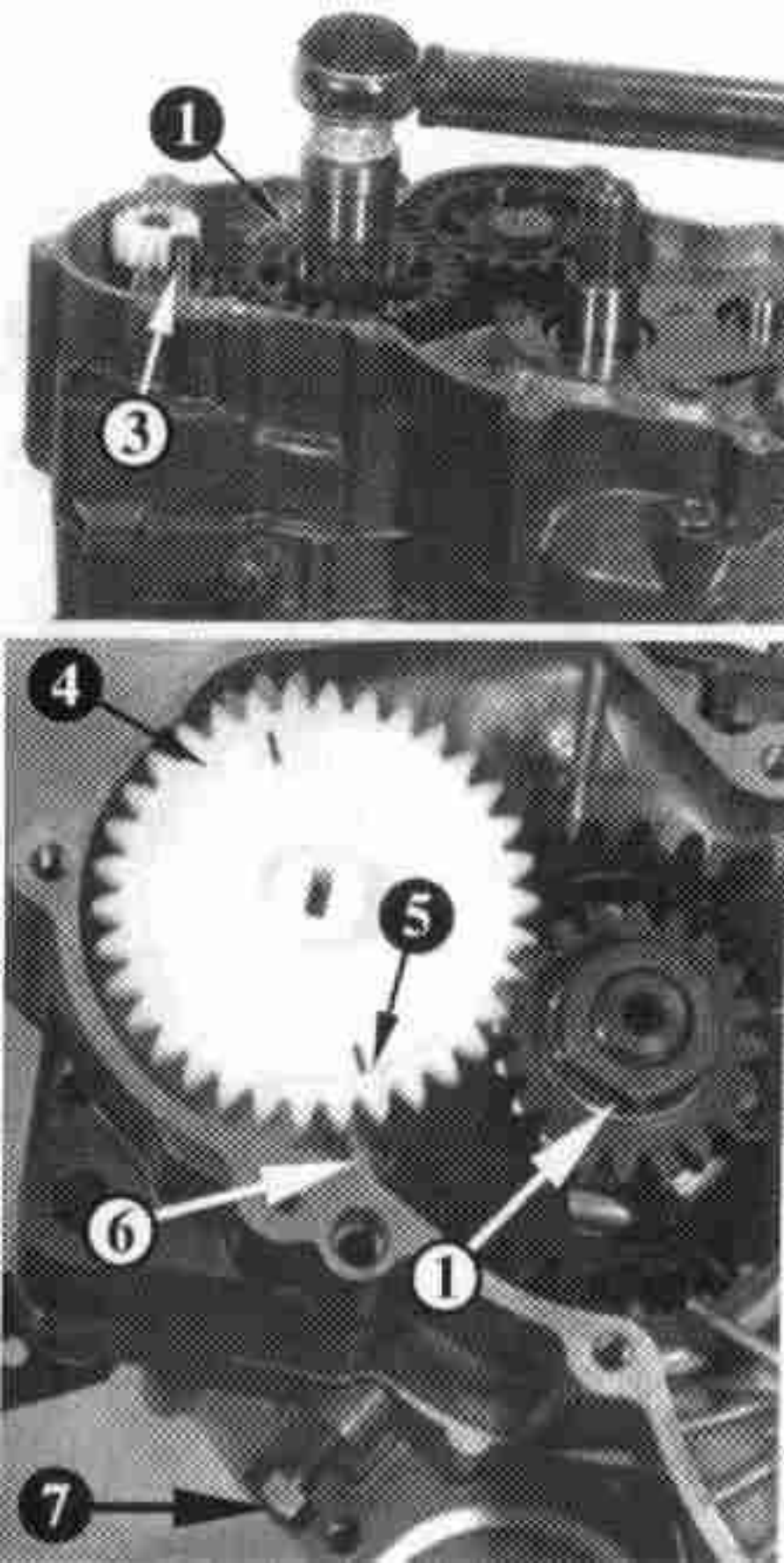
Primary drive:

Fit drive gear ❶, with shoulder facing outwards, and lockwasher on crankshaft. Apply LOCTITE 221 on hex. nut ❷ and tighten at 70 Nm.
Place thrust washer on idle gear shaft ❸ and place idler gear ❹ so that the marks ❺ correspond as exactly as possible with the boss ❻ on crankcase. This is necessary to allow the oilpump shaft to engage.

ATTENTION: For this procedure it is very important that the crankshaft is locked at top dead centre by crankshaft locking screw ❼.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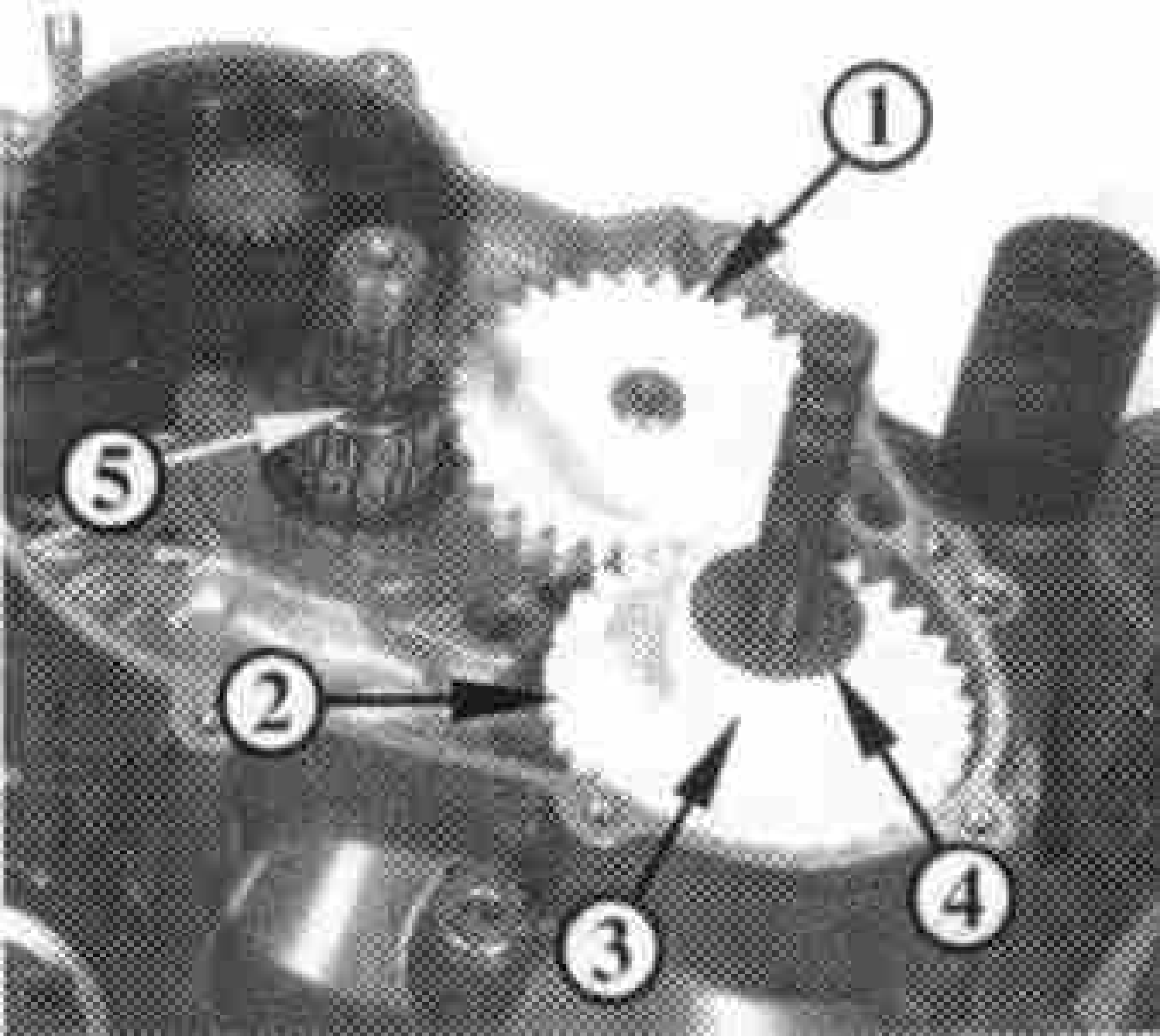
Clutch (version without kickstarter):

Fit intermediate gear ❶ with large collar downwards (inscription upwards) on mainshaft. Slide thrust washer, rev. counter drive gear ❷ with helical gear ❸ and thrust washer ❹ on shift shaft. Turn the 2 pinions and check for easy movement. Fit thrust washer (2 mm thick) and oiled needle cages on clutch shaft and fit O-ring ❺ .

Fit clutch drum and thrust washer (3 mm thick) over O-ring ❺ and fit pre-assembled set of clutch plates in clutch drum. To facilitate assembly, screw 2 hex. screws M5 into pressure plate ❻. Shift into gear so that by turning the mainshaft, the clutch hub and clutch shaft splines ❼ engage.

ATTENTION: Clutch shaft splines ❽ must project by about 1 mm from clutch hub ❼ to engage with tab washer.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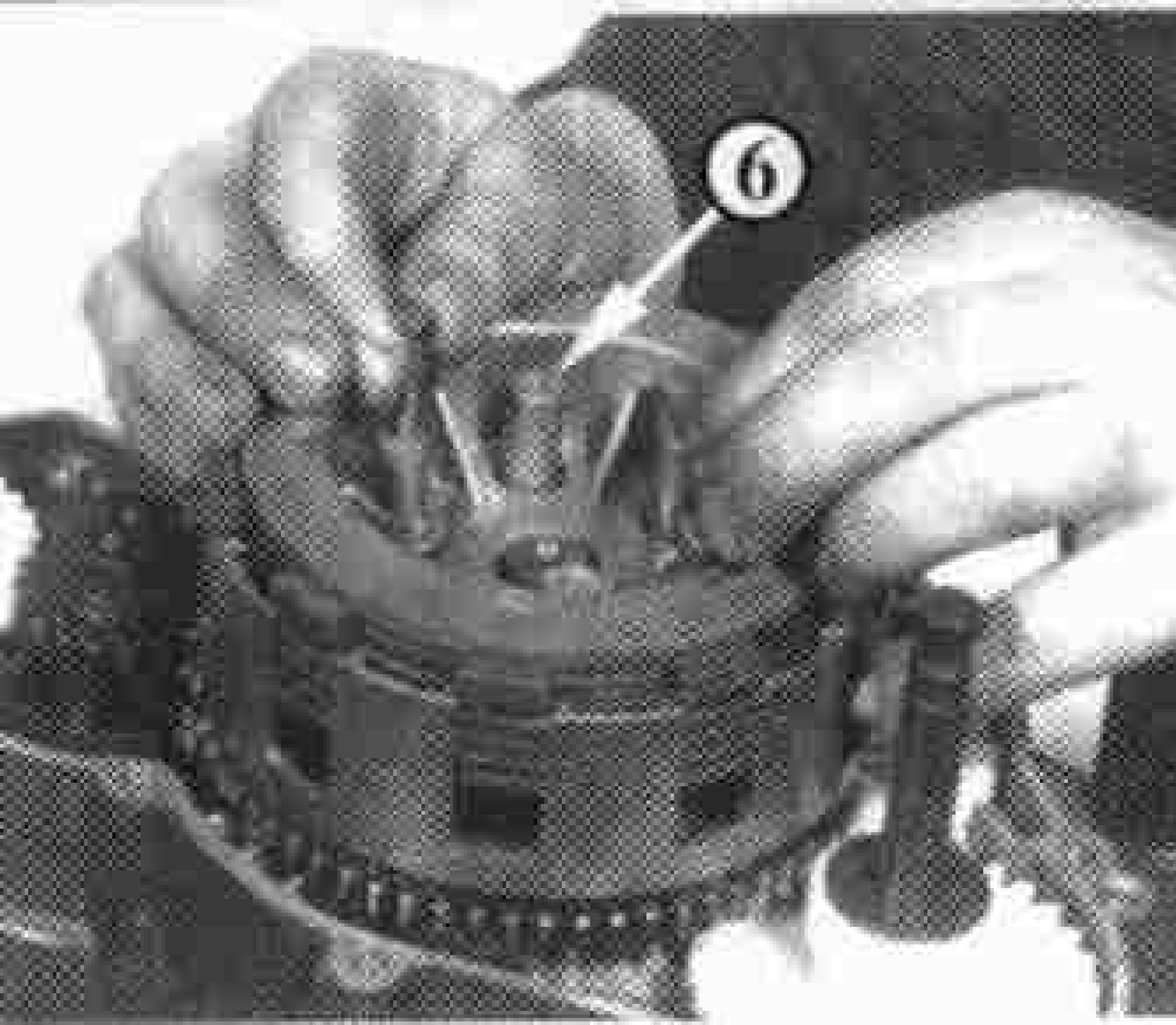
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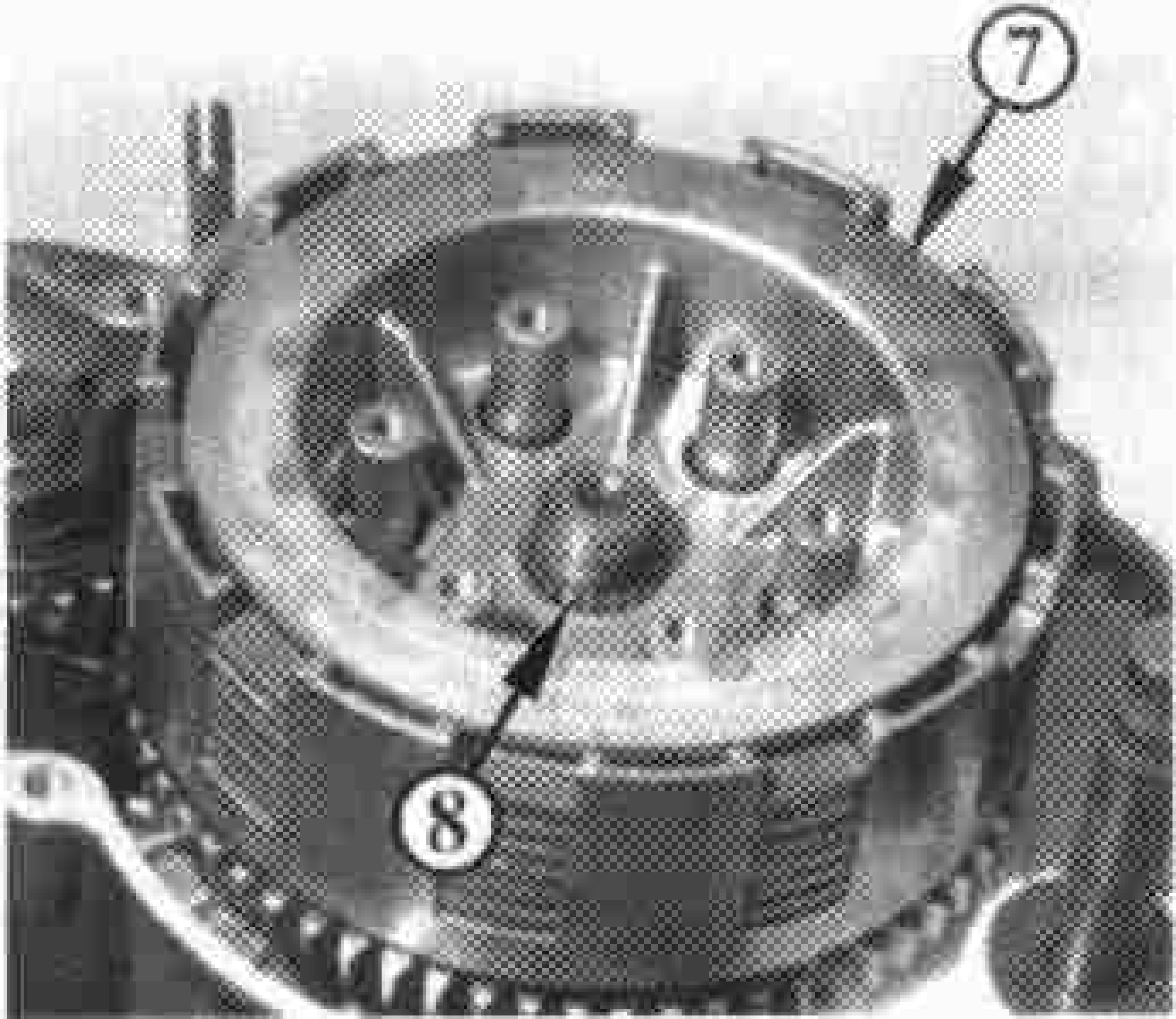
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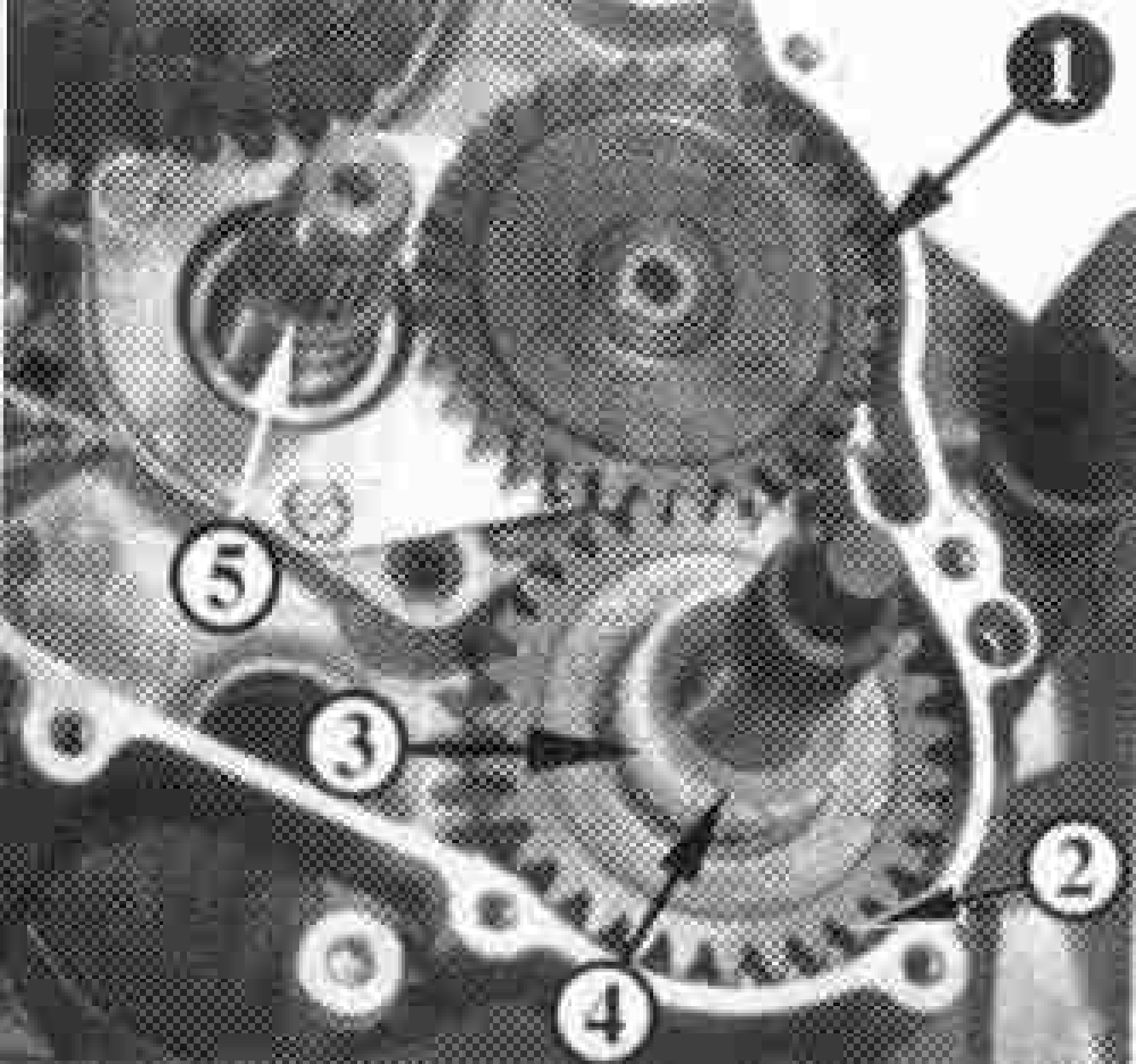
Clutch (version with kickstarter):

Fit intermediate gear ❶ with collar downwards on mainshaft. Slide thrust washer and starter gear ❷, with splines inwards, on starter shaft. Turn the 2 pinions and check for easy movement. Fit helical gear ❸ and thrust washer ❹ on starter shaft. Fit O-ring.
Fit thrust washer (2 mm thick) and oiled needle cages on clutch shaft.
Fit clutch drum and thrust washer (3 mm thick) over O-ring ❺ and fit pre-assembled set of clutch plates in clutch drum. To facilitate assembly, screw 2 hex. screws M5 into pressure plate. Shift into gear so that by turning the mainshaft, the clutch hub and clutch shaft splines engage.

ATTENTION: Clutch shaft splines ❻ must project by about 1 mm from clutch hub ❼ to engage with tab washer.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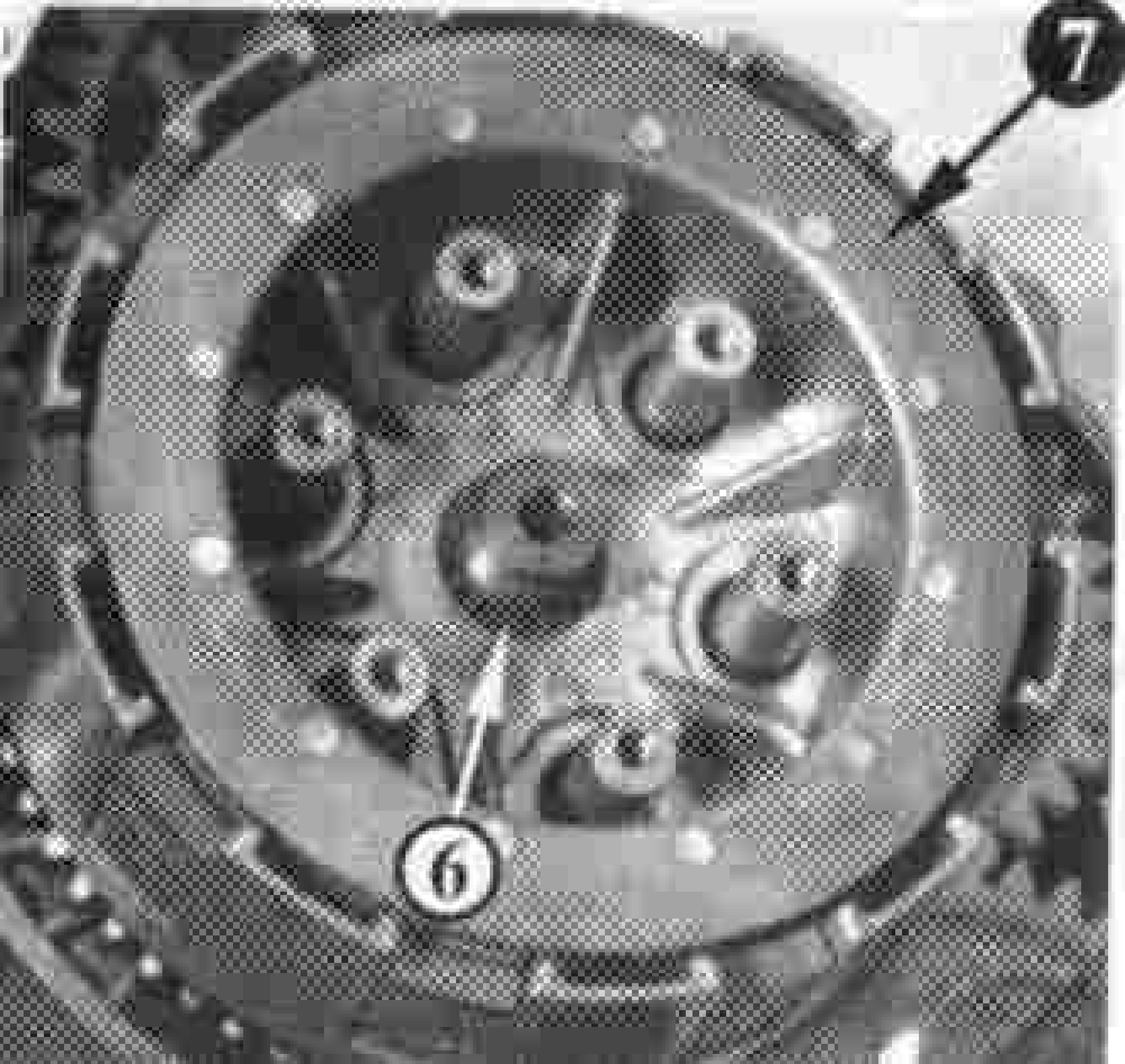
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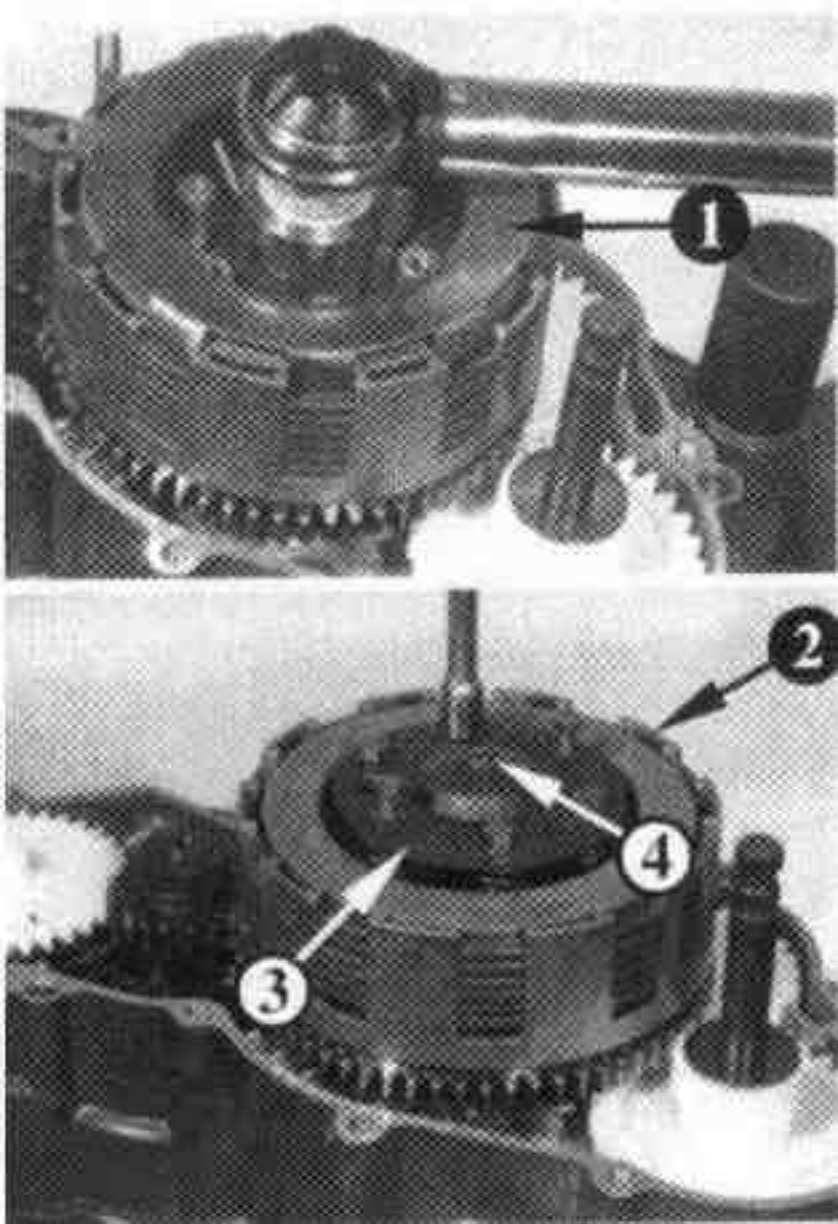
Using clutch hub locking tool ❶, place tab washer, secure hex. nut with LOCTITE 221 and tighten to 80 Nm. Note that the hex. nut must be fitted with chamfered side inwards, towards tab washer. Remove the clutch hub locking tool.

ATTENTION: The clutch hub ❷ must turn easily.

Slacken crankshaft locking screw, turn crankshaft and check all gears for easy movement. A small amount of backlash between drive gear and clutch gear (= primary drive) is important.
Lock crankshaft again to top dead centre. Bend up clutch centre tab washer. Install the 6 clutch springs, fit pressure plate ❸ with release ball ❹ outwards and tighten crosswise with 6 hex. screws M5 and lock-washers.

Take up clutch spring pressure evenly, by taking care not to tighten any screw more than 2 turns at a time. Insert 2 dowels in crankcase cover joint face and place a new gasket for clutch cover.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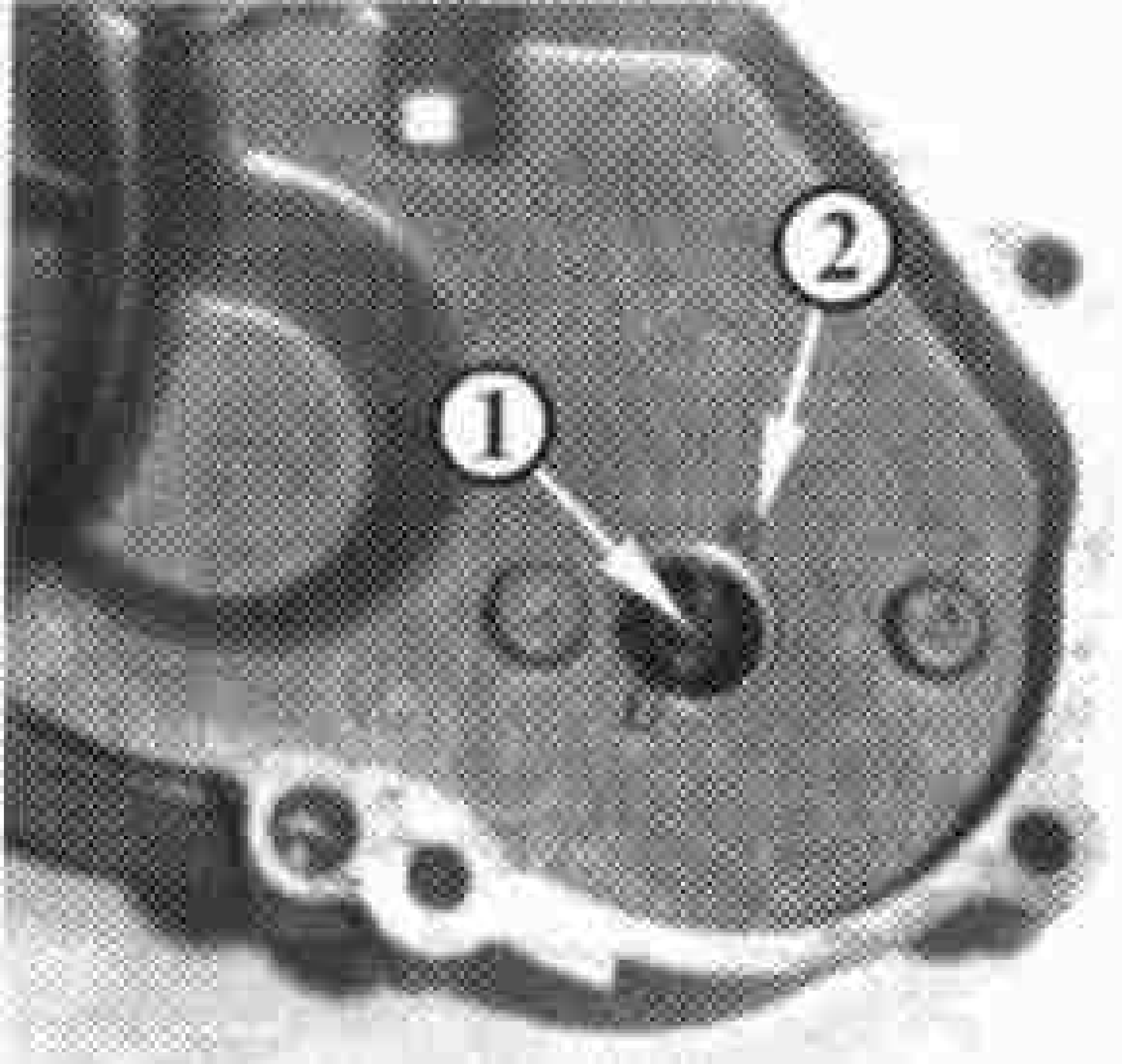
Clutch cover:

Ensure that intermediate gear corresponds with mark (see page 63, point 5). Fit new oil seal and plastic bushing (depending on execution) for starter shaft, with a punch (sealing lips towards inside).

Mount oil pump in clutch cover. Turn oil pump shaft so that lug ❶ is aligned with the cover timing marks ❷. Fit clutch cover and tighten 11 Allen screws M6 in crosswise sequence.

Fit sealing ring on gearshift shaft (on version with kickstarter)

ATTENTION: Do not overtighten the cover screws, or the gasket will be distorted!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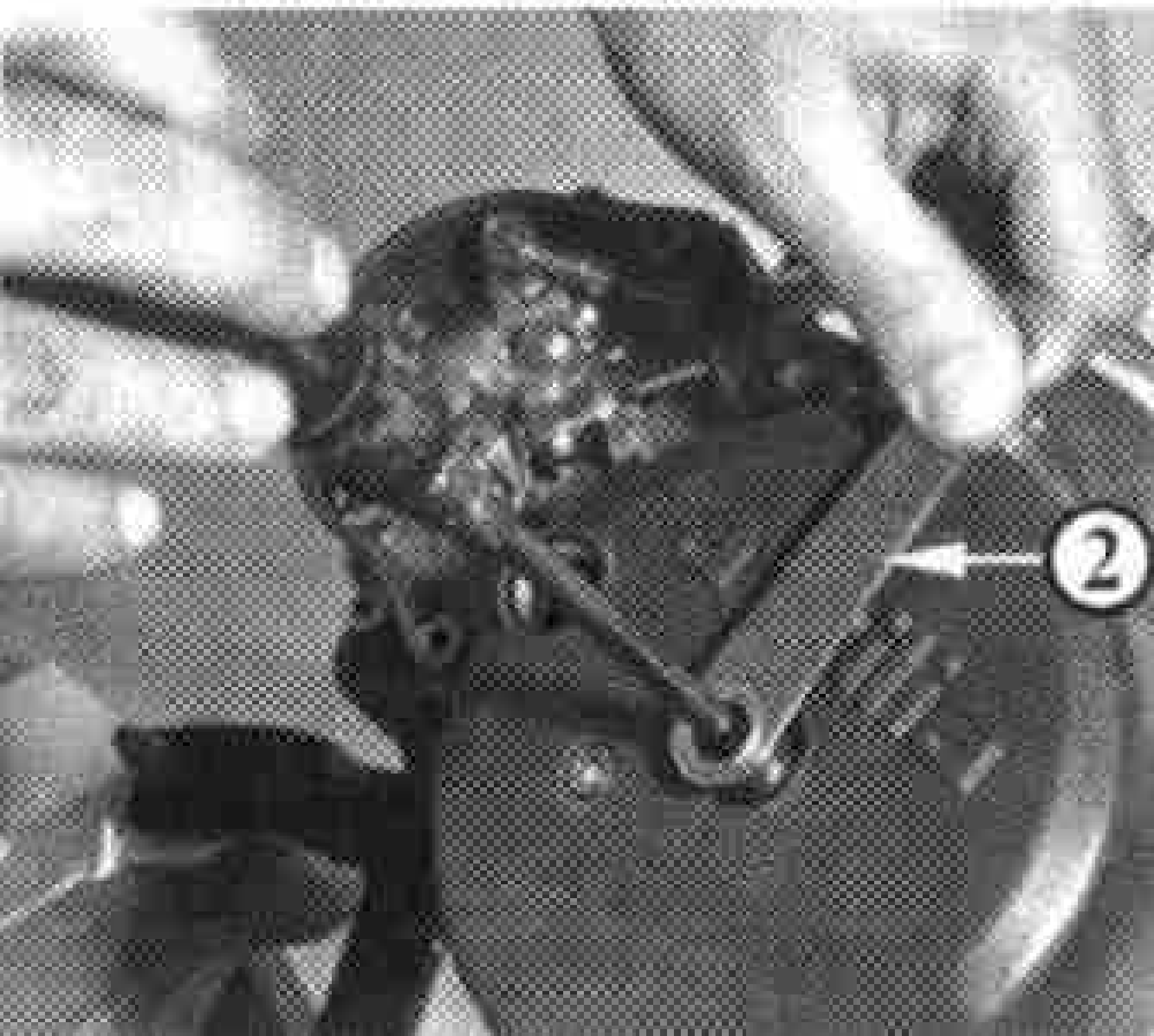
Clutch adjustment:

Unscrew the 2 plastic plugs with O-ring, loosen locknut 11 ❶ with wrench ❷. Turn adjustment screw M8 ❸ fully inwards, until free play is just taken up, then slacken by 1/2 turn, and kept in this position, tighten locknut again.

The lever ❹ for clutch cable must have approx. 6 mm free play. Refit plug with O-ring.

❺ = oil level checking screw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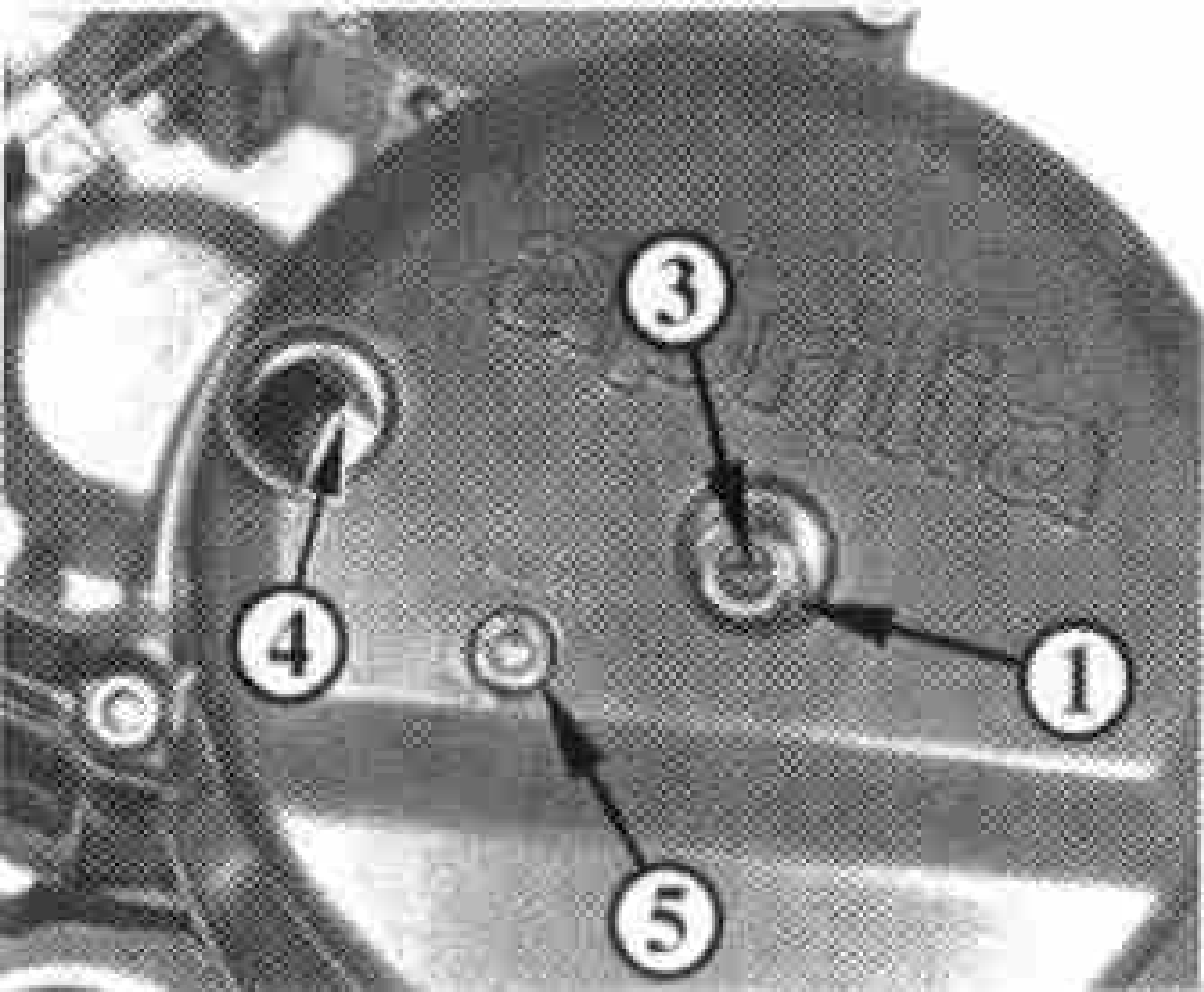
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Fitting cylinder components:

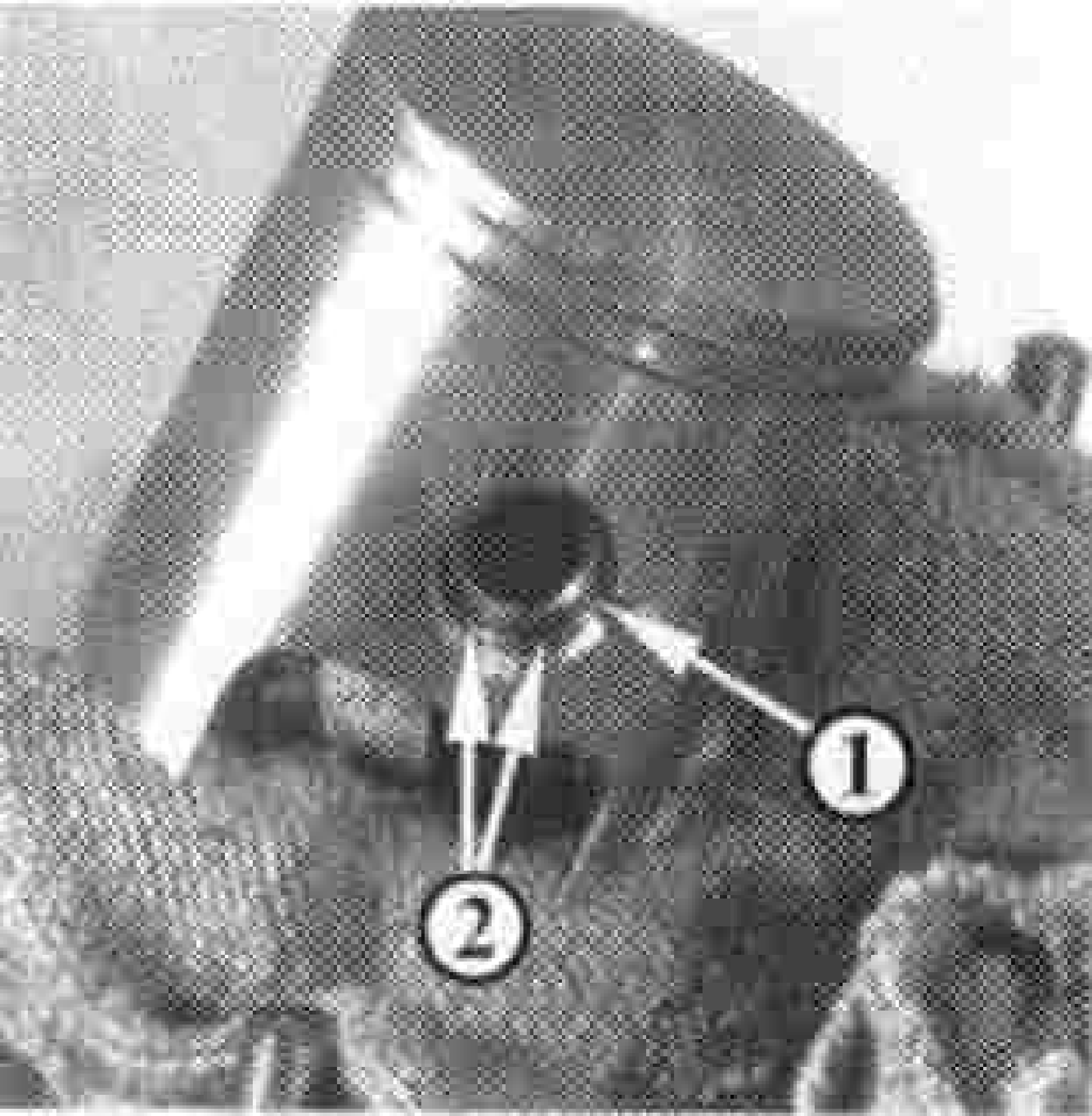
Trim possibly excessive crankcase gasket. Fit appropriate cylinder base gasket 0.5 or 0.3 mm. Insert oiled needle cage for piston pin in the connecting rod, hold piston over con rod and insert piston pin.

ATTENTION: The arrow on the piston crown must point towards e x h a u s t port.

Cover crankcase opening with a cloth. Fix piston pin with new circlips ❶. The circlip opening ❷ must face downwards. Remove cloth covering crankcase. Fit the piston rings in their grooves, carefully locating the gaps over their locating pegs, and then slide piston ring clamp ❸ into position over the rings and fit oiled cylinder.

ATTENTION: Only pistons and cylinders of same tolerance group (= colour marks) can be fitted together (see also page 36 and 44).

Remove piston ring clamp.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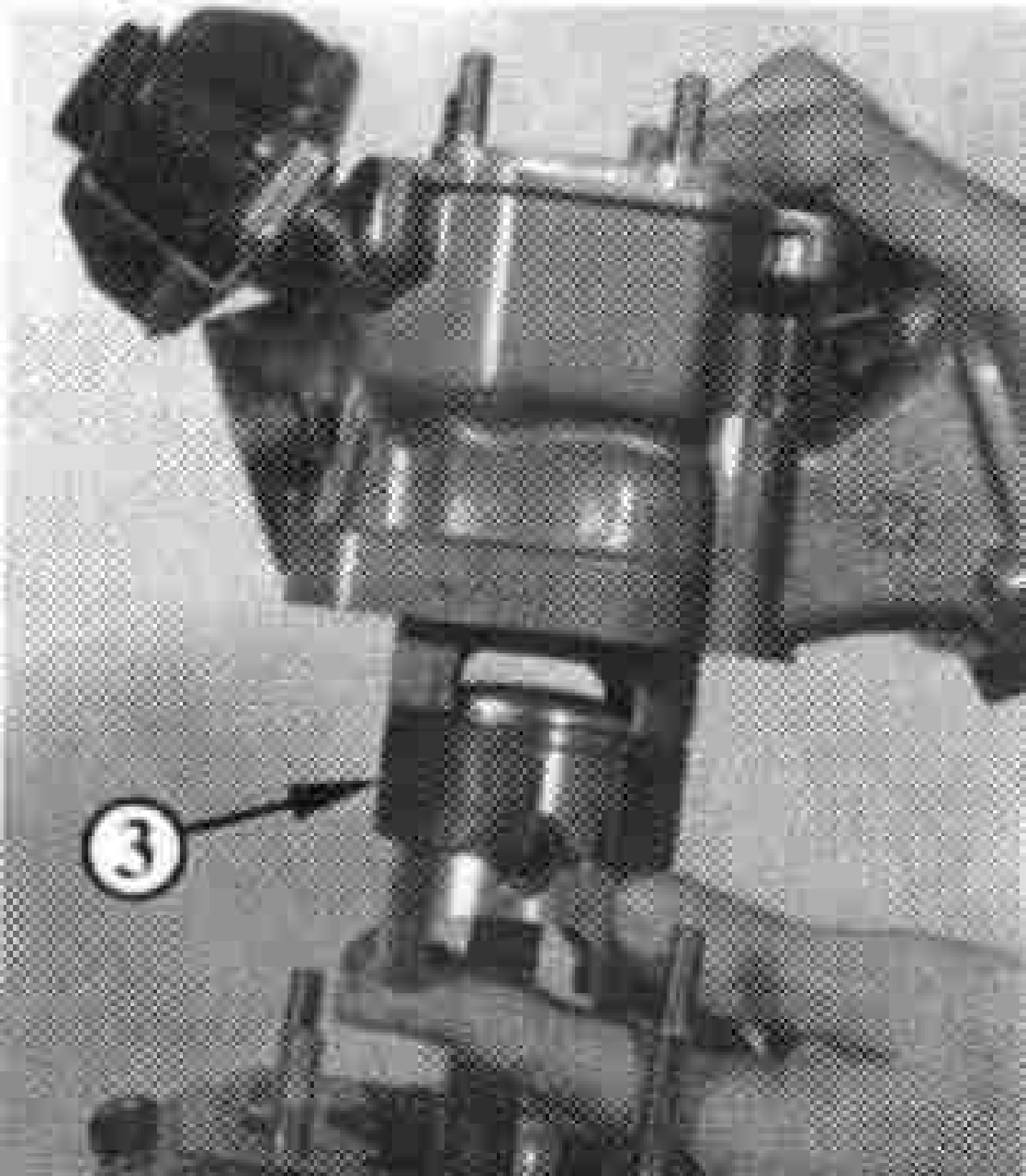
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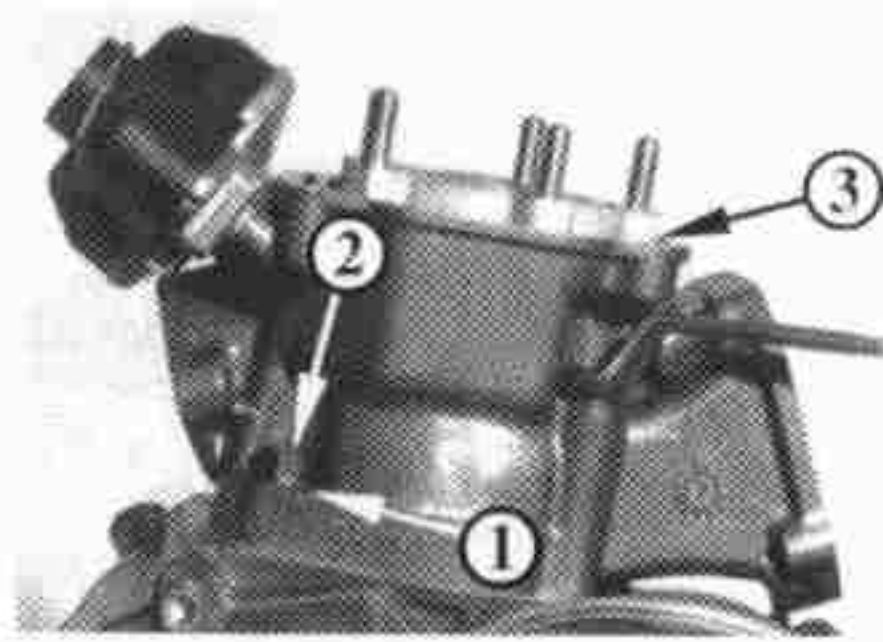
Cylinder:

Tighten cylinder with 4 washers ❶ and nuts M8 ❷ (wrench 11) crosswise. Tightening torque 30 Nm. Insert O-ring for combustion chamber.

Fit combustion chamber insert on the location bosses ❸ and tighten crosswise with 5 shims 7,4 ❹ and nuts M7 (wrench 11) ❺. Tightening torque 20 Nm.

ATTENTION: Don't squeeze the O-ring.

Insert O-ring ❻ and tighten cylinder head cover ❼ with O-ring and installed thermostat with 4 Allen screws M6x20 ❽ crosswise. Retighten cylinder head nuts after the first 500 km, when the engine is cold.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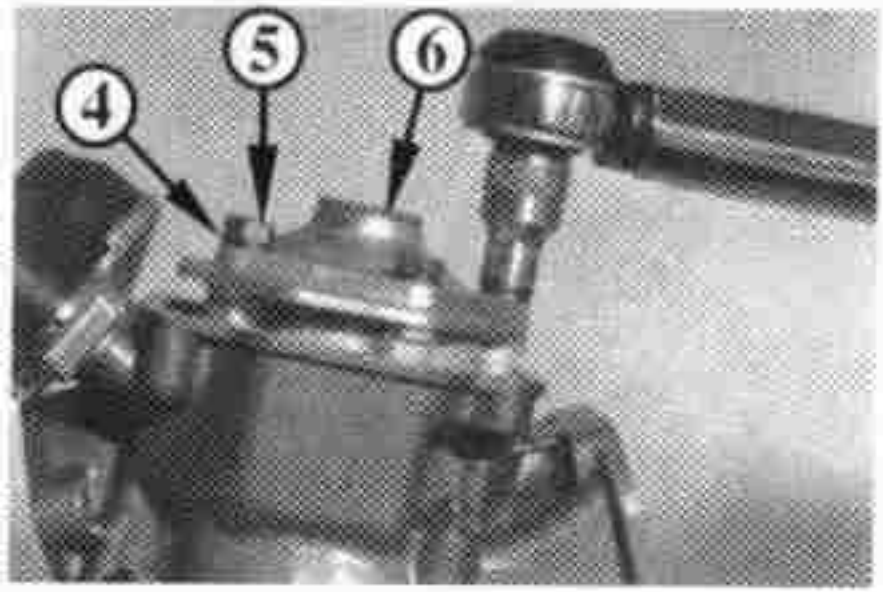
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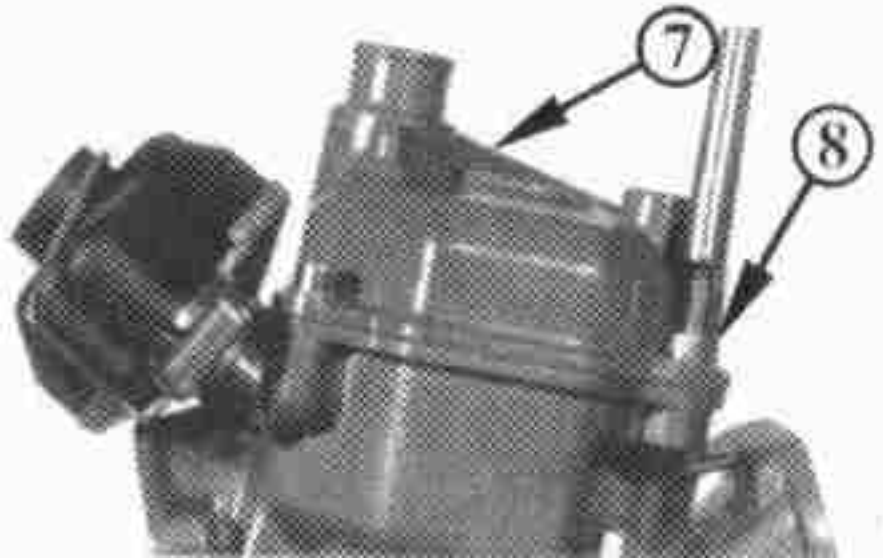
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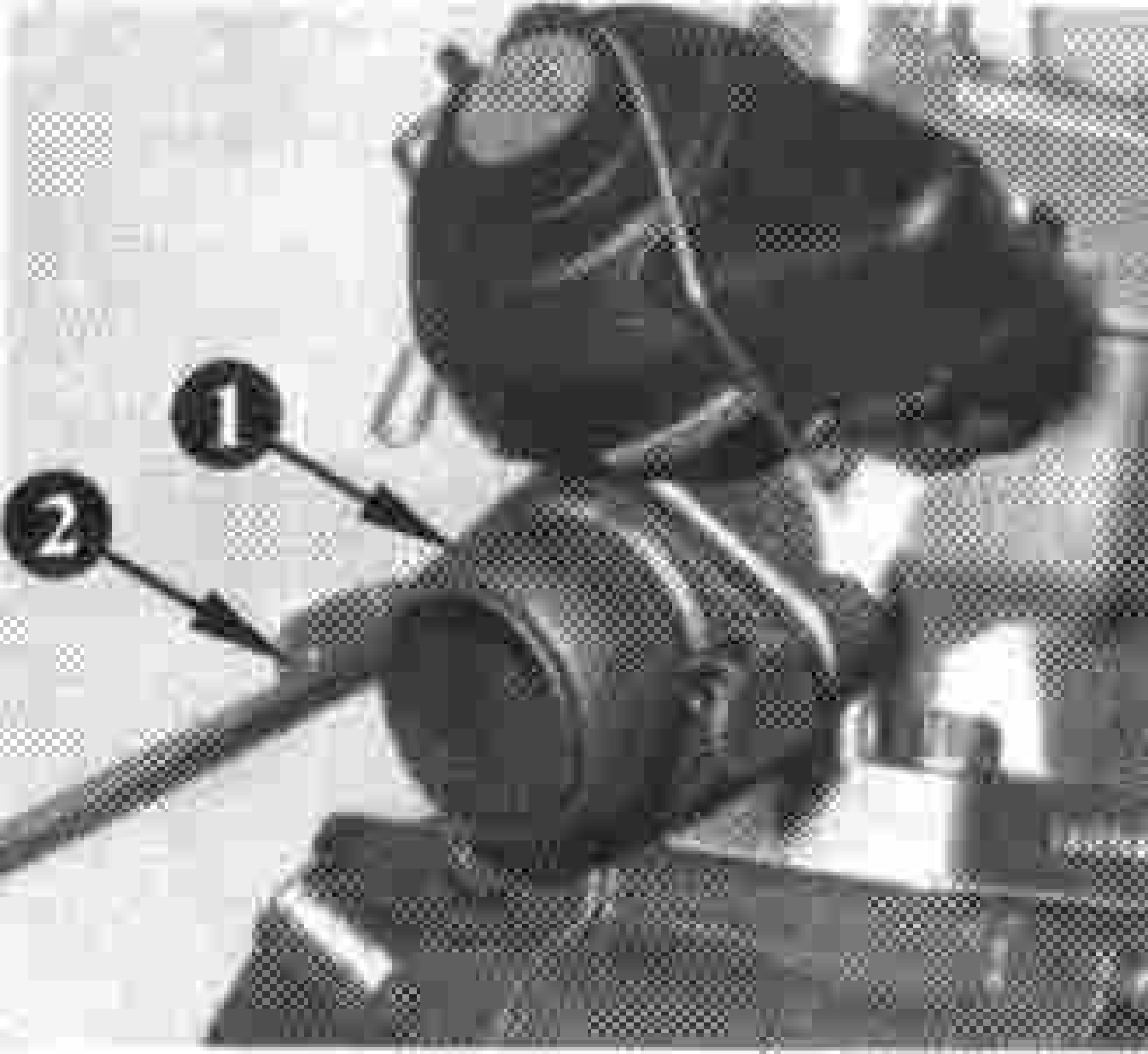
Exhaust socket:

Fit exhaust socket ❶ with gasket and spring brackets ❷ and tighten with 2 Allen screws M8. Tightening torque 20 Nm.

Carburetor flange:

Insert the complete reed valve ❸ and carburetor flange ❹ according to their shape into the cylinder and tighten crosswise with 5 Allen screws M6 x 25.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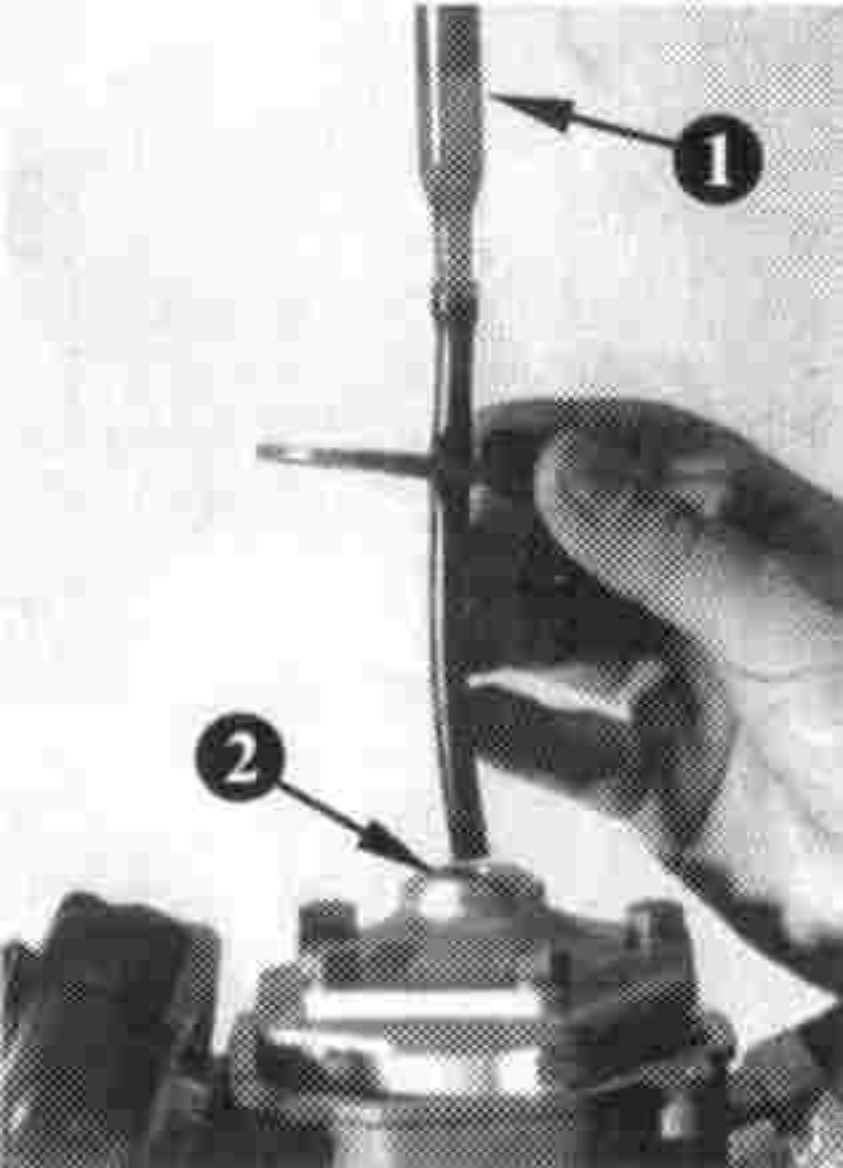
Checking the compression ratio:

The combustion chamber must be completely cleaned of combustion residues. Set piston at top dead centre by means of crankshaft locking screw. From a burette ❶ containing a measured quantity of two-stroke oil, carefully fill the combustion chamber exactly to the top ❷ of the spark plug hole. Allow sufficient time for the oil to drain down the walls of the burette, then calculate the amount added to the combustion chamber.

Calculation of compression ratio:

Deduct 2c.c. from the volume of oil measured (=volume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of spark plug when installed).

$$\text{Compression} = \frac{\text{swept volume + volume of combustion chamber}}{\text{volume of combustion chamber}}$$

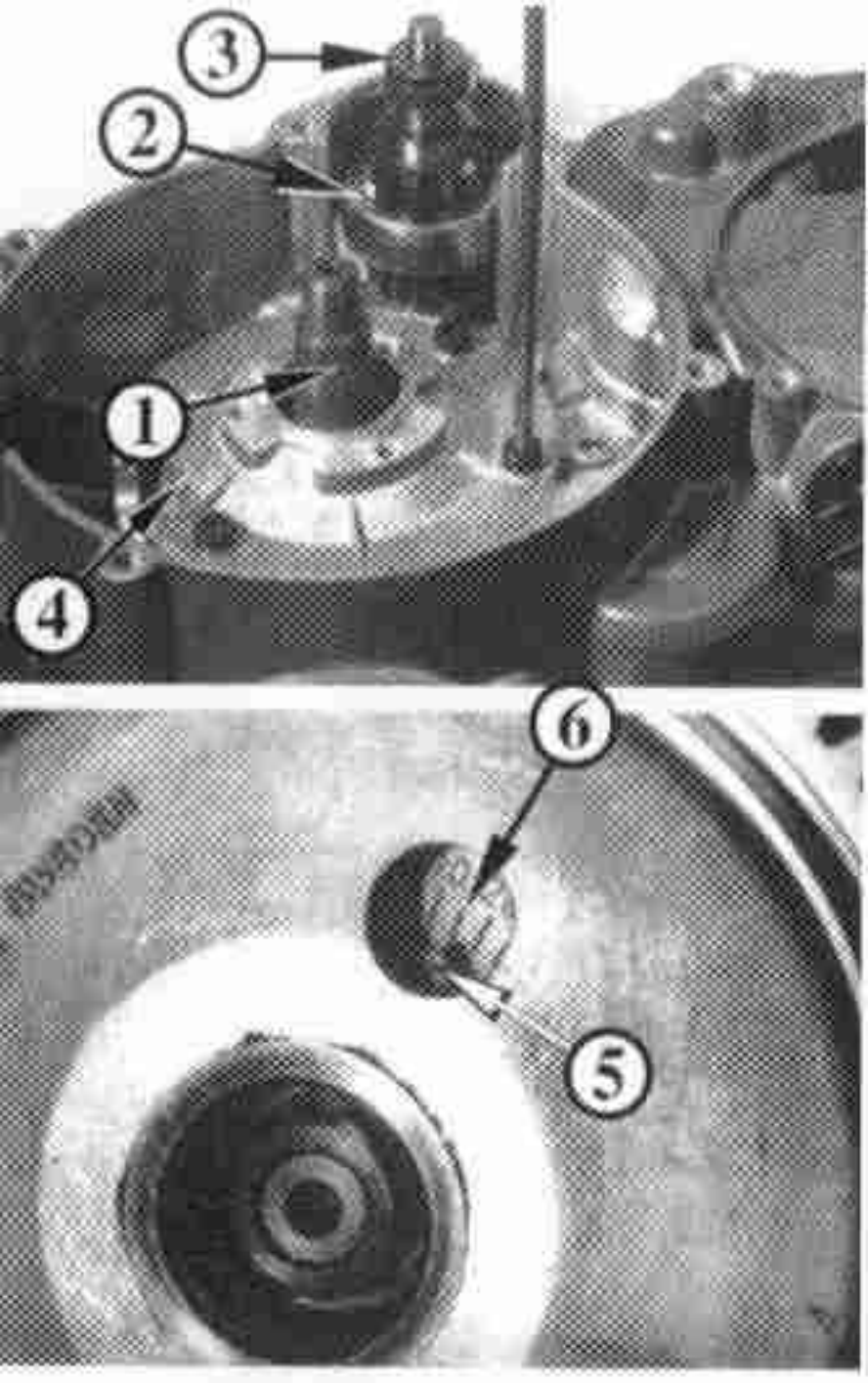
$$= \frac{Vh + Vc}{Vc} = \begin{array}{l} 14,2 \pm 0,5 \text{ for Enduro/AFI/Custom} \\ 12,5 \pm 0,5 \text{ for Enduro ETX Svizzera} \\ 15,3 \pm 0,5 \text{ for Rally} \end{array}$$

Using cylinder base gaskets of different thickness, the prescribed compression ratio can be achieved (see parts list). Remove crankshaft locking screw, turn crankshaft and let oil flow out through exhaust port. Refit crankcase and water drain screws M8 with sealing rings, and also, after cleaning, the magnetic gearbox drain screw.

Fitting of SEM ignition unit:
(type 123 E Custom without variable timing, fited on frames no. 01001 to 01480).

Turn engine on trestle magneto side upwards. Place Woodruff key ❶ into crankshaft. Insert the starter transmission gear ❷ with thrust washers ❸ on each side into the bore with needle bearing.

Fix armature plate ❹ with 3 Allen screws M5 and lock washers, using LOCTITE 221. Tighten stator with 3 slotted head screws M5 and washers in central position (using LOCTITE 221). Degrease tapers of crankshaft and magneto flywheel. Don't use LOCTITE on tapers. Fit magneto flywheel, aligning key and keyway and tighten, but only slightly.



Lock crankshaft at top dead centre with crankshaft locking screw. In this position the mark ❺ on magneto flywheel must correspond with the 14 degrees mark ❻ on stator. If not, the magneto flywheel has to be removed and the stator moved as required.

Ignition adjustment:
Type 123E Custom without variable timing

Checking with a dial gauge:

Screw dial gauge into cylinder head combustion chamber. Loosen the crankshaft locking screw and turn the crankshaft backwards 14 degrees (= 1,0 mm piston stroke). In this position the cast mark must correspond with mark '0 degrees' on stator.

In case of checking the ignition timing with stroboscope lamp:

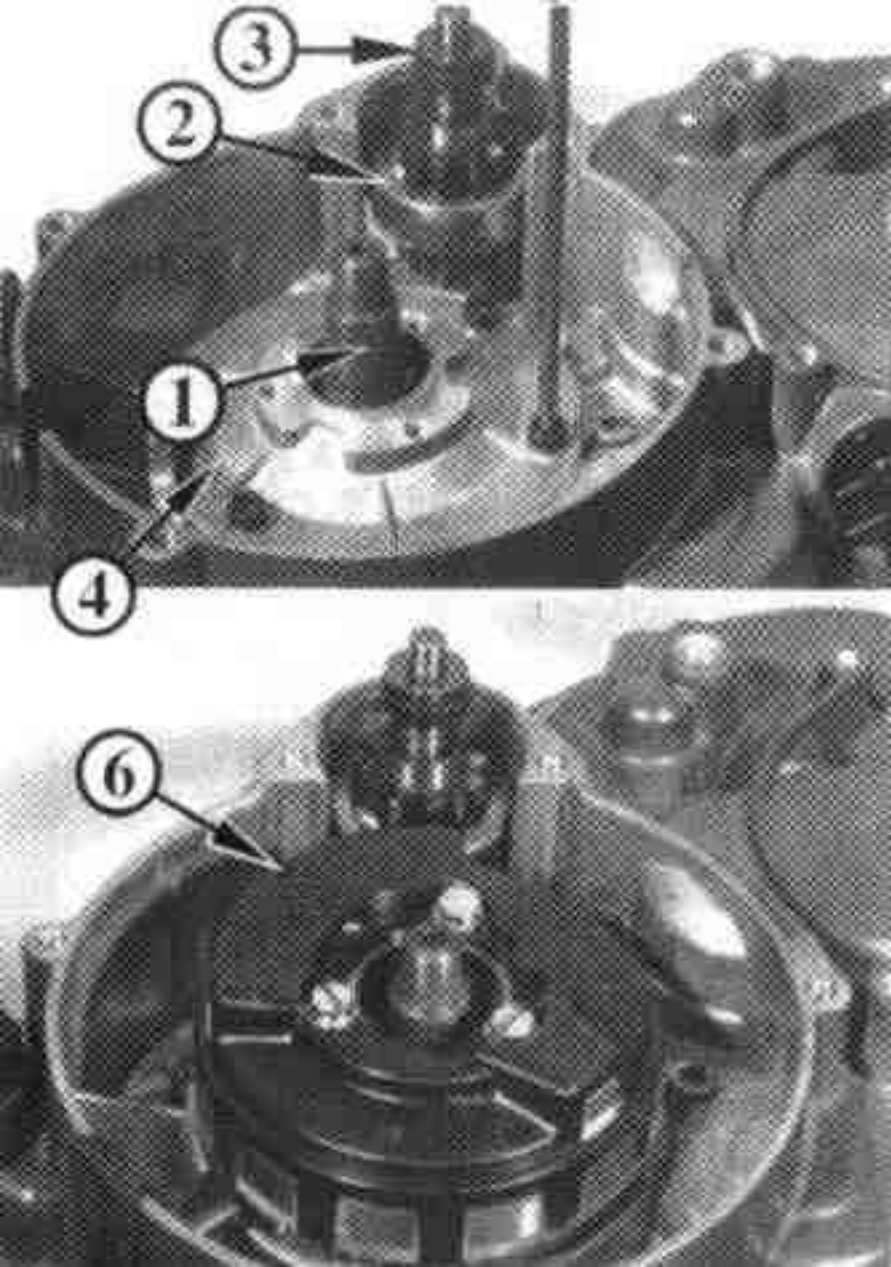
The mark on the magneto flywheel has to align with the '0 degrees' mark on the stator at 5000 r.p.m. When satisfied that the ignition timing is correctly set, fit lockwasher, hex. nut M12x1 using LOCTITE 648 and tighten to 70 Nm. Don't apply LOCTITE to the
taper!

Finally, check the ignition timing with the engine running at 5000 r.p.m. using a stroboscope lamp.

Fitting of SEM ignition unit:
(types 123 w i t h variable timing)

Turn engine on trestle, magneto side upwards. Place Woodruff key ❶ into crankshaft. Insert the starter transmission gear ❷ with thrust washers ❸ on each side into the bore with needle bearing.

Fix armature plate ❹ with 3 Allen screws M5 and lock washers, using LOCTITE 221. Tighten stator with 3 slotted head screws M5 and washers in central position (using LOCTITE 221).
Degrease tapers of crankshaft and magneto flywheel. Don't use LOCTITE on tapers. Fit magneto flywheel.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aligning key and keyway and tighten, but only slightly. Loosen crankshaft locking screw, insert dial gauge into spark plug threads, and set dial gauge to "0". Turn flywheel backwards by

1,84 mm = 19 ° for type Enduro, Custom, AF 1
1,30 mm = 16 ° for type Enduro ETX-Svizzera
2,03 mm = 20 ° for type 123 Rally.

In this position the 2 mm peg ⑤ pushed through the bore in flywheel must engage in the slot ⑥ of the stator. Otherwise remove magneto flywheel and turn stator as required.

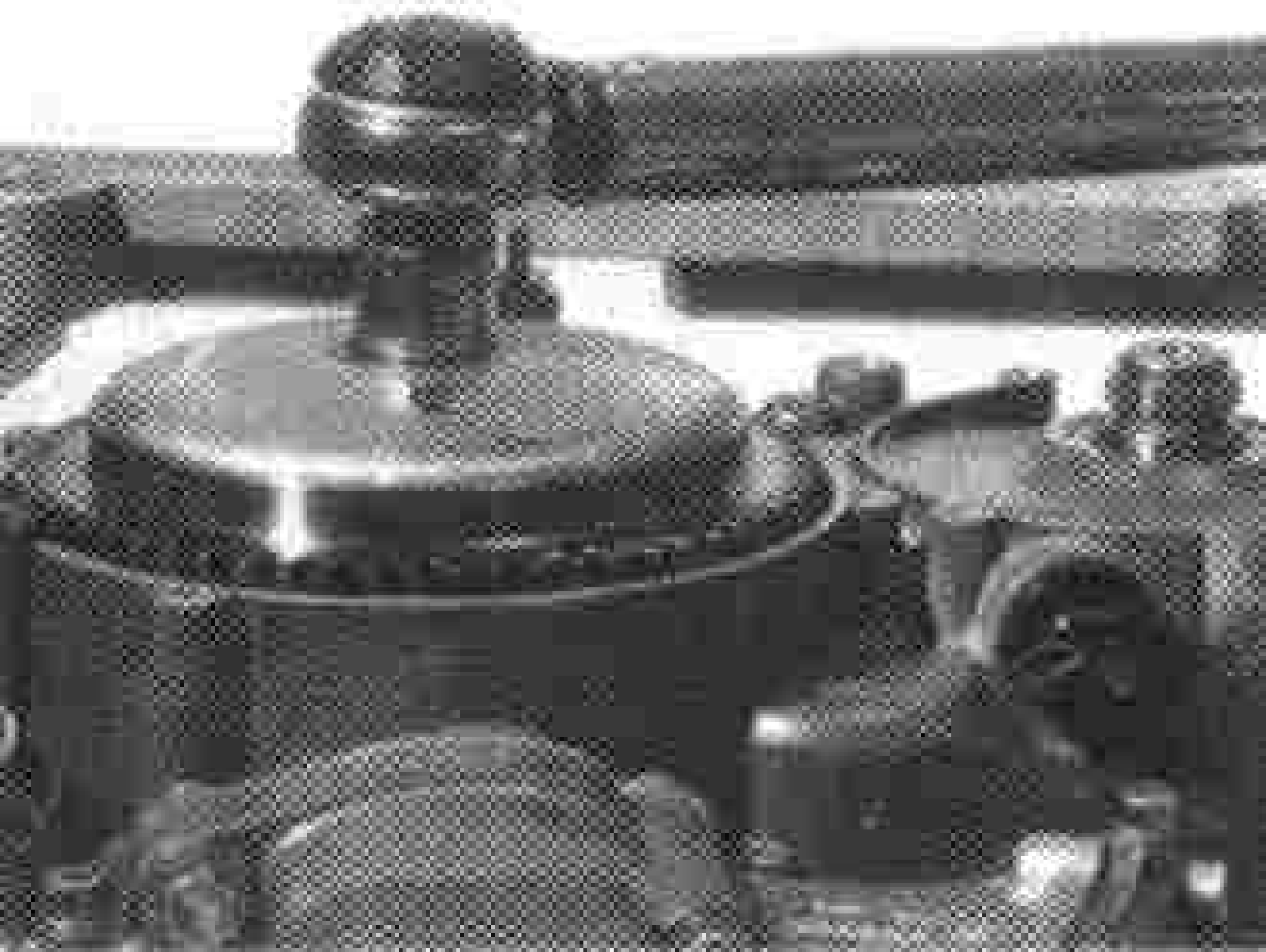
Fit lockwasher, apply LOCTITE 648 to the hex. nut M12x1 and tighten it at 70 Nm. Don't use LOCTITE on the taper.

Ignition adjustment types 123 with variable timing:

The final check of ignition timing is done on the engine running at 10.000 r.p.m. using a stroboscope lamp.

To check for correct ignition timing with stroboscope lamp make a mark on crankcase and magneto flywheel at the moment of ignition, i.e.
0,74 mm = 12 ° BTDC for type Enduro, AF1.Custom
0,41 mm = 9 ° for type 123 Enduro ETX Svizzera,
0,87 mm = 13 ° for type 123 Rally.

These marks must correspond at 10.000 r.p.m.



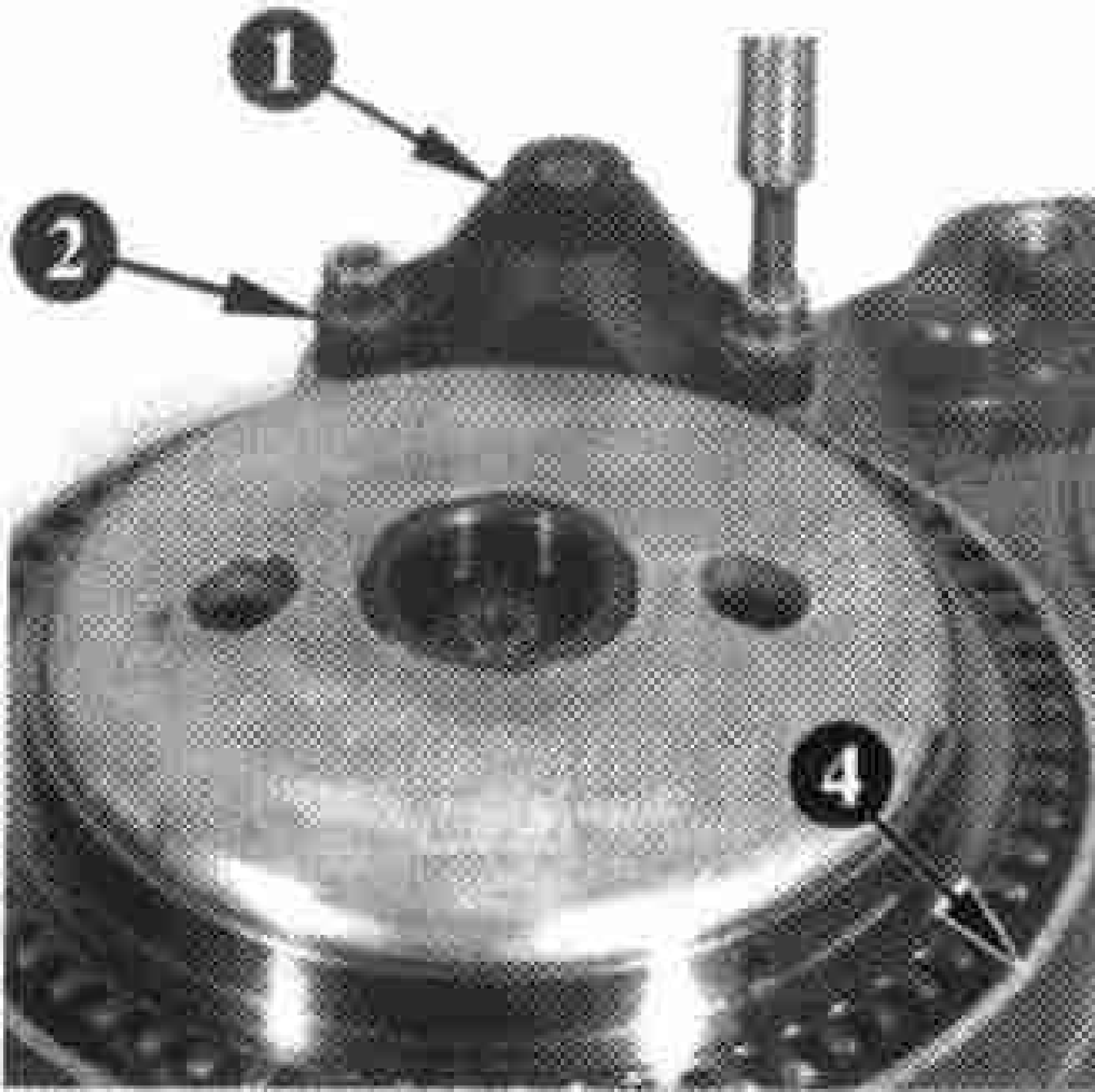
Starter gear cover:

Fit starter gear cover ❶ and fix it with spring washer ❷ and Allen screw M6 x 20. Tightening torque 4,5 Nm.

ATTENTION: Fit the spring washer with its back ❸ (= convex side) towards the screw head, to avoid damaging the cover.

Ignition cover:

Coat the ignition cover joint face ❹ with SILASTIC and fix the ignition cover ❺ with 4 Allen screws M6 x 25. Tightening torque 4,5 Nm.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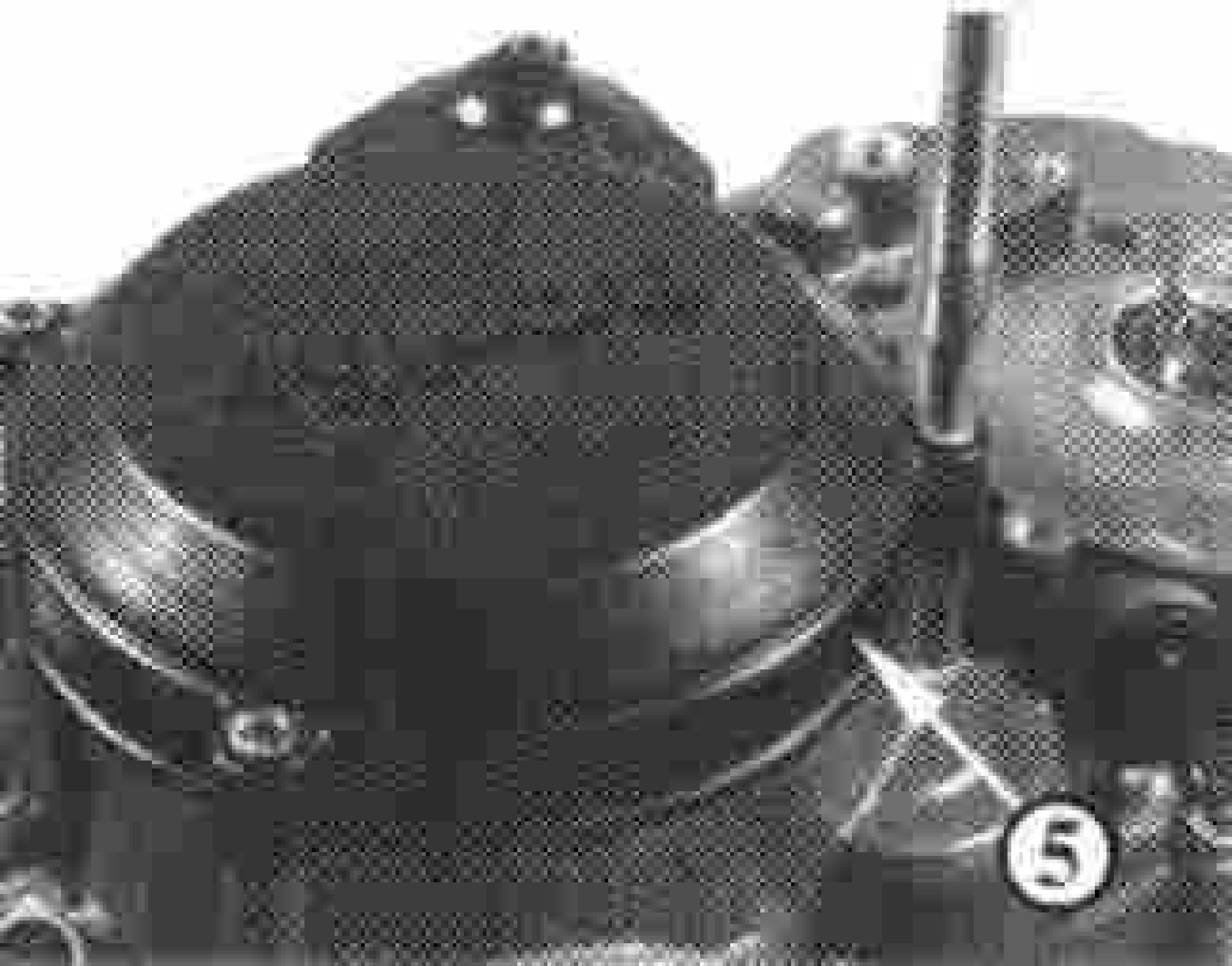
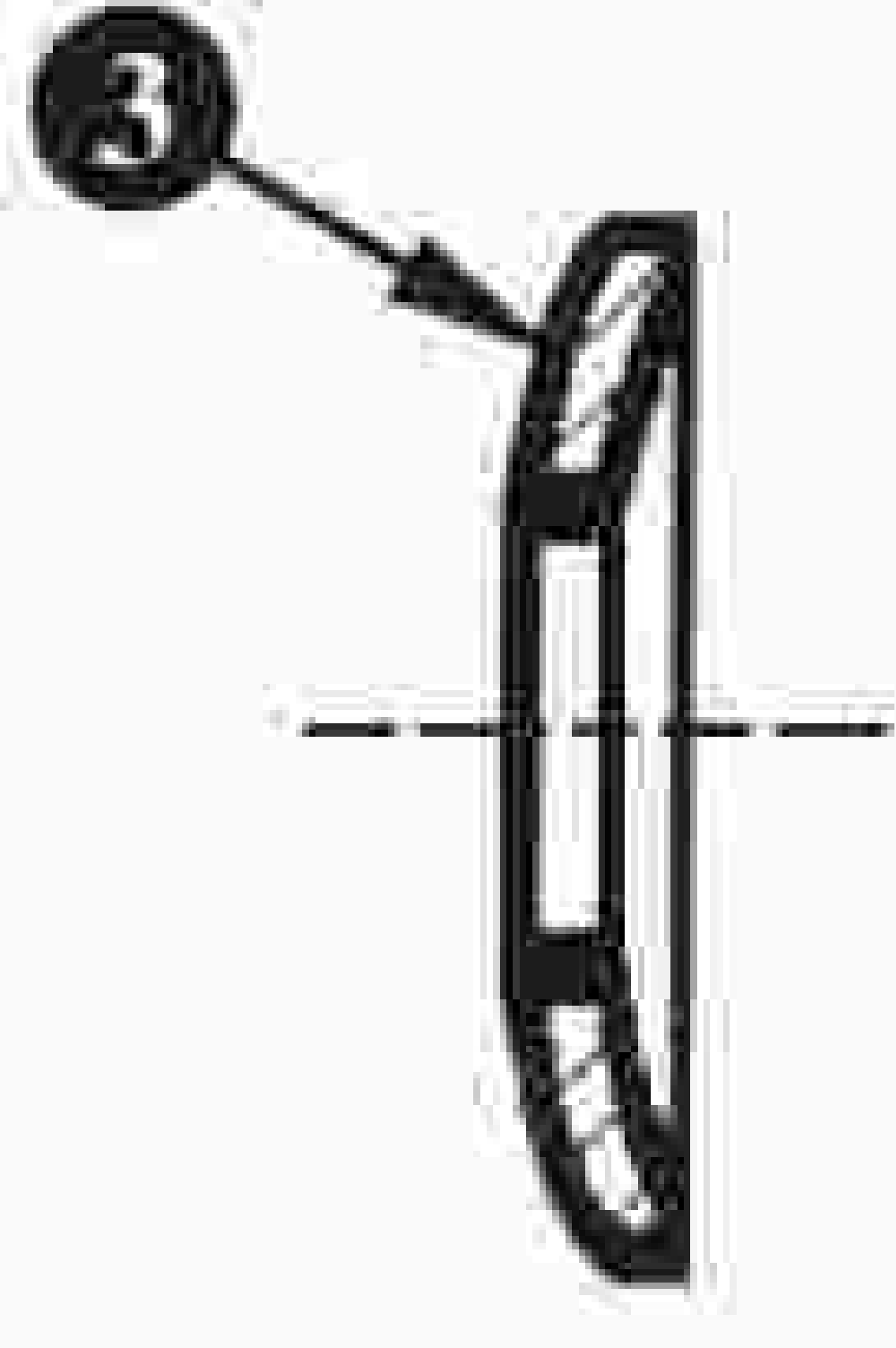




Sprocket:

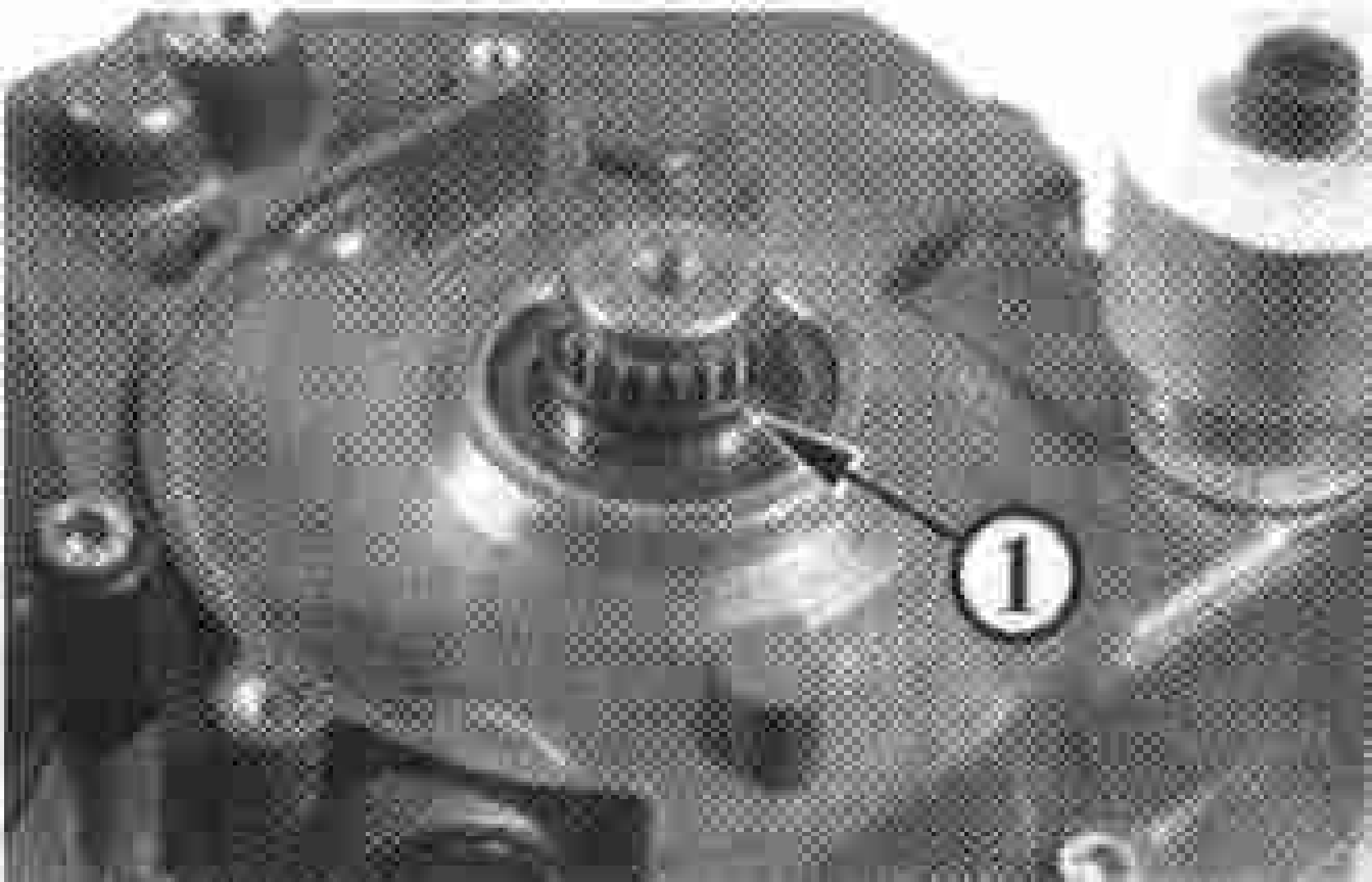
Engage 1st gear. Place O-ring ❶ into the groove of the mainshaft. Position sprocket ❷, press it towards O-ring and secure with new circlip ❸.

ATTENTION: The circlip must be securely seated in its groove, with its sharp edge outwards!

Remove crankshaft locking screw and fit Allen screw with sealing ring.

Fitting of electric starter:

Turn the starter gears and check for free movement. Grease the starter pinion with MOLYKOTE 111, insert the electric starter ❹ into the crankcase and tighten equally with 2 collar screws ❺ (wrench 7) and lock-washers.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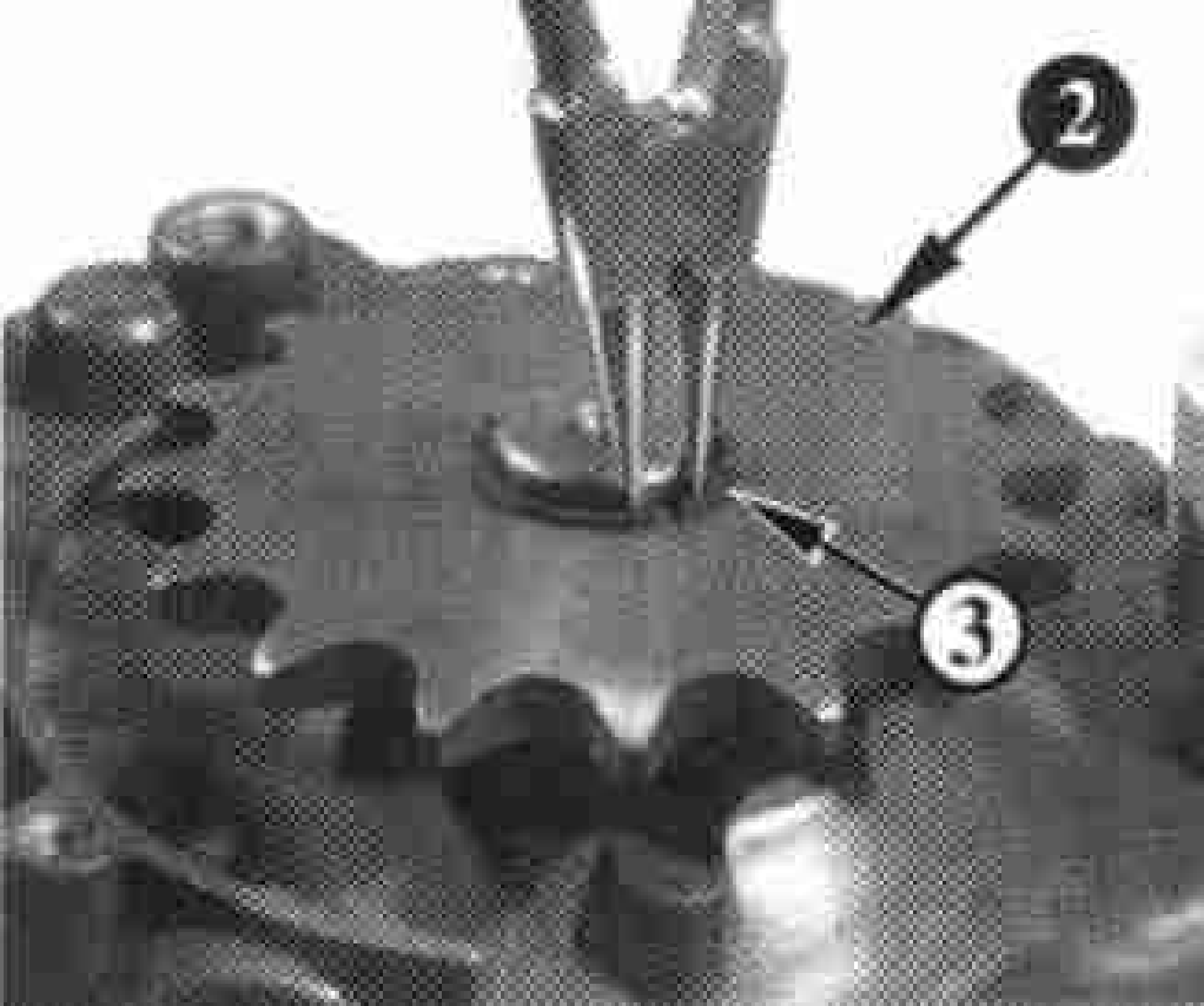
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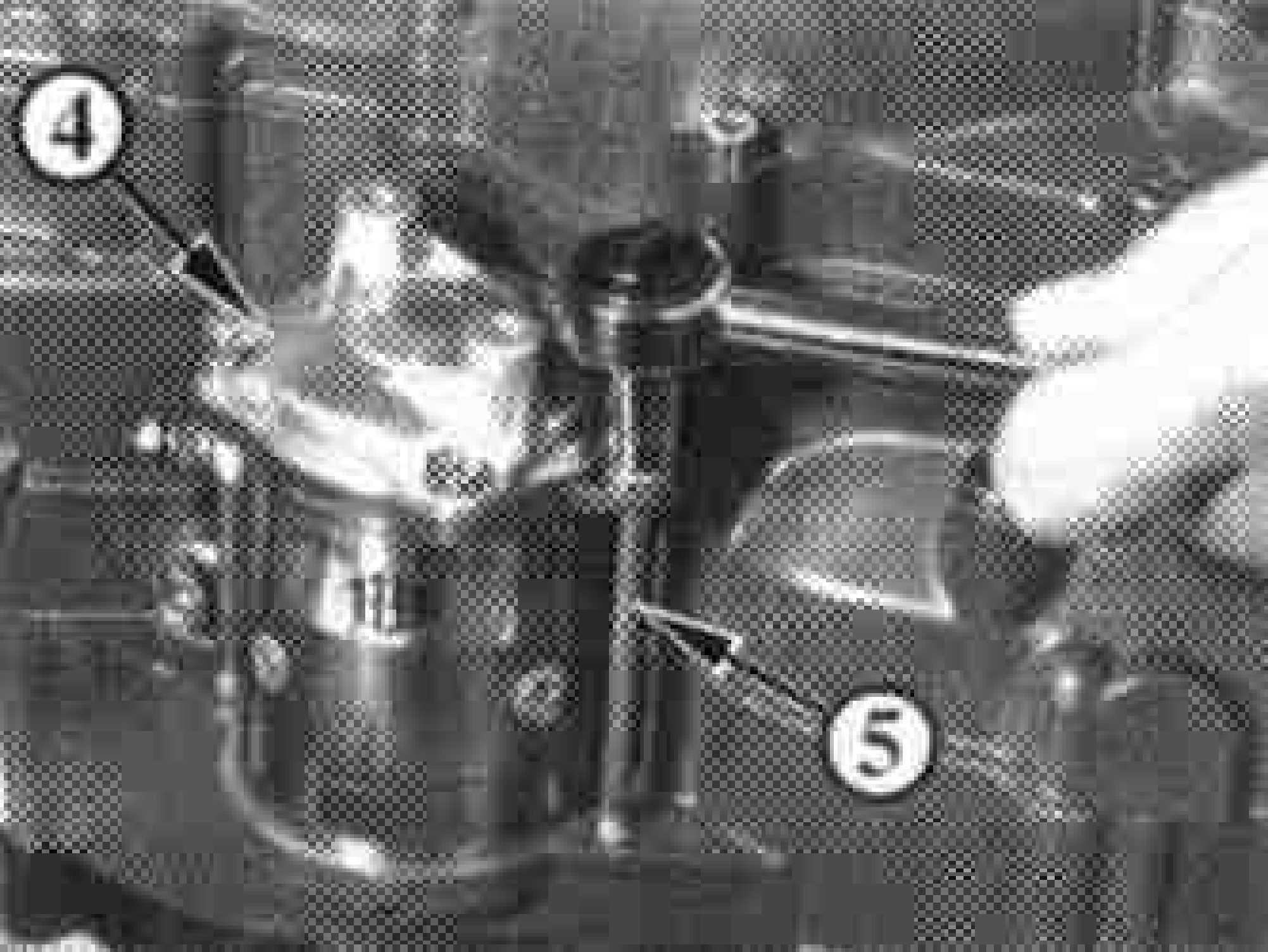
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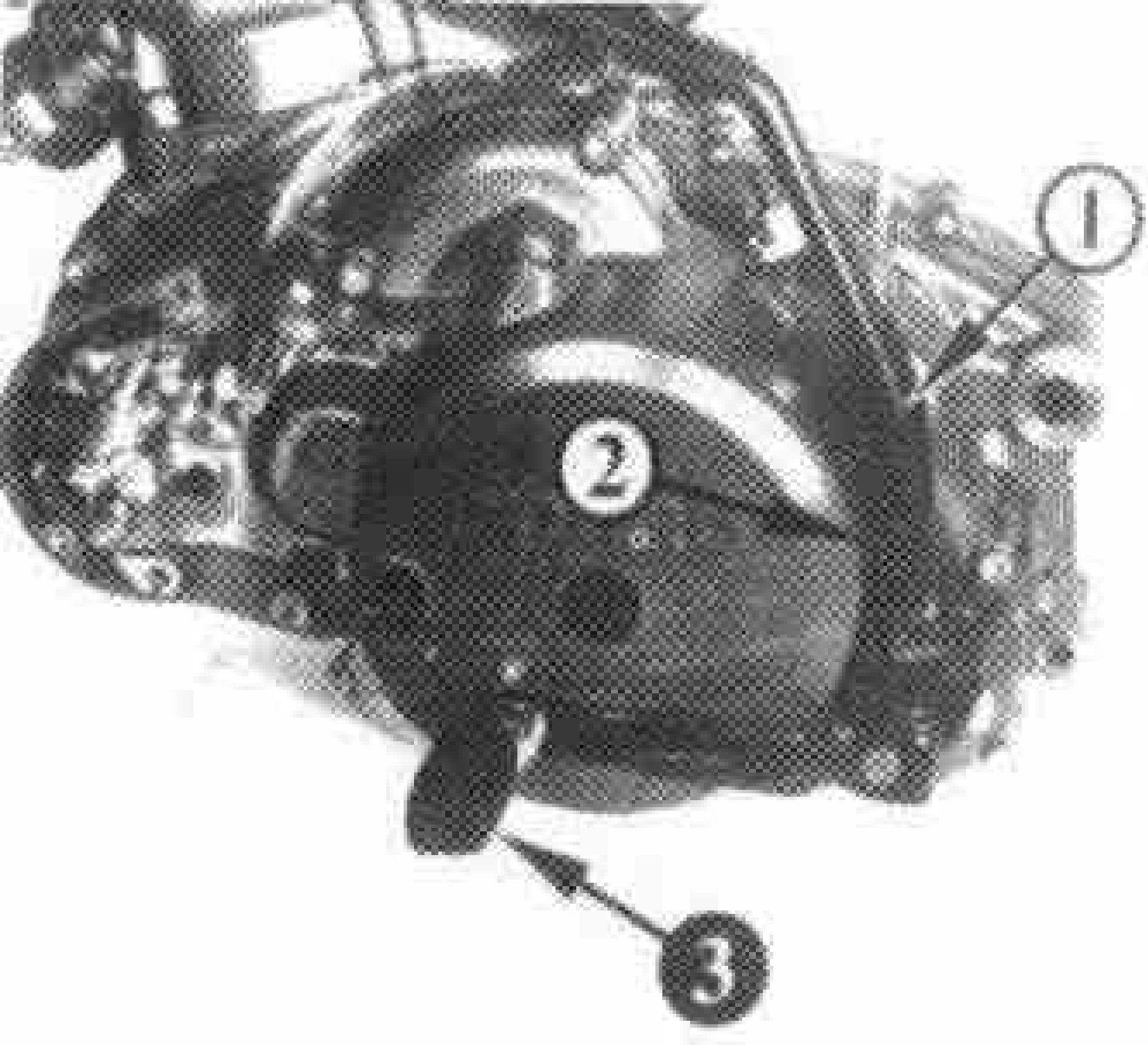
Fitting kickstart and gearshift levers:

The kickstart lever ❶ (only version with kickstarter) should be fitted as close as possible to the clutch cover ❷ but must not touch it. Tighten with Allen screw M8.
Fit gearshift lever ❸ on gearshift shaft and fix it with Allen screw M6.
Remove engine from trestle.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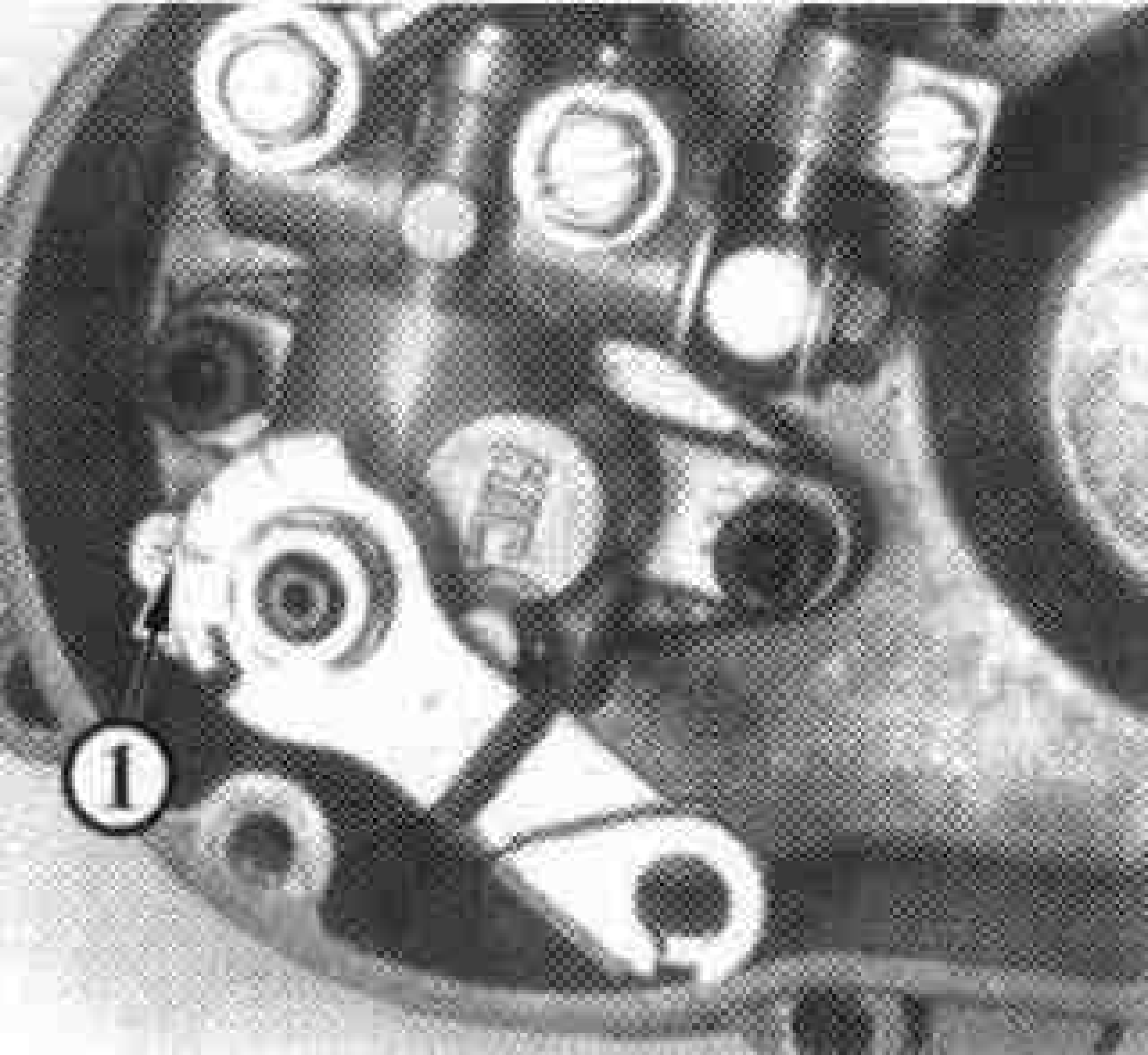
Engine installation:

Mount the engine on its suspension points in the frame. Connect oil lines, fit oil pump control cable and adjust it according to the mark ❶ . Fit clutch cable, adjust the necessary free-play and fit plug screw ❷ with O-ring. Connect cable for RAVE II. Fit water drain screw. Connect water hoses and refill cooling liquid.

Fit cleaned and checked carburetor. Apply LOCTITE Antiseize on the exhaust ball joint and mount exhaust system. Fit drive chain, make all electrical connections and attach rev. counter shaft.
Make a first test run with fuel/oil mixture until the oil tubes are filled with oil and free of air bubbles. Fit oil pump cover and gasket with 4 Allen screws.

ATTENTION: After test run check that cooling water circuit is free of air bubbles.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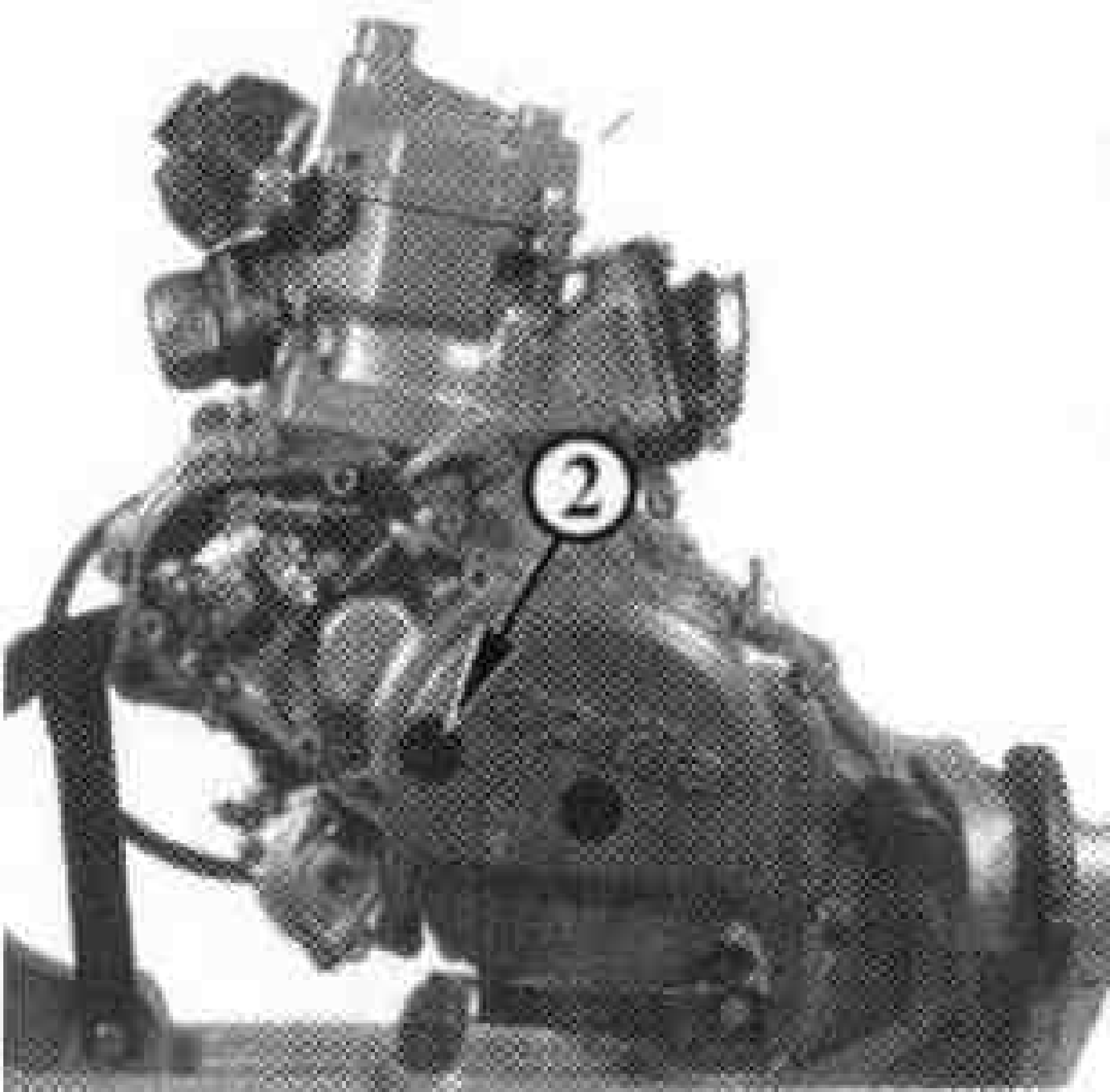
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Checking of RAVE II (pneumatic) function:

The switch point of RAVE is checked with motorcycle running (on even road). The switch point of the exhaust valve is adjusted by the red plastic screw in exhaust valve cover.

Switch point RAVE II:

Strada:	7700 ÷7800 l/min.
Enduro	7300 ÷7400 l/min.
Custom:	7300 ÷7400 l/min.
Rally:	8300 ÷8400 l/min.

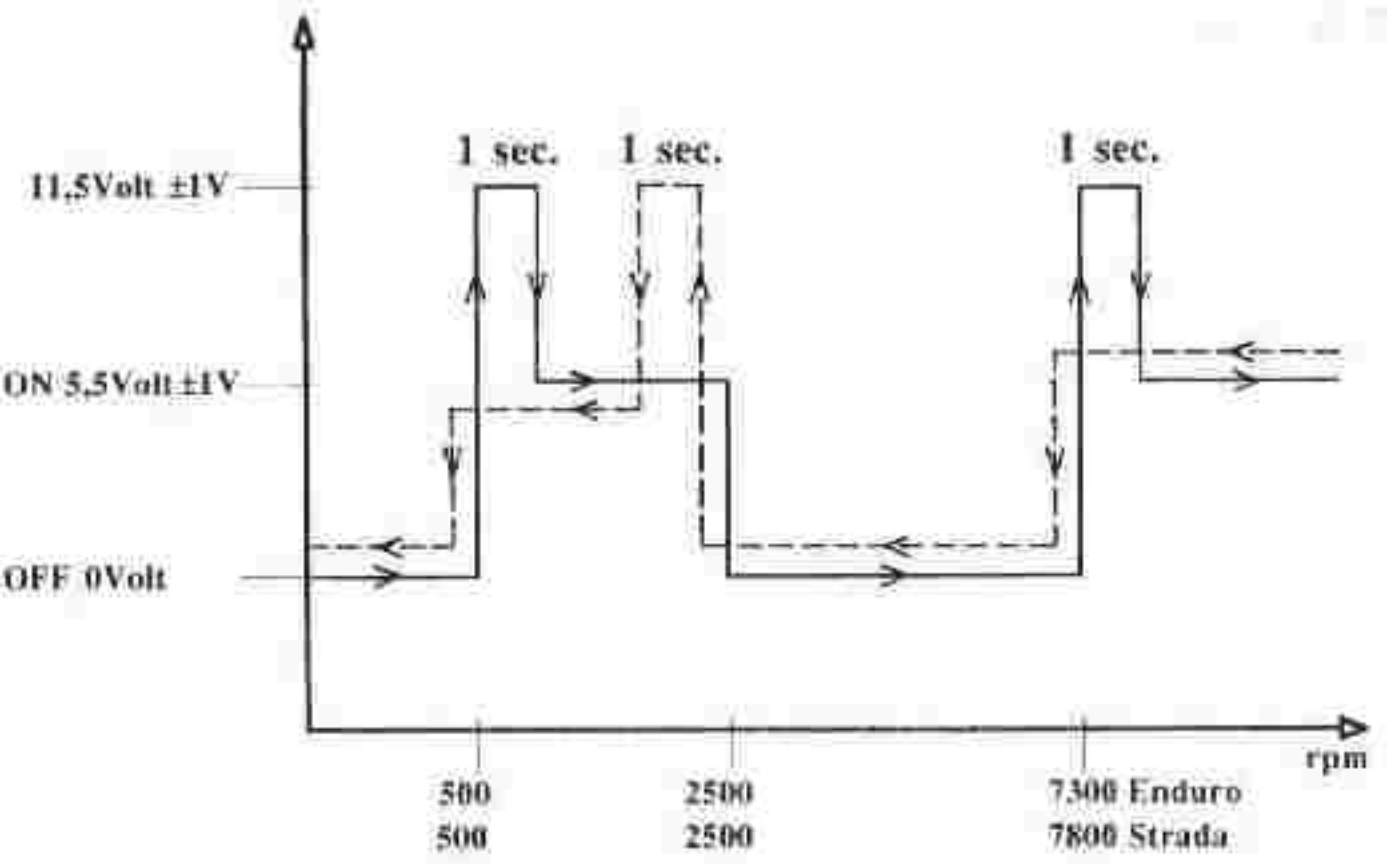
Checking of RAVE-E (electronic) function:

The exhaust valve is open between 500 and 2500 r.p.m. for self-cleaning of the valve rod, closed between 2500 r.p.m. and switch-point (=7300÷8300 r.p.m., depending on engine type) and above the switch point it is open. For checking of the control unit, remove the 6-way connector, start the engine and light the dipped headlamps. Voltage at 2500 r.p.m. between cables green and blue = 12,25±1V D.C., and 8.5±1V A.C. between cables yellow and blue. If these values are not reached, the fault is not in the control unit but in the system.

For checking the solenoid, check its piston for easy movement and test resistance value between the 2 cables (2,2 ohms ±10%). The voltage measured between the cables of the solenoid should be at idling speed during an impulse of (only) 1 second 11,5 ±1V, and after this initial impulse 5,5 ±1V D.C.

Switch point RAVE-E:

Enduro .....7300 ÷ 7400 1/min.
Custom .....7300 ÷ 7400 1/min.
Pegaso .....7300 ÷ 7400 1/min.
Strada.....7700 ÷ 7800 1/min.
Rally + RX: ...8300 ÷ 8400 1/min.


1 sec.
1 sec.
1 sec.
11,5Volt ±1V
ON 5,5Volt ±1V
OFF 0Volt
rpm
500
500
2500
2500
7300 Enduro
7800 Strada

TECHNICAL DATA

Engine type	123
Design	1-cylinder-, 2-stroke engine, liquid-cooled
Bore / stroke	54 / 54,5 mm
Displacement	124,8 mm
Compression : Enduro, AF1, Custom	theoretical: 14,2 ±0,5 effective: 7,9
Compression: Enduro ETX Svizzera	theoretical: 12,5 ±0,5 effective: 7,0
Compression: Rally	theoretical: 15,3 ±0,5 effective: 8,0
Fuel	PREMIUM gas, min. ROZ 98
Crankshaft bearings	2 ball bearings
Con rod bearing	needle bearing
Cylinder	light alloy cylinder with GILNISIL treatment
Piston	light alloy
Piston rings	2 rectangular rings
Engine lubrication	with SUPER 2-stroke oil (e.g. MOBIL Synth) by oil pump

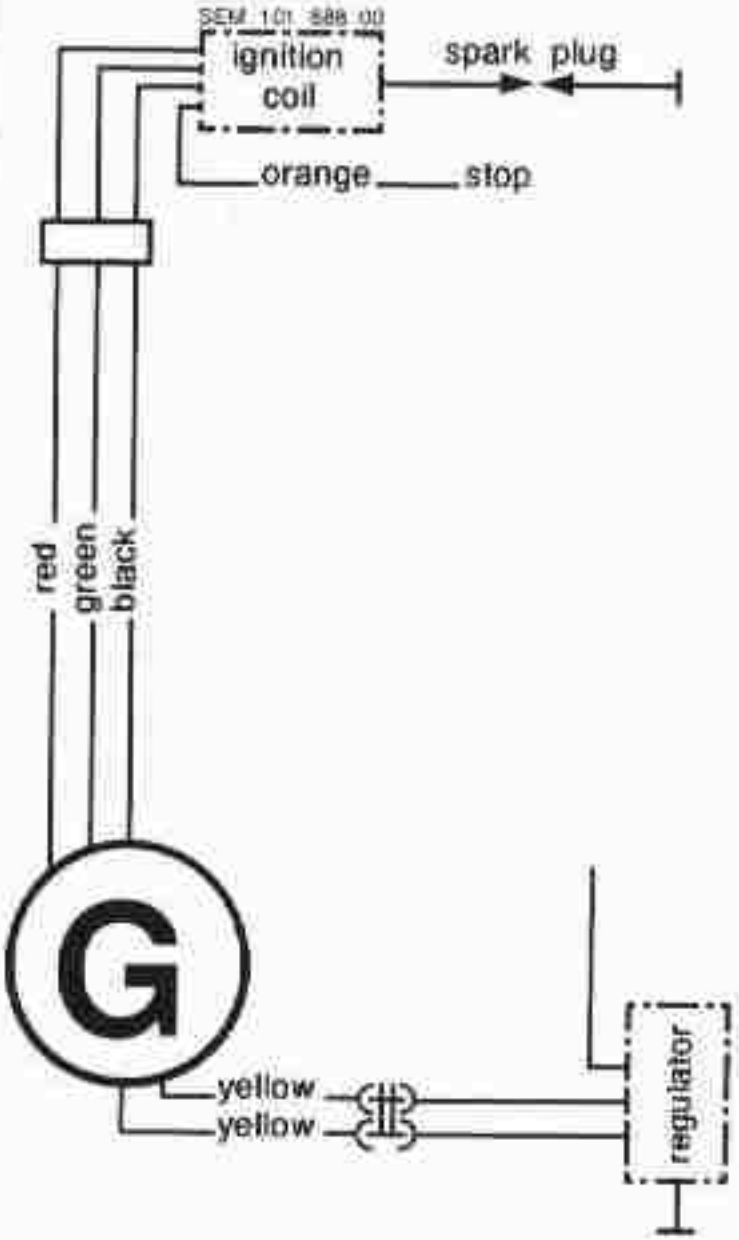
TECHNICAL DATA

Transmission lubrication	MOBILUBE SHC or SHELL Rotella X 30 or BP Vanellus M SAE 30
Primary drive	straight gears 20 : 64
Clutch	multi-plate, in oil-bath
Transmission	6-speed, dog engagement
Ignition unit unit	electronic SEM C.D. ignition unit
Generator output	12V / 180 W AC
Ignition timing: Enduro, Custom, AF1	1,84 mm=19 ° at 6000 1/min 0,74 mm=12 ° at 10000 1/min
Ignition timing: Enduro ETX Svizzera	1,30 mm=16 ° at 6000 1/min 0,41mm = 9 ° at10000 1/min
Ignition timing: Rally	2,03 mm=20 ° at 6000 1/min 0,87 mm=13 ° at 10000 1/min
Ignition timing: Custom without variable timing	1,00 mm=14 ° at 5000 1/min
Spark plug	NGK B10EG, 14 mm
Electrode gap	0,5 mm
Electric starter	EFEL pinion type electric starter,and/or kickstarter

TIGHTENING TORQUES

		Screw fixation or sealing compound
hex. nut M12x1, flywheel	70 Nm	LOCTITE 648 green
hex. nut M16x1,5 crankshaft, clutch side	70 Nm	LOCTITE 221 violet
hex. nut M18x1,5, clutch shaft, clutch hub	80 Nm	-
hex. nut M8 cylinder	30 Nm	-
hex. nut M7 combustion chamber insert	20 Nm	-
Allen screw M6 exhaust flange	20 Nm	-
Allen screw M6, starter gear cover	4,5 Nm	-
Allen screw M6 ignition cover	4,5 Nm	-
collar screw electric starter	8 Nm	-
countersunk screw M5, bearing plate for gearbox shafts and balance shaft		LOCTITE 221 violet
Taptite screw M5, leaf spring, clutch cover	5 Nm	LOCTITE 221 violet
Allen screw M5 stator plate	6 Nm	LOCTITE 221 violet

ignition coil
spark plug
orange
stop
red
green
black
G
blue
blue
regulator



Stator in WG-version has yellow lighting cables and must imperatively be used with WG-ignition coil (SEM no. 101 888 00 printed on it).
The WG-ignition coil can however be used together with previous stator (blue lighting cables).

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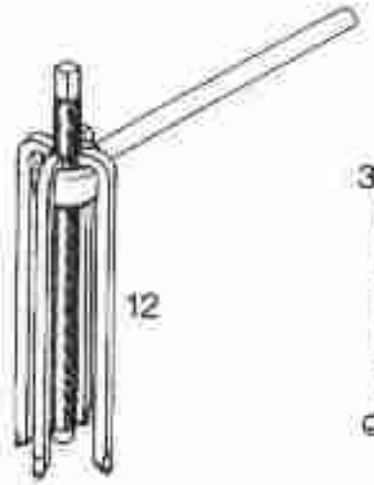

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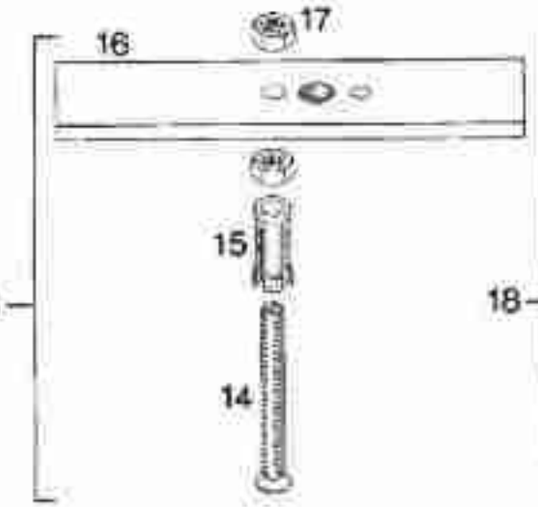

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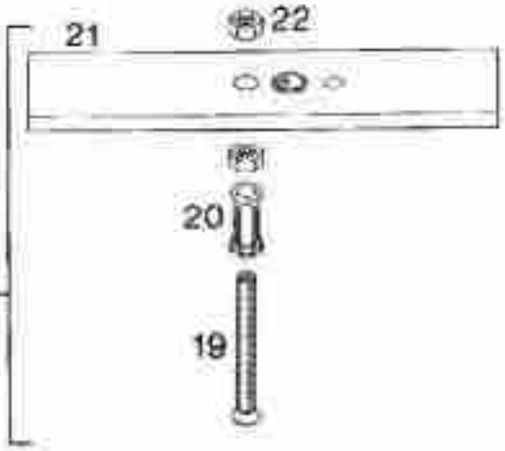

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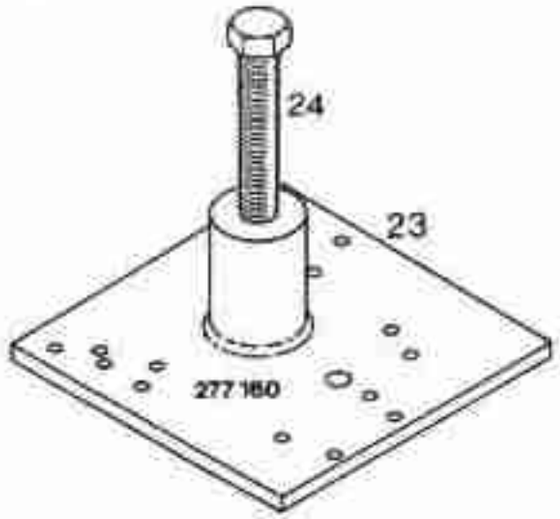

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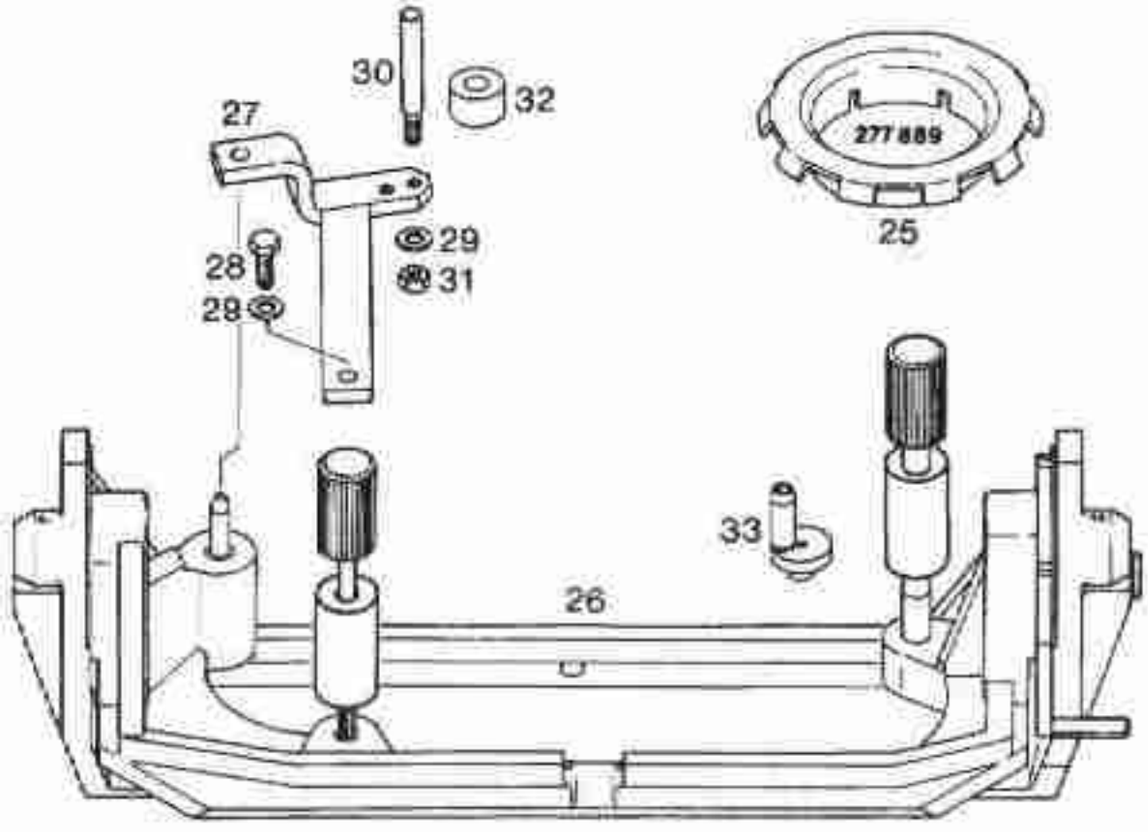

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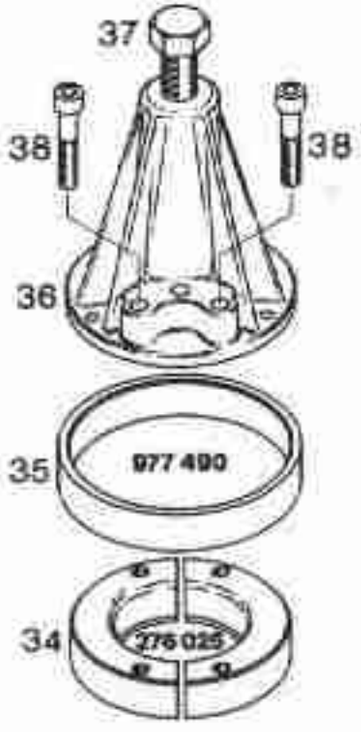

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ROTAX

Zylinder
Dichtungssatz

Cylinder
Gasket set

Guarnizione
cilindro

46

ROTAX

Motor
Dichtungssatz

Engine
Gasket set

Guarnizione
Motore

Ill.	Description	qty.	part no.
1	insertion jig for oil seal 230 355, kickstart shaft	1	277 850
2	insertion jig for oil seal 230 425, crankshaft, magneto and clutch side	1	277 875
3	insertion jig for oil seal 930 675, mainshaft	1	276 502
4	insertion jig for oil seals 230 195 and 250 450 pump shaft, shift shaft bushing	1	276 770
5	insertion jig for oil seal 930 500, rev. counter shaft	1	277 090
6	protection cap for crankshaft magneto side	1	276 790
7	puller assy., for magneto flywheel	1	276 807
8	crankshaft locking screw	1	241 965
9	guide sleeve for oil seal 930 675	1	277 970
10	piston ring spanner,for piston 54 mm	1	876 973
11	clutch adjustment wrench	1	276 040
12	ball bearing puller set	1	277 180
13	puller assy., ball bearing 6203, clutch shaft, magneto side	1	276 360
14	bolt for puller, ball bearing 6203	1	276 380
15	puller sleeve	1	276 370
16	support plate	1	276 390
17	hex. nut M10, for puller bolt	2	242 090
18	puller assy., for bearing 6302, balance shaft, magneto side	1	276 362
19	bolt for puller, bearing 6302	1	276 382
20	puller sleeve, for bearing 6302	1	276 372
21	support plate	1	276 390
22	hex. nut M8, for puller bolt	2	242 200
23	puller plate assy., for crankshaft removal	1	277 160

Ill.	Description	qty.	part no.
24	hex. screw M16x1,5x150	1	940 755
25	clutch hub locking tool	1	277 889
26	trestle assy.	1	277 917
27	insert kit for trestle assy.	1	277 107
27	adaptor assy.	1	277 100
28	hex. nut M8 x 20	2	940 590
29	washer 8,4	1	250 311
30	bolt, adapter	1	277 110
31	hex. nut M8	1	242 201
32	spacer 10,5/24/15	1	847 160
33	eccentric sleeve, for engine 123	1	276 662
34	ring half, for ball bearing 6206	1	276 025
35	ring, for ring halves	1	977 490
36	puller assy. for bearing, crankshaft	1	876 298
37	hex. screw	1	940 755
38	Allen screw M8x40, for puller	4	840 681
39	LOCTITE Anti-Seize 76710	1	297 431
40	MOLYKOTE 111	1	897 161
41	LOCTITE 221, violet, screw securing compound, weak	1	899 785
42	LOCTITE 648 green, screw securing compound, strong	1	899 788
43	SILASTIC 732 RTV, 100 gr.	1	297 386
44	Lithium grease, 250 gr.	1	897 330
45	gasket set, cylinder	1	293 381
46	gasket set, for complete engine	1	293 380

Gear ratios -Enduro, Custom, Rally

primary drive ratio	gear ratios
with straight gears	1st gear 34 : 10 = 3,400
64 : 20 = 3,200	2nd gear 30 : 13 = 2,308
	3rd gear 27 : 16 = 1,688
	4th gear 25 : 19 = 1,316
	5th gear 23 : 21 = 1,095
	6th gear 21 : 22 = 0,955

Gear ratios-Strada (AF 1)

Primary drive ratio	gear ratios
straight gears	1st gear 34 : 10 = 3,400
64 : 20 = 3,200	2nd gear 30 : 13 = 2,308
	3rd gear 27 : 16 = 1,688
	4th gear 25 : 19 = 1,316
	5th gear 24 : 21 = 1,143
	6th gear 23 : 22 = 1,045

Overall reduction ratio-Enduro, Custom, Rally

i total at 6th gear = 3,056

Overall reduction ratio-Strada (AF 1)

i total at 6th gear = 3,345

Lubrication and sevice table

	after 500 km	as required	every 3000 km	every 6000 km	at least once a year	every 15000 km
Change gear oil	X		X	X	X	X
Check gear oil level			X			
Check RAVE (for tightness and free movement)			X			
Examine play of clutch release	X	X		X		
Check oil and fuel tubes	X	X	X	X	X	
Clean carburetor and readjust idling		X		X		
Check electronic ignition and timing		X		X		
Clean spark plug, adjust electrode gap		X	X			
Replace spark plug		X		X		
Re-tighten cylinder and combustion chamber insert	X					
Replace balance shaft drive gears every 15.000 km						X

TROUBLE SHOOTING

Engine fails to start:

CAUSE	REMEDY
Incorrect handling open	Switch on ignition, open fuel cock, ensure full fuel supply.
Fuel line blocked and fuel line.	Clean fuel cock, fuel tank and fuel line.
Spark plug sooty, wet or bridged	Clean or replace spark plug.
Electrode gap too large	Adjust electrode gap.
Ignition cable or spark plug protecor damaged	Fit new ignition coil or spark plug protector
Wire chafed in cable harness (short circuit).	Disconnect plug with black-white / black cable and test for spark. If there is a spark (i.e. ignition unit is in order), check for possible cable damage
Ignition switch or kill button faulty	(short-circuit), check ignition switch and kill-button.
Insufficient ignition voltage	Check ignition system
No ignition voltage (no spark)	Disconnect orange shorting cable from ignition coil and start again
Engine cannot be stopped	Mass defect in stator.
Water in carburetor or jets obstructed	Dismantle and clean carburetor.
Reed valve defective:	Check and replace if necessary.

TROUBLE SHOOTING

Engine will not idle:

CAUSE	REMEDY
Idling jet blocked	Clean idle jet.
Idle mixture screw incorrect adjustment	Adjust idle mixture screw.
Ignition unit defective	Check ignition unit.
Filter element, intake system leaking	Check and replace.
Reed valve defective	Replace.

Engine splutters into carburetor:

CAUSE	REMEDY
Insufficient fuel and carburetor.	Check and clean fuel system.
Engine air intake faulty on intake side.	Check or replace seals and flanges

Engine knocks under full load:

CAUSE	REMEDY
Carburetor setting too lean	Adjust carburetor.
Engine overheats	Check cooling liquid and thermostat.
Ignition timing too much advanced	Check ignition timing at max. r.p.m.
Fuel octane rating too low	Use fuel with higher octane rating
Too high compression ratio	Check compression ratio.

TROUBLE SHOOTING

Engine does not reach full speed:

CAUSE	REMEDY
Carburetor flooding, float level set too high, float needle seat dirty or damaged, loose carburetor jets, float punctured	Clean carburetor, replace float if necessary and adjust float level.
Defective ignition	Check ignition.

Lack of engine performance:

CAUSE	REMEDY
Fuel supply intermittent or water/dirt in carburetor	Clean fuel system and carburetor.
Air filter dirty	Clean or replace air filter.
Loss of compression due to loose spark plug, loose combustionchamber insert, defective O-ring	Check for leaks and replace faulty parts.
Electronic ignition timing faulty	Checkelectronic ignitiontiming.
Exhaust leaking or blocked	Tighten exhaust flange, replace faulty parts.
RAVE does not open	Clean and check RAVE components, clean impulse bore in cylinder.
Check cylinder, cylinder head, piston and rings	Replace defective parts
Insufficient compression	Check compression.