

03-310 Checking, renewing and tightening connecting rod bolts

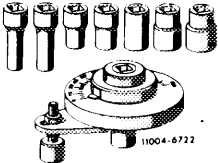
Dimensions of connecting rod bolt

Part no.	Thread dia.	Necked-down dia. when new (Fig. item 1)	Min. necked-down dia. c
615 038 02 71	M 10 x 1	8.4-0.1	8.0
Installation pressure of connecting rod bolt			45000 N

Tightening of connecting rod nuts

Initial tightening torque	40-50 Nm
Angle of rotation torque	90-100°

Special tool

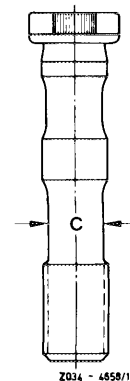
Angle of rotation tool		116 589 01 13 00
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Self-made tool

Steel plate	refer to Fig. item 3
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Checking

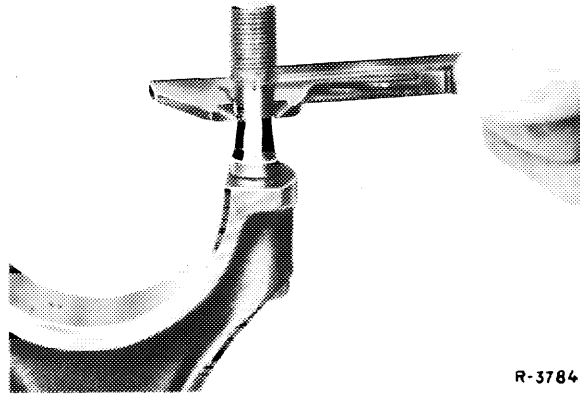
- 1 Measure minimum necked-down dia. prior to re-use.



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Note: When the minimum necked-down dia. of 8.0 mm has been attained or is less than 7.2 mm, renew connecting rod bolt.

Knock-out connecting rod bolt only for replacement.

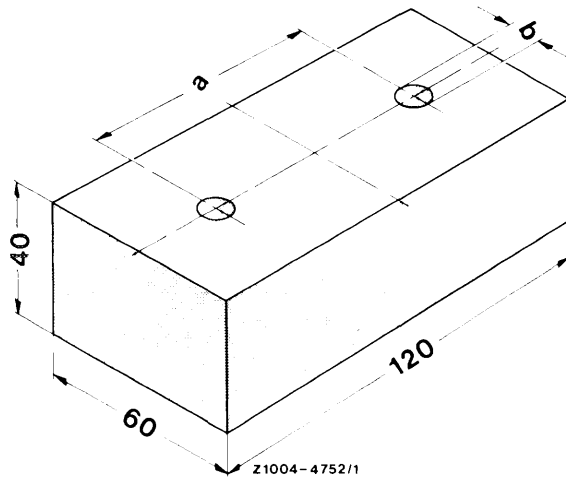


Replacement

2 Knock-out connecting rod bolts.

3 Press new connecting rod bolts into connecting rod at approx. 45 000 N or knock-in with a hammer and mandrel.

When knocking-in or pressing-in connecting rod bolts, place connecting rod on a ground steel plate.



Hole spacing $a = 67$ mm
Bore $b = 11$ mm

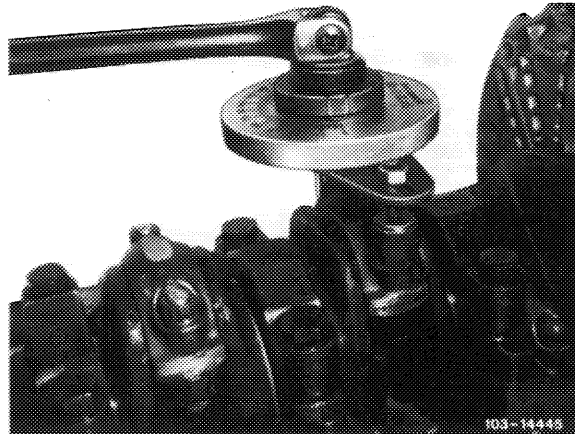
Tightening

4 Lubricate nuts and threaded support.

5 Tighten connecting rod nuts to 40–50 Nm initial torque and 90–100° angle of rotation torque.

Attention!

Tighten connecting rod bolts knocked-in with a **hammer for the first time at 60–70 Nm** initial torque and 90–100° angle of rotation torque.



This specification must be strictly observed, since otherwise the connecting rod nuts may become loose.

Note: If no angle of rotation tool is available, the connecting rod nuts can also be tightened by means of a normal socket wrench with tommy bar **in one step** by an angle of 90–100°. This angle should be estimated as accurately as possible. **To eliminate angle of rotation errors, do not use torque wrench for tightening according to angles of rotation.**

03--313 Reconditioning and squaring connecting rod

Data

Center of connecting rod bearing bore to center of connecting rod bushing bore	<u>148.95</u> 149.05
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Width of connecting rod at connecting rod bearing bore	<u>31.84</u> 31.88
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Width of connecting rod at connecting rod bushing bore	<u>27.90</u> 28.10
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Basic bore for connecting rod bearing shells	<u>55.60</u> 55.62
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Basic bore for connecting rod bushing	standard dimension	<u>31.000</u> 31.025
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repair stage	<u>31.500</u> 31.525
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Connecting rod bushing OD	standard dimension	<u>31.060</u> 31.100
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repair stage	<u>31.560</u> 31.600
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Connecting rod bushing ID	<u>28.018</u> 28.024
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Roughness of connecting rod bushing, inside	0.004
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Permissible offset of connecting rod bearing bore in relation to connecting rod bushing bore with reference to a length of 100 mm	0.1
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Permissible deviation of parallel alignment of axes: Connecting rod bearing bore in relation to connecting rod bushing bore with reference to a length of 100 mm	0.045
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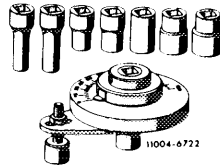
Permissible difference in weight of complete connecting rods within one engine	5 g
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Tightening torque

Connecting rod nuts	initial torque	40–50 Nm
	angle of rotation torque	90–100°

Special tool

Angle of rotation tool



116 589 01 13 00

Conventional tool

Connecting rod straightening tool

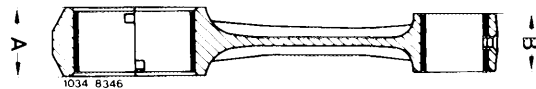
e.g. made by Hahn & Kolb, D-7000 Stuttgart
model BC 503

Note

Connecting rod bearing bore (A) and connecting rod bushing bore (B) are of different width.

Do not install these connecting rods on the other diesel engines.

It is also not possible to install the connecting rods of the other diesel engines in this engine.

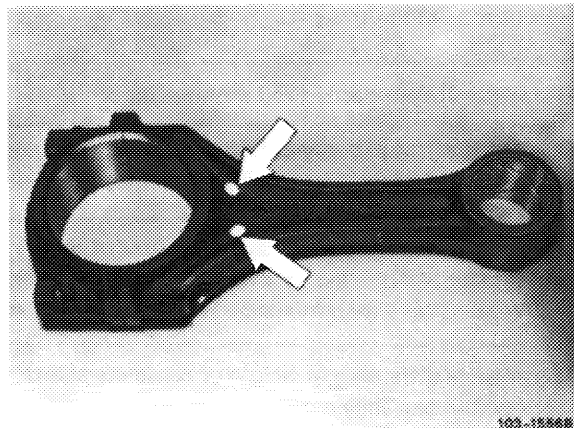


A Width of connecting rod bearing bore
B Width of connecting rod bushing bore

The connecting rods are subdivided into weight classes.

Colored dots on shank serve to identify the individual weight classes.

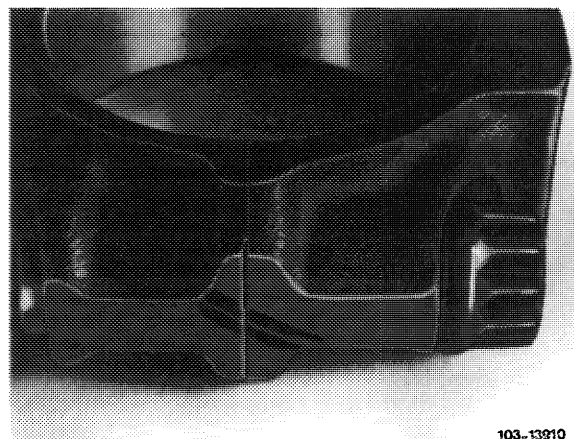
Install only connecting rods with the same color dots in engine.



Connecting rods which are overheated as a result of bearing damage (blue discoloration) should no longer be used.

Connecting rod and connecting rod bearing cap are marked together. The connecting rod shank should have no transverse score marks and notches.

Connecting rods with machined connecting rod bushing are available as spare parts.



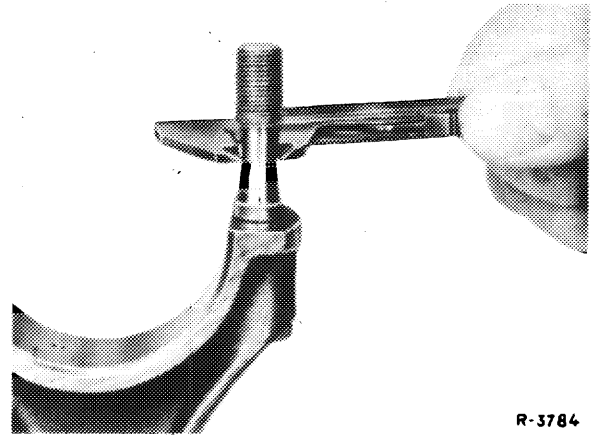
In the period from May to October 1980, connecting rod bearing shells of a second manufacturer (Karl Schmidt) were installed. Standard shells from Glyco.

Installation

Model	Engine	Engine end no.	Chassis end no.
116.120	617.950	026417 – 028938	026101 – 028643
123.193	617.952	000001 – 000238	000006 – 000331
126.120	617.951	000001 – 001399	000001 – 001350

Reconditioning

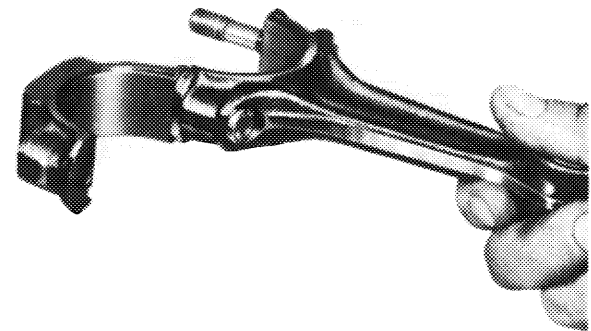
1 Check connecting rod bolts and renew, if required (03–310).



R-3784

2 Check bores for connecting rod bolts.

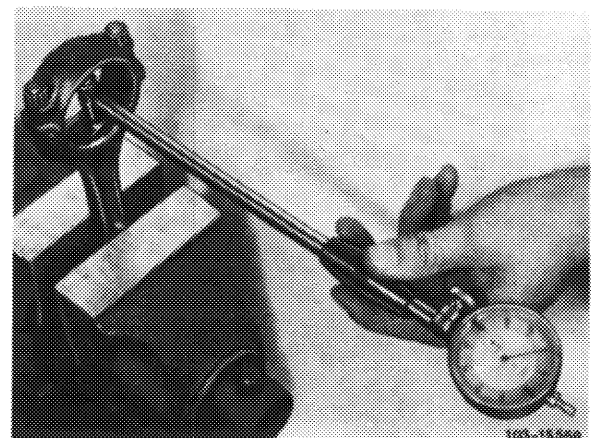
Mount connecting rod bearing cap on a connecting rod bolt. If the connecting rod bearing cap is moving downwards under its own weight, the connecting rod must be replaced.



103-9232

3 Mount connecting rod bearing caps, lubricate connecting rod nuts and tighten to 40–50 Nm preload and 90–100° angle of rotation torque.

4 Measure connecting rod bearing basic bore. If basic bore exceeds a specified value of 55.62 mm or is conical in shape, refinish bearing cap supporting surface on a face plate up to max. 0.02 mm.



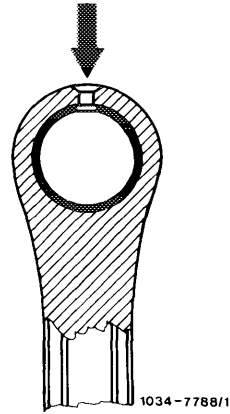
103-18989

5 Press-in new connecting rod bushing in such a manner that the oil bores are in alignment.

Pressing-in pressure 2500 N.

6 Machine or ream connecting rod bushing.

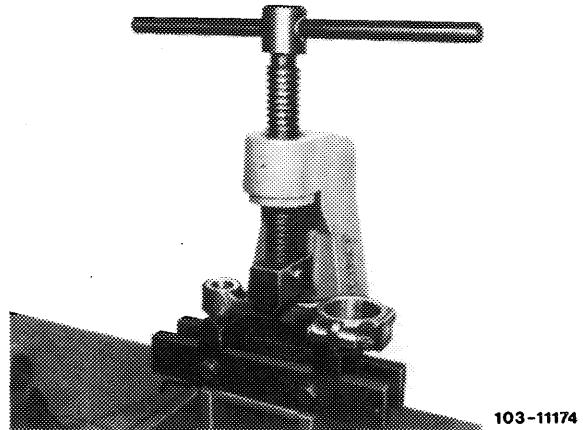
7 Refinish lateral contact surfaces of connecting rod on a face plate.



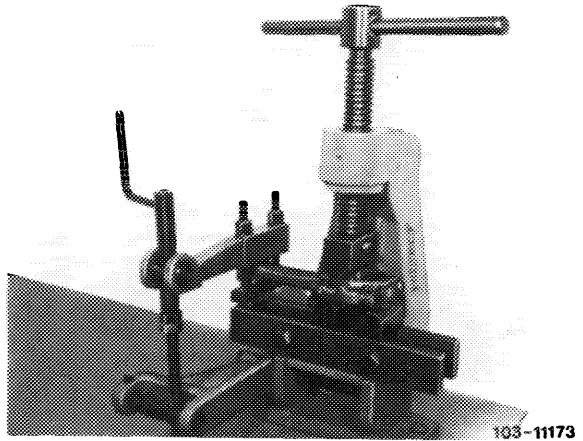
Squaring

8 Square connecting rod by means of connecting rod tester.

9 Align connecting rod bearing bore in relation to connecting rod bushing bore (parallel alignment).



10 Check offset of connecting rod bearing bore in relation to connecting rod bushing bore and make corrections, if required.



03–316 Removal and installation of pistons

Coordination piston-cylinder

Engine	Piston code number	Group no.	Standard dimension Std	
			Piston dia.	Cylinder dia.
All	10.18	0	90.845 – 90.855	90.898 – 90.908
		1	above 90.855 – 90.865	above 90.908 – 90.918
		2	above 90.865 – 90.875	above 90.918 – 90.928

Piston standout

Distance between piston crown and cylinder crankcase parting surface	standout max. 0.9 standout min. 0.5
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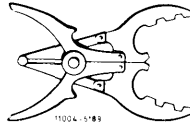
Test values	When new	Wear limit	
Piston clearance	0.043–0.063	0.12	
Difference in weight of pistons in one engine	5 g	10 g	
Piston pin dia.	27.995–28.000		
Piston pin clearance	in bushing	0.018–0.029	–
	in piston	0.00–0.01	–
Gap clearance of piston rings	groove 1	0.20–0.40	1.5
	groove 2	0.15–0.35	1.0
	groove 3	0.20–0.45	1.0
Side clearance of piston rings	groove 1	0.110–0.142	0.20
	groove 2	0.070–0.112	0.15
	groove 3	0.030–0.062	0.1

Tightening torque

Connecting rod nuts	initial torque	40–50 Nm
	angle of rotation torque	90–100°

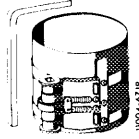
Special tools

Expanding pliers for piston rings



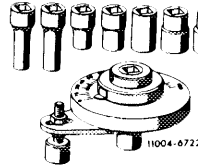
000 589 51 37 00

Clamping strap for piston rings



000 589 04 14 00

Angle of rotation tool



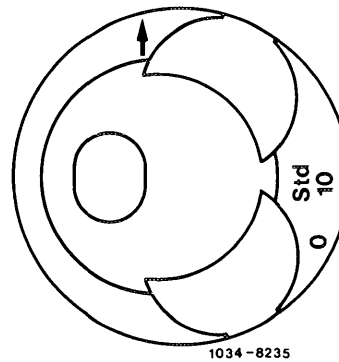
116 589 01 13 00

Note

The group number 0, 1 or 2, the piston code number, e.g. 10 and the driving direction arrow are punched into piston crown.

The group number is also punched into cylinder crank-case parting surface.

Both group numbers (cylinder bore and piston) must be in agreement.

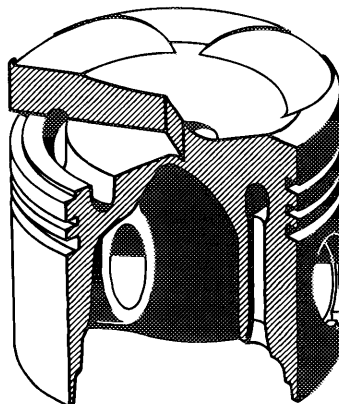


The specified piston clearance will then be maintained.

In the event of repairs, hone cylinder bores to dimensions of available piston plus piston clearance.

The piston shank is graphite-treated.

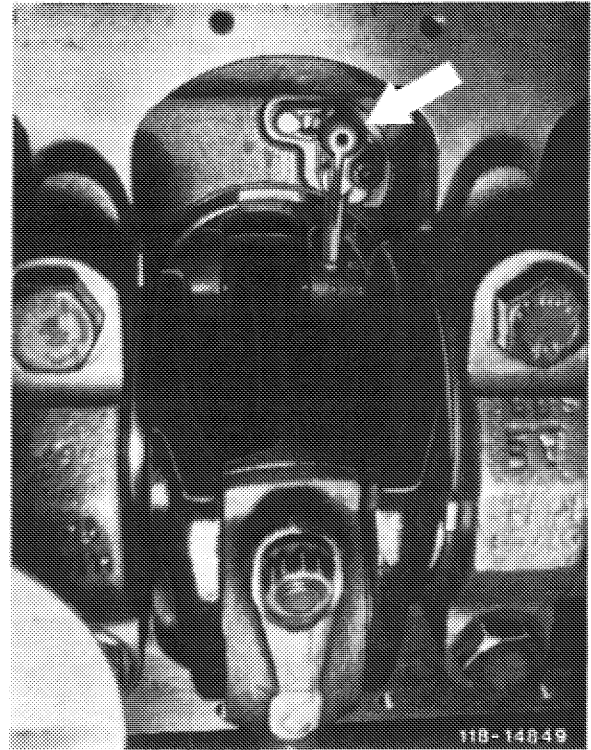
Due to the higher thermic load, the pistons are cooled by means of an annular duct located in piston crowns (functional description refer to 18-040).



Removal

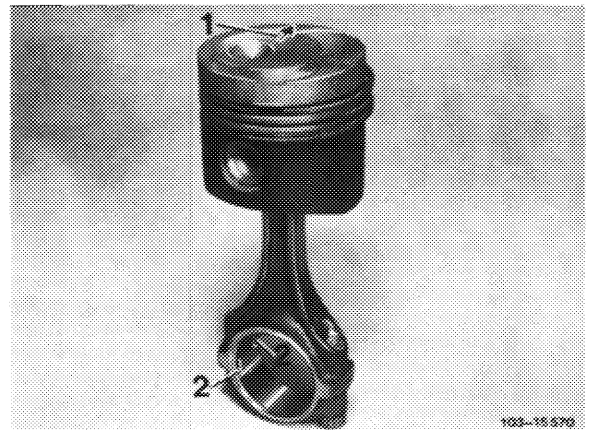
Attention!

To avoid damage to oil spray nozzles caused by contact with connecting rod during removal of piston, remove oil spray nozzles (arrow) first (18-040).

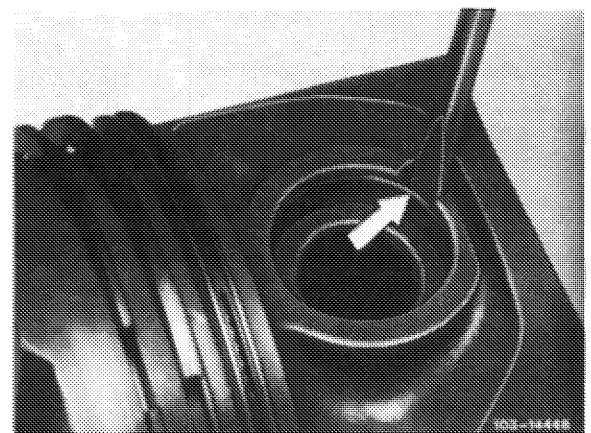


Removal

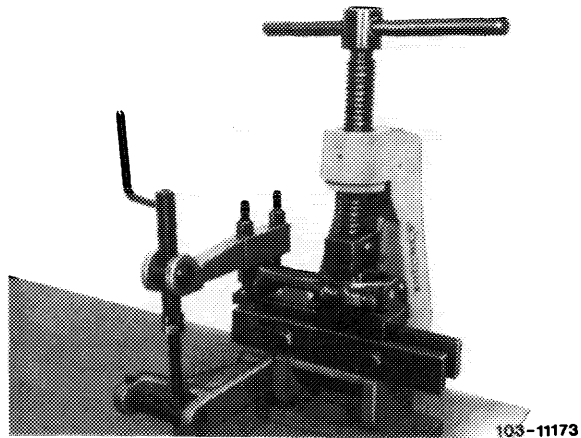
1 Remove connecting rod with piston in upward direction.



2 Remove piston pin lock and force out piston pin.



3 Recondition and square connecting rod (03-313).

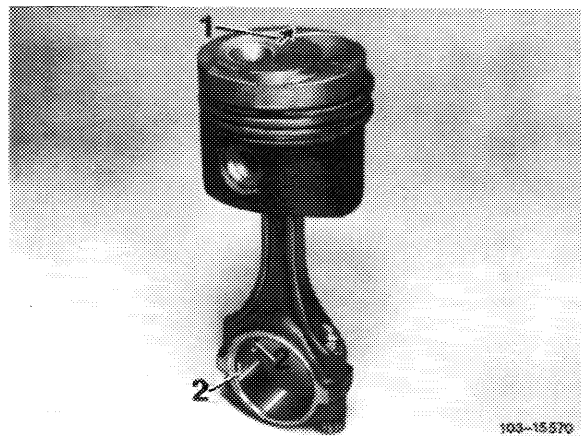


Installation

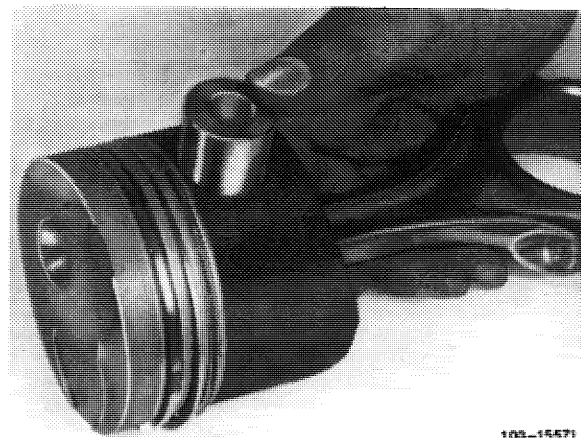
4 Place piston on connecting rod in such a manner that the arrow (1) is pointing in driving direction and the lock nuts (2) in connecting rod are pointing to lefthand engine side.

Attention!

Do not heat piston.



5 Push-in piston pin coated with engine oil **manually**.

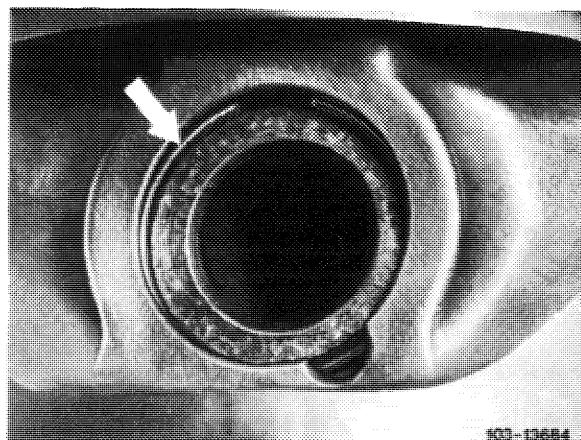


6 Place piston pin lock into groove.

Check piston rings for easy operation.

When installing used pistons, check piston rings for gap and side clearance.

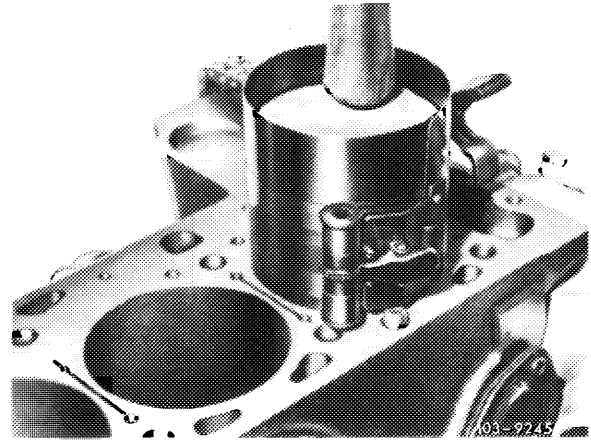
7 Lubricate clean cylinder bores, connecting rod bearing journals, connecting rod bearing shells and pistons.



8 Distribute gaps of piston rings uniformly along circumference of piston.

9 Position piston ring clamping strap and insert piston.

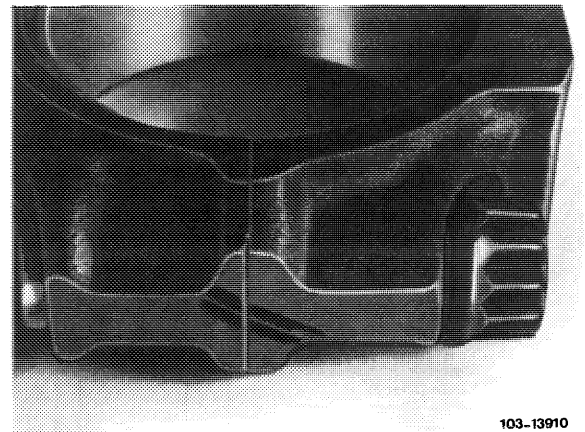
The arrow in piston crown should point in driving direction.



10 Place connecting rod bearing cap with code numbers facing each other on connecting rod, lubricate connecting rod nuts, tighten to 40–50 Nm preload and 90–100° angle of rotation torque.

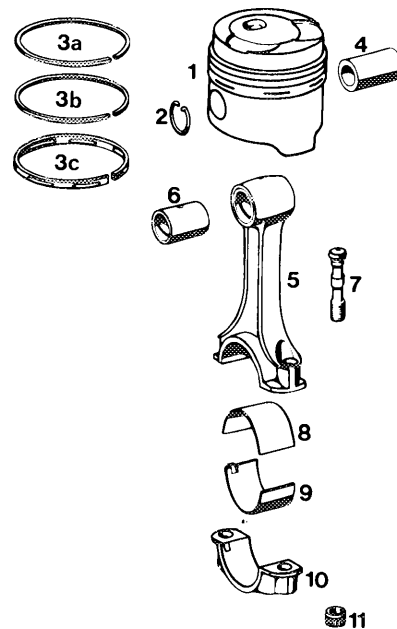
11 Rotate crankshaft and check clearance between piston pin eye and connecting rod.

12 In TDC position of pistons, measure distance between piston crown and cylinder crankcase parting surface (refer to table).



13 Install oil spray nozzles (18–040).

Piston and connecting rod



- 1 Piston
- 2 2 piston pin locks
- 3a Rectangular ring 3 mm
- 3b Rectangular ring 2 mm
- 3c Chamfered oil ring with expanding spring
- 4 Piston pin
- 5 Connecting rod
- 6 Connecting rod bushing
- 7 2 connecting rod bolts
- 8 Connecting rod bearing upper and lower half
- 10 Connecting rod bearing cap
- 11 2 connecting rod nuts

03—318 Checking and reconditioning of crankshaft

Data

Crankshaft standard dimension and repair stages	Crankshaft bearing journal dia.	Fitted bearing Pertinent thickness of thrust washers	Width of journal	Crankpin dia.	Width of pins
Standard dimension	$\frac{69.96}{69.95}$	2.15	$\frac{34.00}{34.03}$	$\frac{51.96}{51.95}$	$\frac{32.00}{32.10}$
		2.20	$\frac{34.10}{34.13}$		
1st repair stage	$\frac{69.71}{69.70}$	2.25 or 2.35 or 2.40	$\frac{34.20}{34.23}$	$\frac{51.71}{51.70}$	to 32.30
2nd repair stage	$\frac{69.46}{69.45}$		or	$\frac{51.46}{51.45}$	
3rd repair stage	$\frac{69.21}{69.20}$		or	$\frac{51.21}{51.20}$	
4th repair stage	$\frac{68.96}{68.95}$		or	$\frac{50.96}{50.95}$	
Permissible out-of-round of crankshaft journals and crankpins				0.005	
Permissible conicity of crankshaft journals and crankpins				0.01	
Permissible radial runout of flywheel flange				0.02	
Permissible axial runout of fitted bearing				0.02	
Filletts	on crankshaft bearing journals			2.5 to 3.0	
	on crankpins			3.0 to 3.5	
Permissible radial runout of crankshaft journals when mounted on outer journals	journal II, V			0.16	
	journal III, IV			0.25	
Scleroscope hardness of crankshaft journals and crankpins				55—74	
Permissible unbalance of crankshaft				15 cmg	

cardiagn.com

Note

The bearing journals of crankshaft are not inductance hardened similar to other engines, but are hardened in a nitride bath.

Contrary to inductance hardened crankshaft, a bath-nitrided crankshaft is hardened at its entire surface.

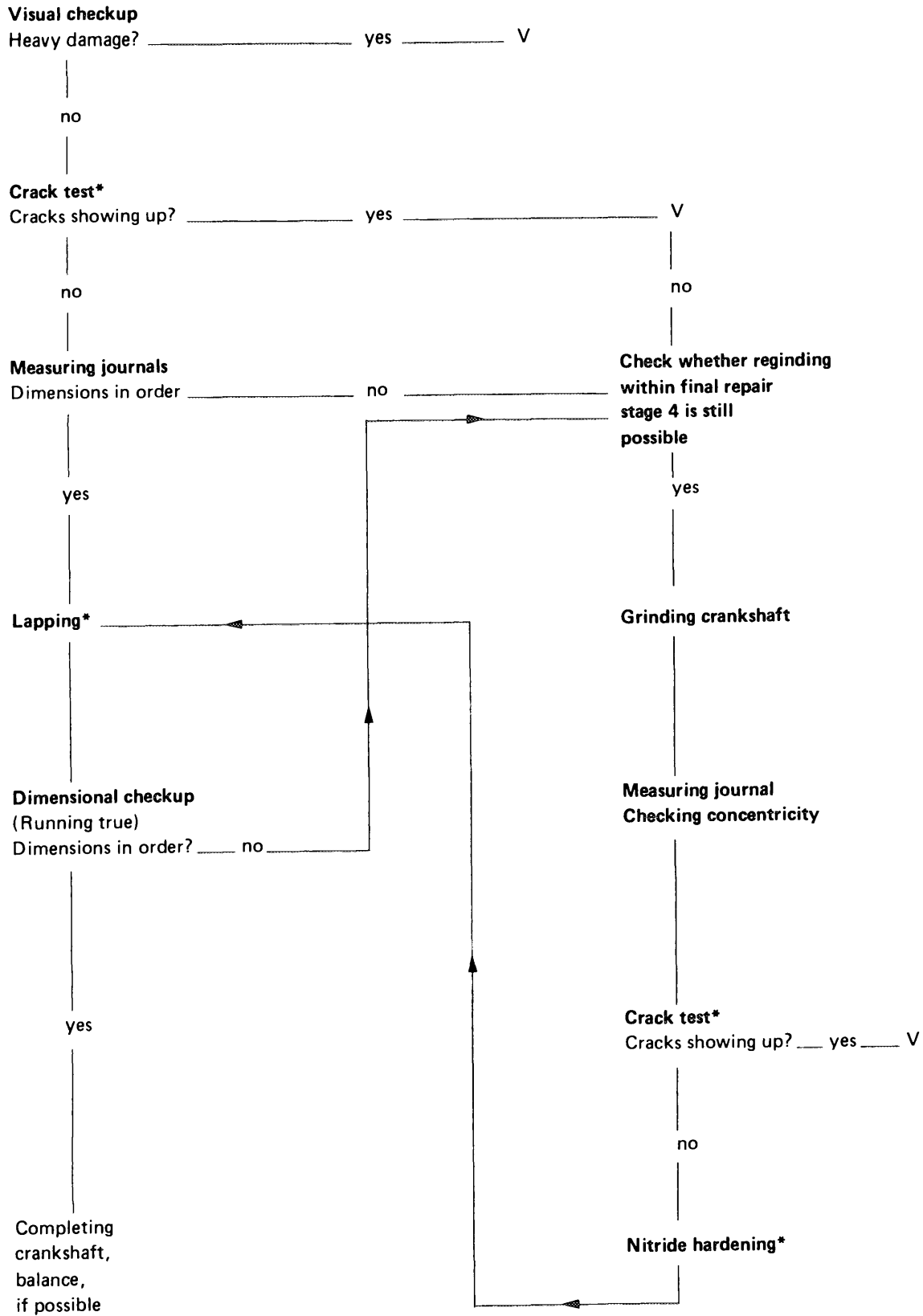
Conventional hardness tester (hardness drop tester) provides no information concerning proper hardness (depth of connecting layer) for crankshafts hardened in a nitride bath. No hardness test according to the above method is therefore required.

When testing and reconditioning crankshafts, proceed in sequence of diagram below.

Diagram

* Refer to section "Explanations Concerning Diagram"

V = scrap.



Explanations concerning diagram

Crack test

Clean crankshaft. Bearing journals should be free of oil and grease.

Magnetize crankshaft and apply fluorescent powder (fluxing).

A color penetration test (immersion in bath or using spray can) may also be applied.

Aid: Paint or fluorescent powder
Cleaning agent
Developer

Hardening

Crankshaft must be nitride-hardened in a salt bath.

Attention!

Prior to nitriding, close all threaded bores in crankshaft.

Hardened threads will loose in strength and may therefore break out when tightening screws.

Screw-in necked-down screws on flywheel flange.

Screw-in a hollow center screw M 18 x 1.5 x 45 at front on crankshaft.

Center screw is bored hollow to prevent a chemical reaction in salt bath caused by the air which might be enclosed behind screw.

Duration and bath temperature are shown in nitriding specifications included upon delivery of nitriding equipment.

To avoid distorsion of crankshaft, suspend crankshaft vertically into nitriding bath.

Material data: 49 Mn VS 3 BY 80–95.

Depth of connecting layer: 0.014–0.022 mm.

Then cool crankshaft in oil or salt water to 90° C.

Upon nitriding, remove nitride residue in oil bores.

Attention!

Do not straighten crankshaft anymore after bath nitriding.

Lapping

Lap bearing journals with a lapping belt (grain 400) as follows:

Slowly pre-lap for approx. 5 seconds

Lap fast for approx. 25 seconds

Checking of hardness

Check nitrided bearing journals by means of metallographic etching.

Pertinent tests can be made on scrapped crankshafts.

Corrosion protection

Coat crankshafts which are not immediately installed again with engine initial operation oil (SAE 30).

03–320 Mounting of crankshaft

Data

Crankshaft standard dimension and repair stages	Crankshaft bearing journal dia.	Fitted bearing Pertinent thickness of thrust washers	Width of journal	Crankpin dia.	Width of pin
Standard dimension	<u>69.96</u> 69.95	2.15	<u>34.00</u> 34.03	<u>51.96</u> 51.95	<u>32.00</u> 32.10
		2.20	<u>34.10</u> 34.13		
1st repair stage	<u>69.71</u> 69.70	2.25	<u>34.20</u> 34.23	<u>51.71</u> 51.70	to 32.30
2nd repair stage	<u>69.46</u> 69.45		or	or	
3rd repair stage	<u>69.21</u> 69.20	2.35	<u>34.40</u> 34.43	<u>51.21</u> 51.20	
4th repair stage	<u>68.96</u> 68.95	or	or	<u>50.96</u> 50.95	
		2.40	<u>34.50</u> 34.53		

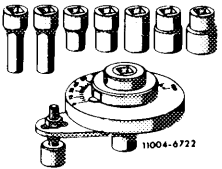
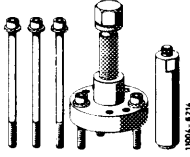
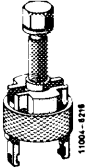
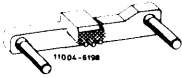
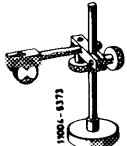
Basic bore and bearing play	Crankshaft bearing	Connecting rod bearing	
Basic bore dia.	<u>74.50</u> 74.52	<u>55.60</u> 55.62	
Basic bore width on fitted bearing	<u>29.48</u> 29.50	—	
Connecting rod width	—	<u>31.84</u> 31.88	
Permissible out-of-true of basic bore		0.01	
Permissible conicity of basic bore		0.01	
Bearing play radial	when new	0.031–0.073 ¹⁾	
	wear limit	0.08	
Bearing play axial	when new	0.10–0.25	0.12–0.26
	wear limit	0.30	0.50

¹⁾ For radial play try for mean value.

Bearing shells	Wall thickness crankshaft bearing	Wall thickness connecting rod bearing
Standard dimension	2.25	1.80
1st repair stage	2.37	1.92
2nd repair stage	2.50	2.05
3rd repair stage	2.62	2.17
4th repair stage	2.75	2.30

Tightening torques	Nm	
Crankshaft bearing bolts	90	
Connecting rod nuts	initial torque	40–50
	angle of rotation torque	90–100°
Bolt M 18 x 1.5 x 45 on crankshaft	270–330	
Necked-down screws for flywheel or driven plate	initial torque	30–40
	angle of rotation torque	90–100°

Special tools

Angle of rotation tool		116 589 01 13 00
Puller for balancing disc		116 589 10 33 00
Puller for crankshaft gear		615 589 01 33 00
Detent		110 589 00 40 00
Dial gauge holder for measuring end play		116 589 12 21 00

Note

Engine removed and disassembled.

Main oil ducts in crankcase open (also refer to 01–130).

Oil spray nozzles removed (18–040).

Oil ducts in cylinder crankcase and in crankshaft carefully cleaned.

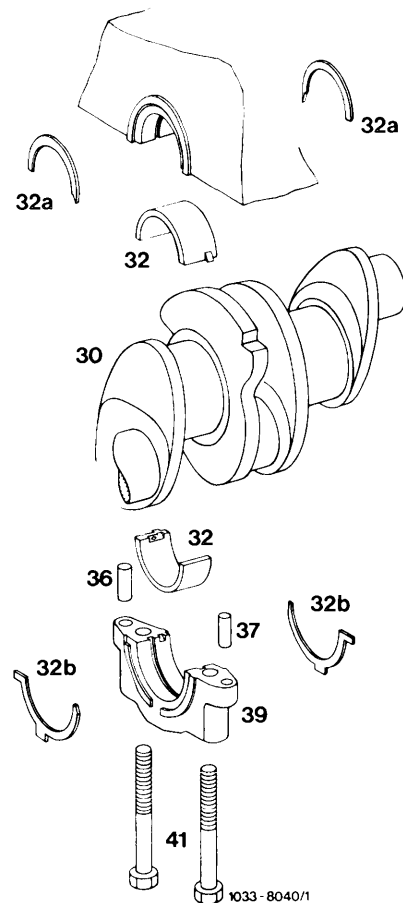
Check crankshaft for cracks, dimensional stability and concentricity (03–318).

For durability, the 3rd crankshaft bearing (fitted bearing) has been provided with standard bearing shells and thrust washers.

The thrust washers absorb the axial forces of the crankshaft.

The thrust washers (32a and 32b) inserted in cylinder crankcase and in bearing cap on both sides are similar in design.

As a protection against distortion and to avoid assembly faults, the thrust washers in bearing cap are provided with two holding lugs each, with the lower lug placed out of center. In addition, all thrust washers are chamfered at one end.



32	Bearing shells	36	Cylindrical pin 10m 6 x 16
32a	Thrust washers in cylinder crankcase	37	Cylindrical pin 8m 6 x 16
32b	Thrust washers in bearing cap	39	Bearing cap
		41	Bolts M 12 x 75

When reconditioning crankshafts, regrind width of fitted bearing journals to one of the dimensions named in table (section "Data").

Coordinate thrust washers in accordance with pertinent journal widths (table).

Always install thrust washers of uniform thickness on both sides.

Regrinding of thrust washers is not permitted.

Spare part thrust washers are available in sets only. One set consists of an upper and a lower thrust washer (32a and 32b).

Thrust washer sets

Thickness in mm	Set part no.
2.15	617 586 19 03
2.20	617 586 20 03
2.25	617 586 21 09
2.35	617 586 22 03
2.40	617 586 31 03

Due to the higher combustion pressures the fatigue strength of connecting rod bearing shells has been improved by changing the composition of the material.

On these engines, do not install connecting rod bearing shells of engine 617.912.

To improve bearing shell seat in cylinder crankcase on engine 617.950, the standout of the bearing shells has been increased from 0.000–0.030 mm to 0.030–0.060 mm. On engines 617.951/952, from start of series.

Installation

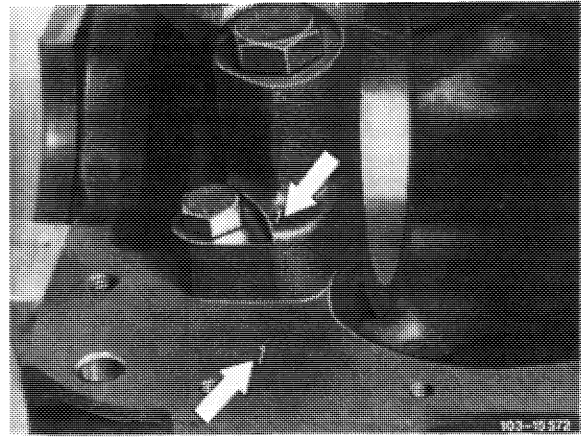
Engine	Engine end no.
617.950	003 768
617.951/952	Start of series

Coordinating crankshaft bearings, installing crankshaft

1 Install crankshaft bearing cap. Pay attention to identification, 1 is at the front.

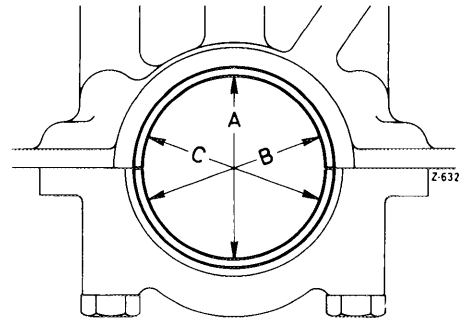
Do not interchange crankshaft bearing caps.

2 Tighten bolts to 90 Nm.

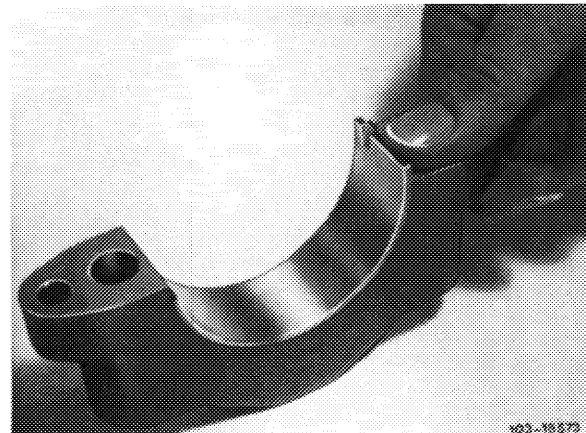


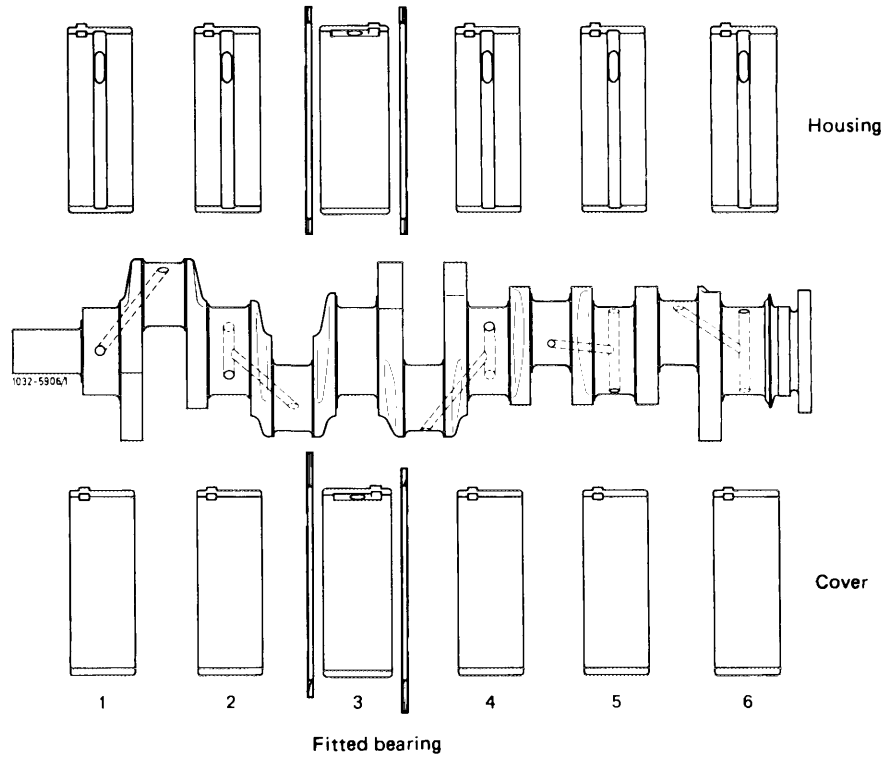
3 Measure basic bore in direction A, B and C on two levels (conicity).

If a basic bore exceeds the specified value or is conical, touch up bearing cap at its contact surface on a surface plate by max. 0.02 mm.

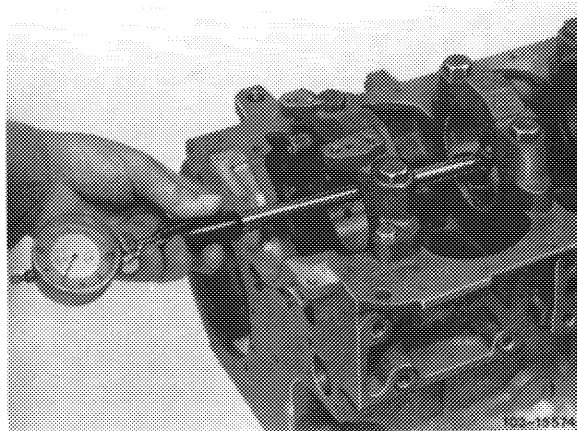


4 Insert crankshaft bearing shells and mount bearing cap. Tighten bolts to 90 Nm.





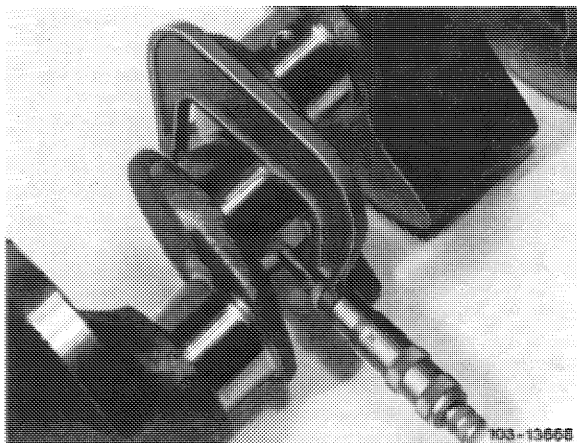
5 Measure bearing dia. and write down.



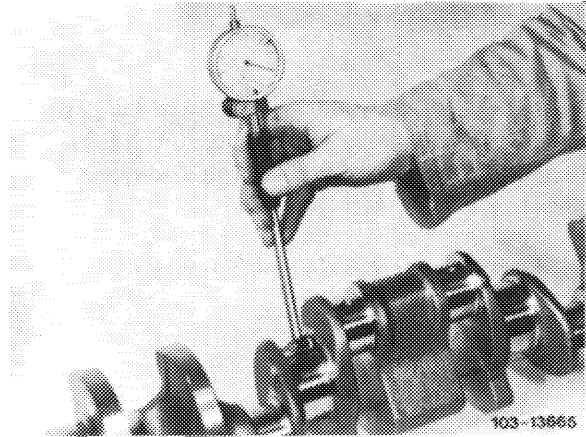
6 Measure crankshaft bearing journal, find crankshaft bearing radial play.

Note: The bearing play can be corrected by exchanging bearing shells, while trying for mean value of specified bearing play.

Crankshaft bearing shells without color coding are thicker than those with blue color coding, while taking into account that the wall thicknesses without color coding and those with color coding may overlap.

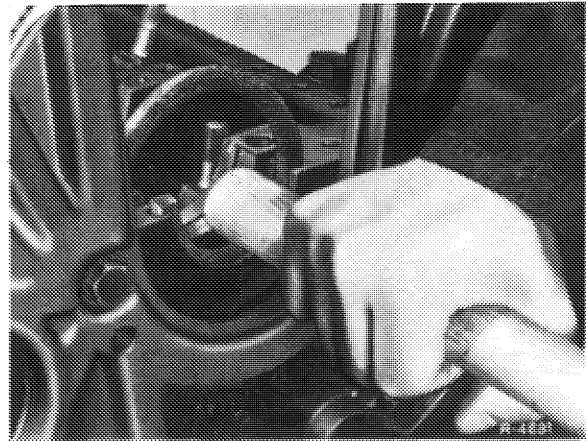


7 Measure width of fitted bearing journal and use pertinent thrust washers (refer to table, section "Data").



8 Renew rear crankshaft radial sealing ring (03-327).

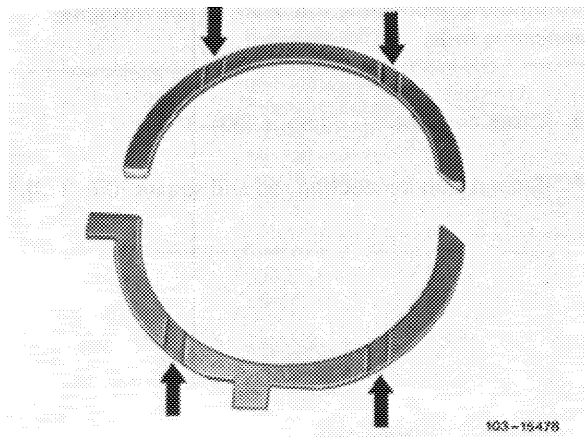
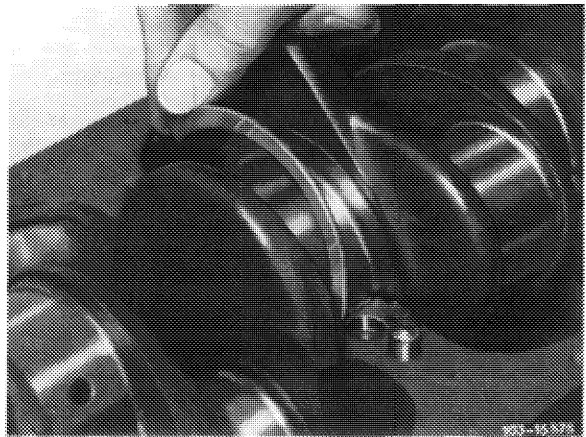
9 Provide bearing shells, crankshaft and radial sealing ring with engine oil and insert crankshaft.



10 Provide thrust washers with engine oil and slip into grooves on fitted bearing (cylinder crankcase).

Attention!

The two oil grooves (arrows) in thrust washers should face crankshaft webs.

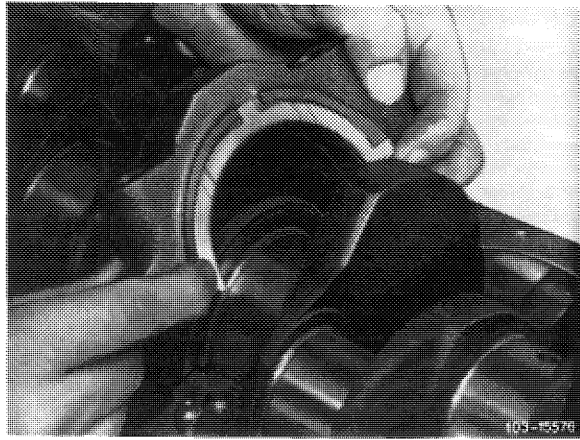


11 Mount fitted bearing cap.

Attention!

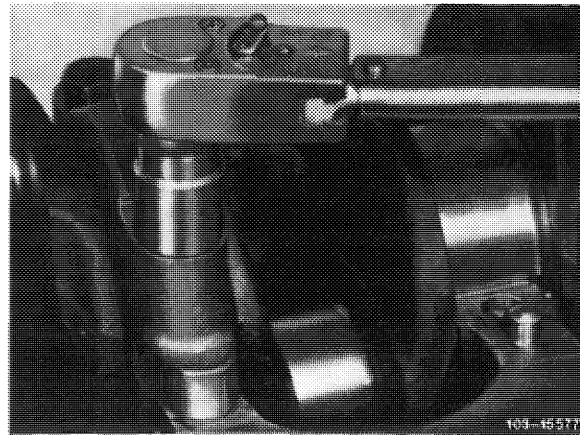
Provide thrust washers with engine oil and place into grooves on fitted bearing cap. The two oil grooves (arrows) in thrust washers should face crankshaft webs.

Hold both thrust washers in position and mount fitted bearing cap.



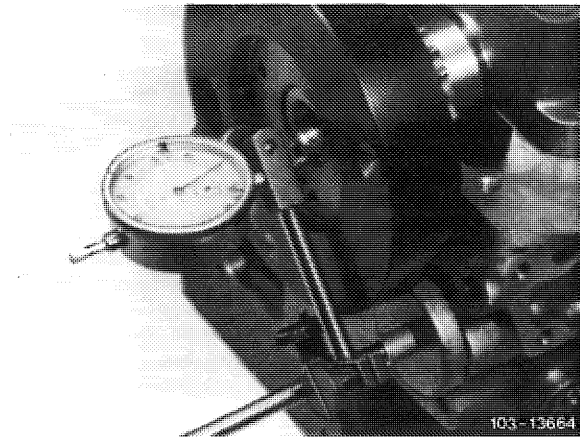
12 Mount crankshaft bearing cap.

13 Tighten all bearing caps to 90 Nm.



14 Measure crankshaft bearing end play.

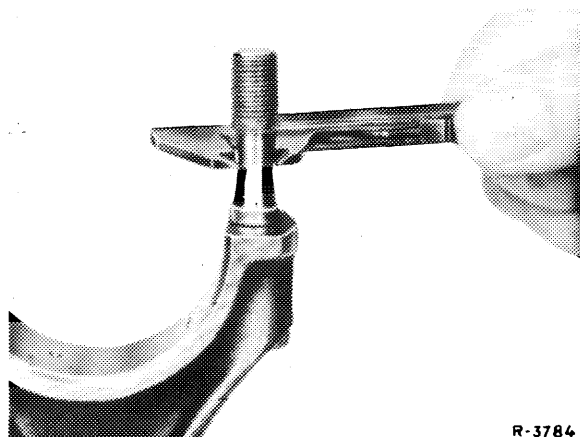
15 Turn crankshaft manually and check for unobstructed running.



Coordinating connecting rod bearings and installing connecting rods

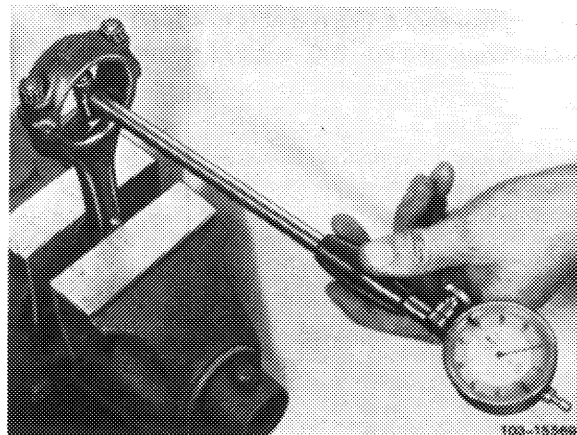
16 Check connecting rod bolts (03-310).

17 Recondition connecting rod and square (03-313).

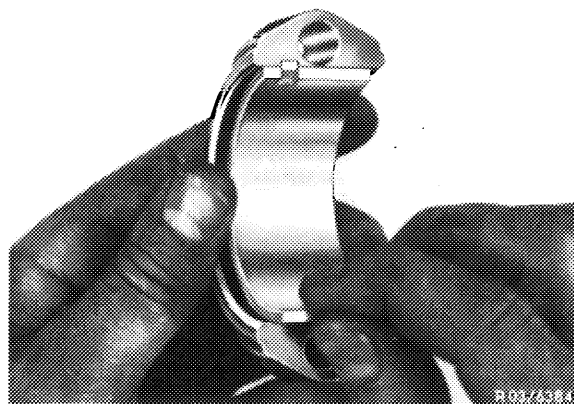


18 Mount connecting rod bearing cap, while paying attention to identification. Lubricate connecting rod nuts and tighten to 40–50 Nm.

19 Measure basic bore in two directions. On a basic bore which exceeds the specified value or is conical, touch up bearing cap at its contact surface on a surface plate by max. 0.02 mm.



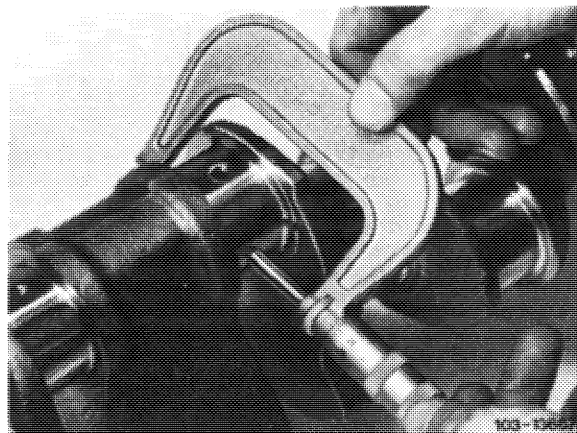
20 Insert connecting rod bearing shells, mount connecting rod bearing cap with bearing shells and tighten connecting rod nuts to 40–50 Nm.



21 Measure bearing dia. and write down.

22 Measure connecting rod bearing journal, find connecting rod bearing radial play.

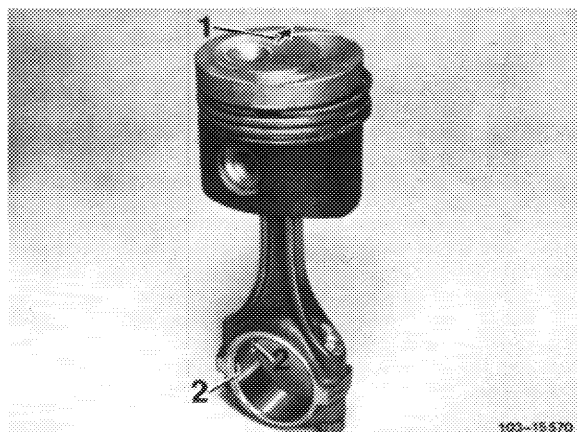
Note: The bearing play can be corrected by exchanging bearing shells, while trying for mean value of specified bearing play. Connecting rod bearing shells without color coding are thicker than those with blue color coding, while taking into account that the wall thicknesses without color coding and those with color coding may overlap.



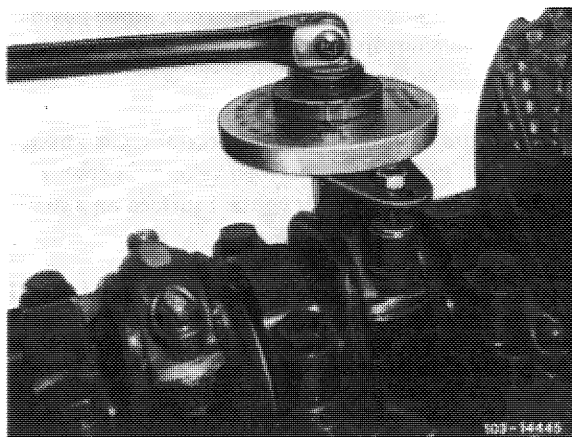
23 Mount piston on connecting rod (03-316).

24 Provide bearing shells, crankshaft, piston and cylinder walls with engine oil, install connecting rod with piston (03-316).

Pay attention to identification.



25 Tighten connecting rod nuts to 40–50 Nm initial torque and 90–100° angle of rotation torque.

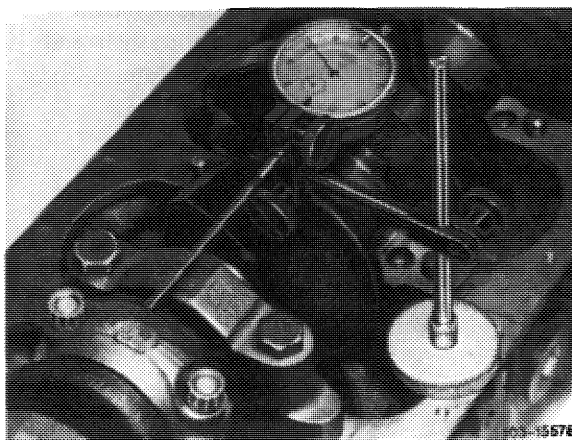


26 Measure connecting rod bearing end play. Check connecting rod for easy operation in piston.

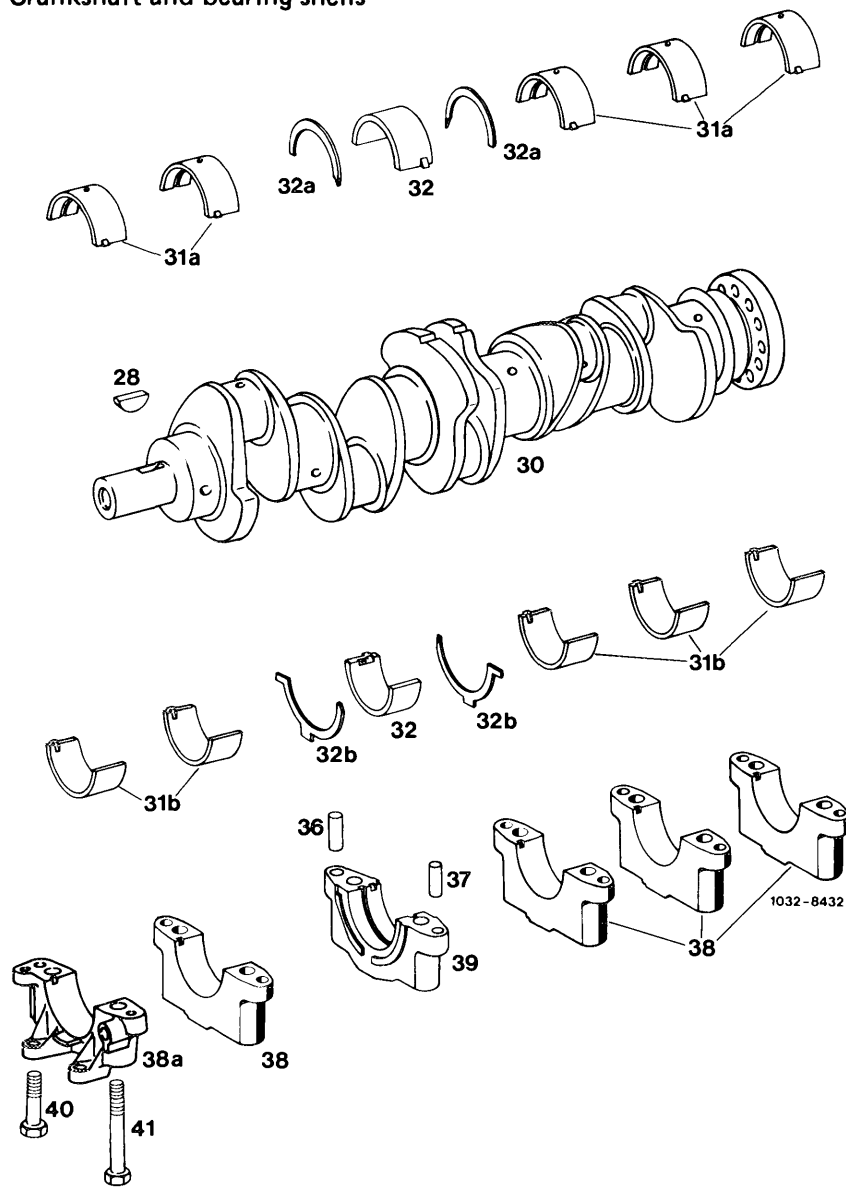
Attention!

Disassemble and clean oil pump and renew, if required. Renew oil pressure relief valve, disassemble oil filter and clean. Carefully clean air-oil cooler. Clean oil spray nozzles (18–040).

Install initial operation oil filter element. Change engine oil and oil filter element after 1000–1500 km.



Crankshaft and bearing shells



- | | | | |
|-----|---------------------------------|-----|---------------------------------------|
| 28 | Woodruff key | 36 | 6 Cylinder pins 10m 6 x 16 |
| 30 | Crankshaft | 37 | 6 Cylinder pins 8m 6 x 16 |
| 31a | Bearing shells upper halves | 38 | Camshaft bearing cap |
| 31b | Bearing shells lower halves | 38a | Camshaft bearing cap no. 1 |
| 32 | Bearing shells (fitted bearing) | 39 | Camshaft bearing cap (fitted bearing) |
| 32a | Thrust washers upper halves | 40 | Bolt M 8 x 25 |
| 32b | Thrust washers lower halves | 41 | 12 bolts M 12 x 75 |

03-324 Renewing front crankshaft radial sealing ring

Tightening torques

Nm

Bolt M 18 x 1.5 x 45 to crankshaft

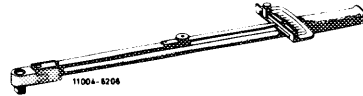
270-330

Bolts M 8 x 65

35

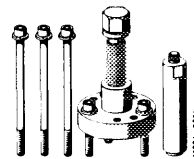
Special tools

Torque wrench 150-500 Nm,
3/4" square



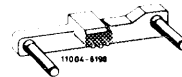
001 589 31 21 00

Puller for balancing disc



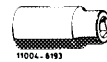
116 589 10 33 00

Detent



110 589 00 40 00

Socket 27 mm, 1/2" square



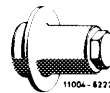
001 589 65 09 00

Puller for spacing ring



616 589 00 33 00

Installer for radial sealing ring



130 589 00 61 00

Conventional tool

Adaptor 3/4" square socket to 1/2" square head

e.g. made by Hazet, D-5630 Remscheid
order no. 1058 R-1

Note

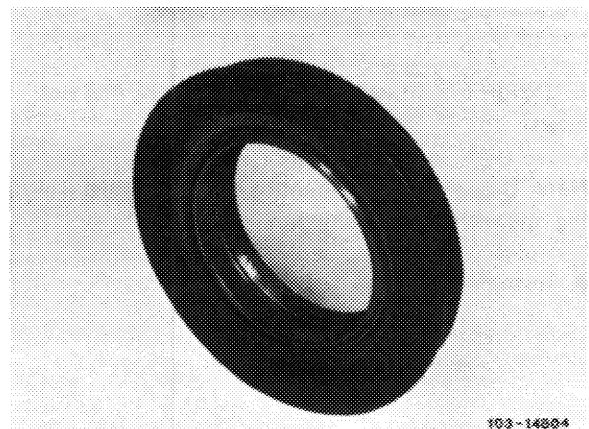
The radial sealing ring is a so-called combination ring with all-around shoulder and contoured outer ring.

The ring consists of two different materials.

Inside: Viton (green)

Outside: Acryl (black)

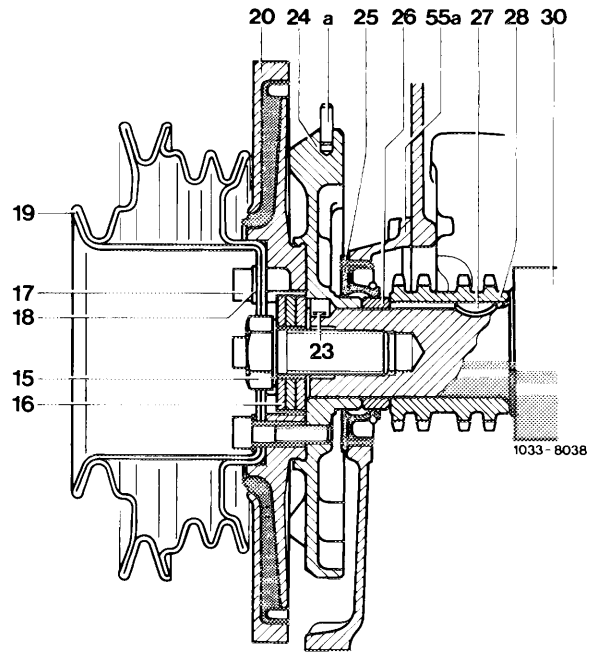
This radial sealing ring requires no chrome-plated spacing ring.



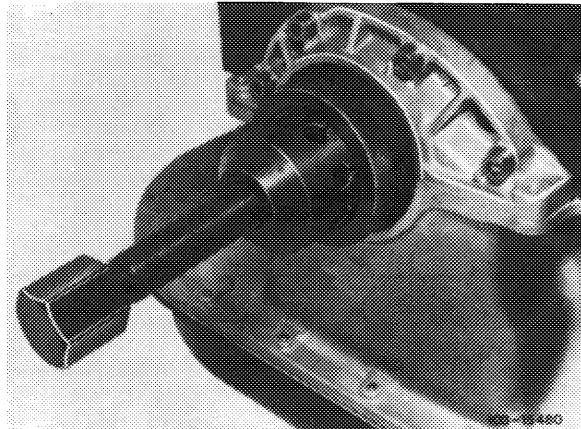
703-1480-4

Removal

- 1 Remove cooler and fan.
- 2 Remove pulley (19), vibration damper (20) and balancing disc (24) (03-340).
- 3 Push out radial sealing ring by means of a screwdriver. Make sure that crankshaft journal and mounting bore are not damaged.



- 4 Pull off spacing ring with puller, if noticeably worn.



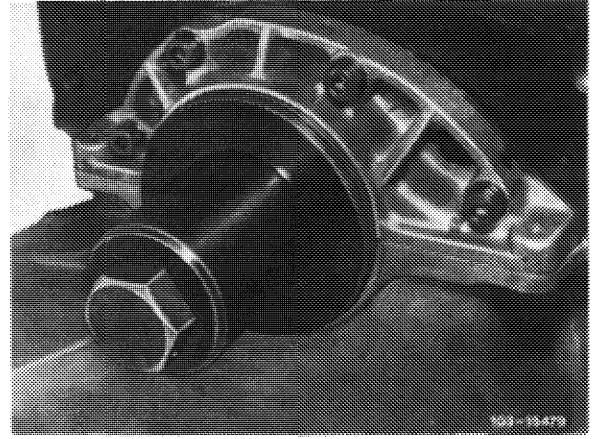
Installation

- 5 Deburr mounting bore for radial sealing ring and clean.
- Note:** Do not provide mounting bore and radial sealing ring with sealing compound.
- 6 Install new spacing ring.

7 Coat new radial sealing ring on sealing lip and in range of dust-sealing lip with grease and insert by means of installer.

Attention!

The radial sealing ring should be accurately square in relation to crankshaft journal, since otherwise no perfect sealing will be obtained.



8 Install balancing disc, vibration damper and pulley (03-340).

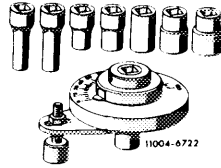
9 Install fan and cooler.

03-327 Renewing rear crankshaft radial sealing ring

Tightening torques		Nm
Necked-down screw for camshaft gear		80
Connecting rod nuts	initial torque	40-50
	angle of rotation torque	90-100°
Necked-down screws for flywheel or driven plate	initial torque	30-40
	angle of rotation torque	90-100°
Crankshaft bearing bolts		90

Special tool

Angle of rotation tool



116 589 01 13 00

Self-made tool

Gauge for cutting-off rear radial sealing ring

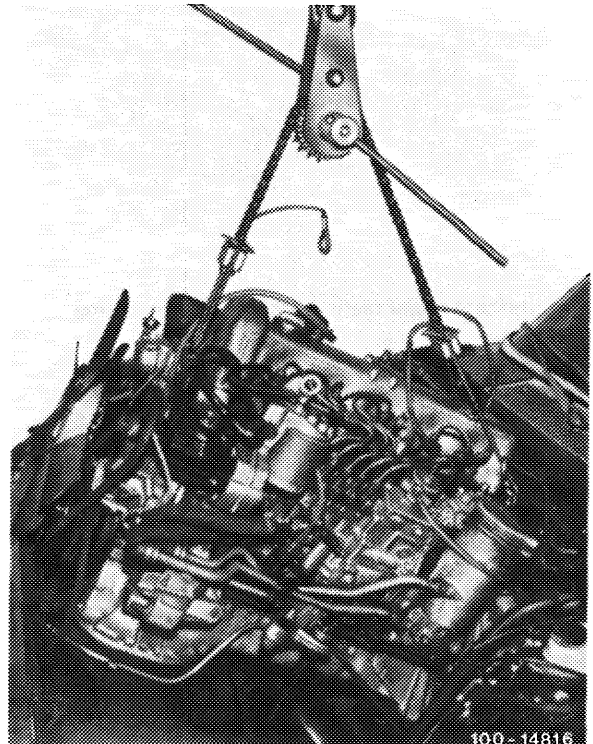
refer to Fig. item 4

Note

The radial sealing ring is graphite gray similar to that in other diesel engines.

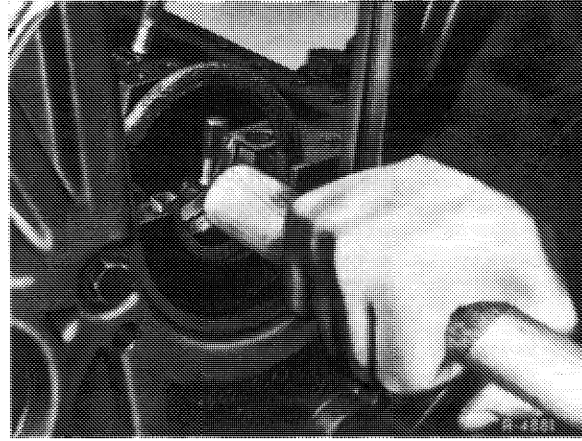
Renewing

- 1 Remove engine (01-030).
- 2 Remove crankshaft.

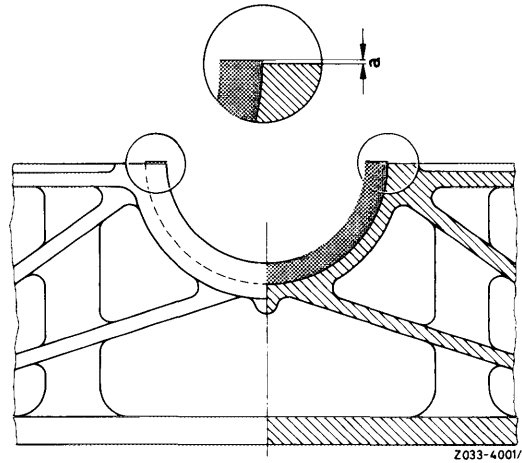


100 - 14816

3 Place radial sealing ring into cylinder crankcase and into oil pan and work in by means of a lubricated hammer handle.

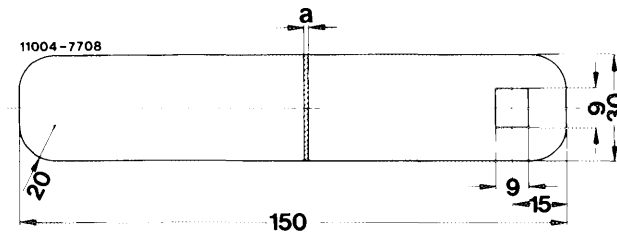


4 To obtain the required overlap, cut off radial sealing ring in cylinder crankcase and oil pan approx. 1.0 mm above parting surface.



Dimension a = 1.0 mm

Note: For cutting-off, a self-made template according to drawing can be used.




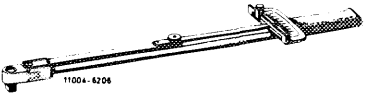

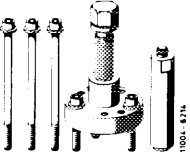
Dimension a = 1.0 mm

5 Lubricate radial sealing ring prior to installing crankshaft.

6 Install crankshaft.

7 Mount oil pan, rotate crankshaft and check for unobstructed operation.

03—340 Removal and installation of pulley, vibration damper and balancing disc

Tightening torques		Nm
Bolt M 18 x 1.5 x 45 on crankshaft		270—330
Bolts M 8 x 30		25
Special tools		
Socket 27 mm, 1/2" square		001 589 65 09 00
Torque wrench 150—500 Nm, 3/4" square		001 589 31 21 00
Detent		110 589 00 40 00
Puller for balancing disc		116 589 10 33 00
Conventional tool		
Adaptor 3/4" hex. socket to 1/2" hex. head	e.g. made by Hazet, D-5630 Remscheid order no. 1058 R-1	

Note

The **vibration damper** can be renewed **without balancing**.

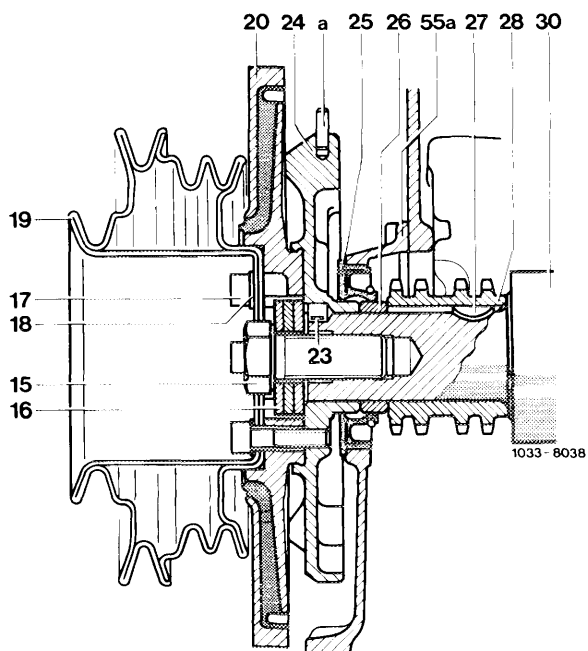
When the **balancing disc** is renewed, static **balancing is absolutely required** (03—344).

Since January 1979, the fastening screws (17) for pulley and vibration damper on engine 617.950 are inserted **without washers** (18). On engines 617.951/952 from start of series.

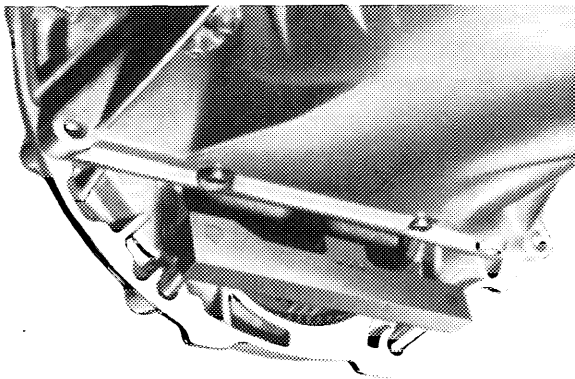
Removal

- 1 Remove radiator and fan.
- 2 Remove all V-belts (13–340).
- 3 Remove pulley and vibration damper.

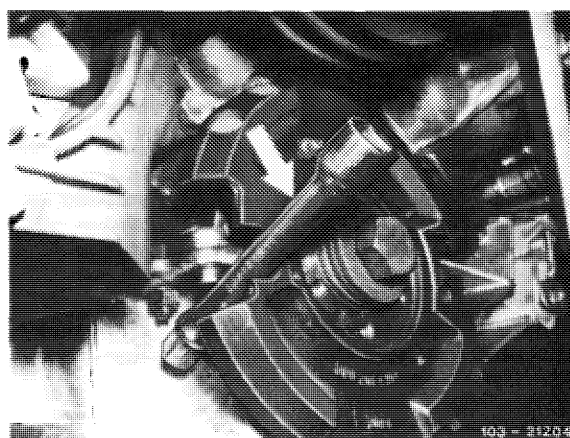
15 Bolt M 18 x 1.5 x 45	25 Radial sealing ring
16 Cup spring	26 Spacing ring
17 Bolt M 8 x 30	27 Woodruff key
18 Washer	28 Crankshaft gear
19 Pulley	30 Crankshaft
20 Vibration damper	55a Cover
23 Fitted pin 8 x 8	a Pin
24 Balancing disc	



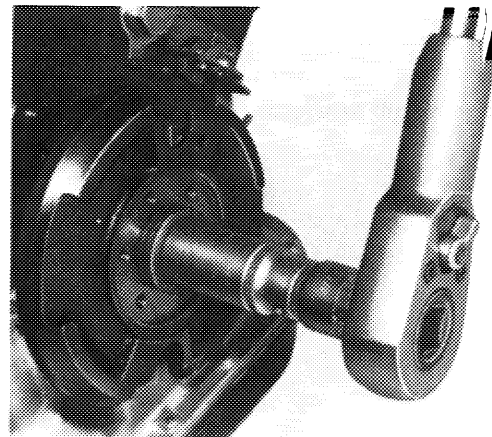
- 4 On models 116.120 and 123 with automatic transmission 722.120 (W4B 025), insert detent at flywheel as a counterhold when loosening screw in crankshaft.



On models 126.120 and 123 with automatic transmission 722.303 (W4A 040) use a steel bolt as a counterhold in one of the recesses on balancing disc and on cylinder crankcase (arrow).

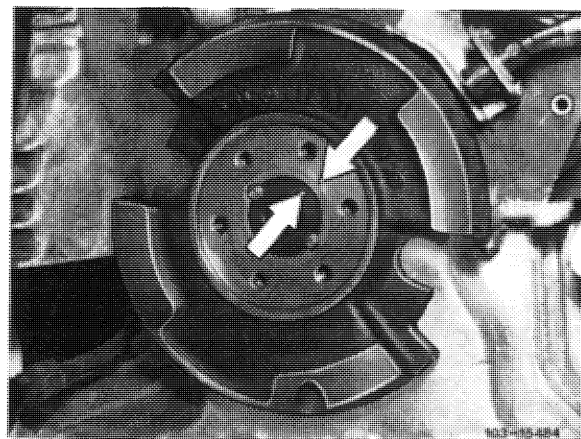


5 Remove screw on crankshaft.



103-15477

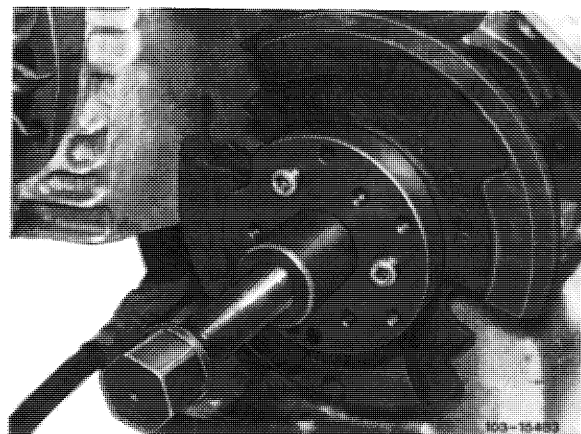
6 Identify balancing disc and crankshaft by punch marks.



103-15484

7 Pull off balancing disc by means of puller. For this purpose, place recess in balancing disc under water pump pulley.

Do not screw-in puller screws too far, since this might damage the radial sealing ring.



103-15483

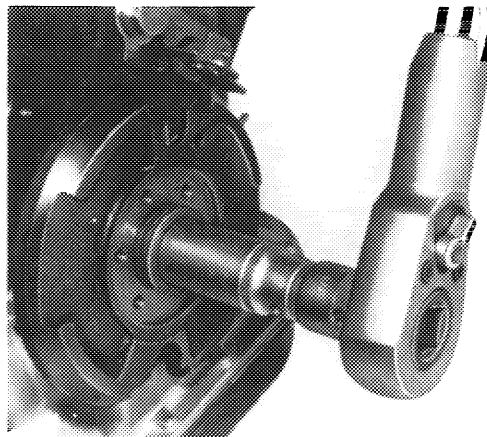
Installation

8 Place balancing disc on crankshaft in such a manner that the bores for the fitted pins are in alignment.

Note: The balancing disc is located on crankshaft by means of two offset fitted pins.

9 Mount balancing disc on crankshaft with screw M 18 x 1.5 x 45 and cup springs.

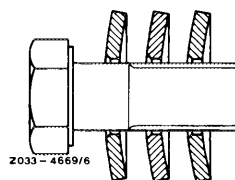
10 Knock-in both fitted pins.



103-15477

11 Mount the three cup springs with crown toward bolt head.

12 Lubricate bolt on crankshaft and tighten to 270–330 Nm, while applying counterhold to crankshaft with detent or steel bolt.

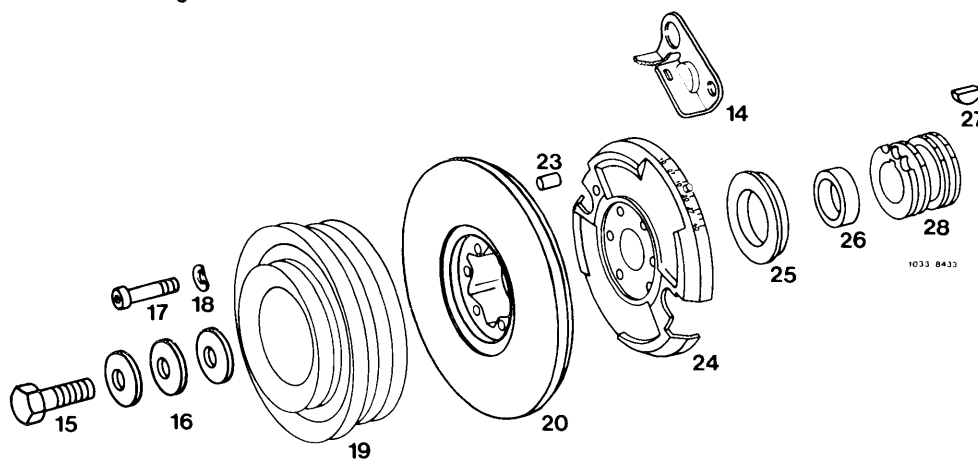


13 Install vibration damper, pulley, fan and radiator.

14 Tension V-belt.

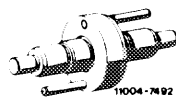
Pulley, vibration damper and balancing disc

- 14 Adjusting indicator
- 15 Bolt M 18 x 1.5 x 45
- 16 Cup springs
- 17 6 bolts M 8 x 30
- 18 6 washers 8.4
- 19 Pulley
- 20 Vibration damper
- 23 2 fitted pins 8 x 8
- 24 Balancing disc
- 25 Radial sealing ring
- 26 Spacing ring
- 27 Woodruff key
- 28 Crankshaft gear (sprocket)



Special tool

Mounting mandrel for balancing disc



617 589 02 63 00

Conventional tool

Rotating fixture

e.g. made by Trebel, D-4030 Ratingen
type EO

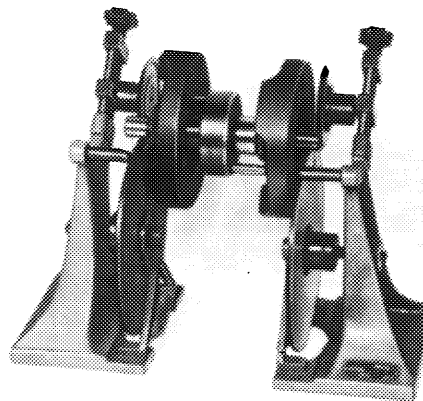
Note

The state of balance of the old balancing disc must be transferred to the new balancing disc.

Whenever possible, a broken balancing disc should be glued together with all its parts and should be statically balanced together with the new balancing disc.

Static balancing

- 1 Place new balancing disc on balancing mandrel offset by 180° in relation to old balancing disc.
- 2 Let balancing mandrel with both balancing discs swing to a stop on rotating fixture.

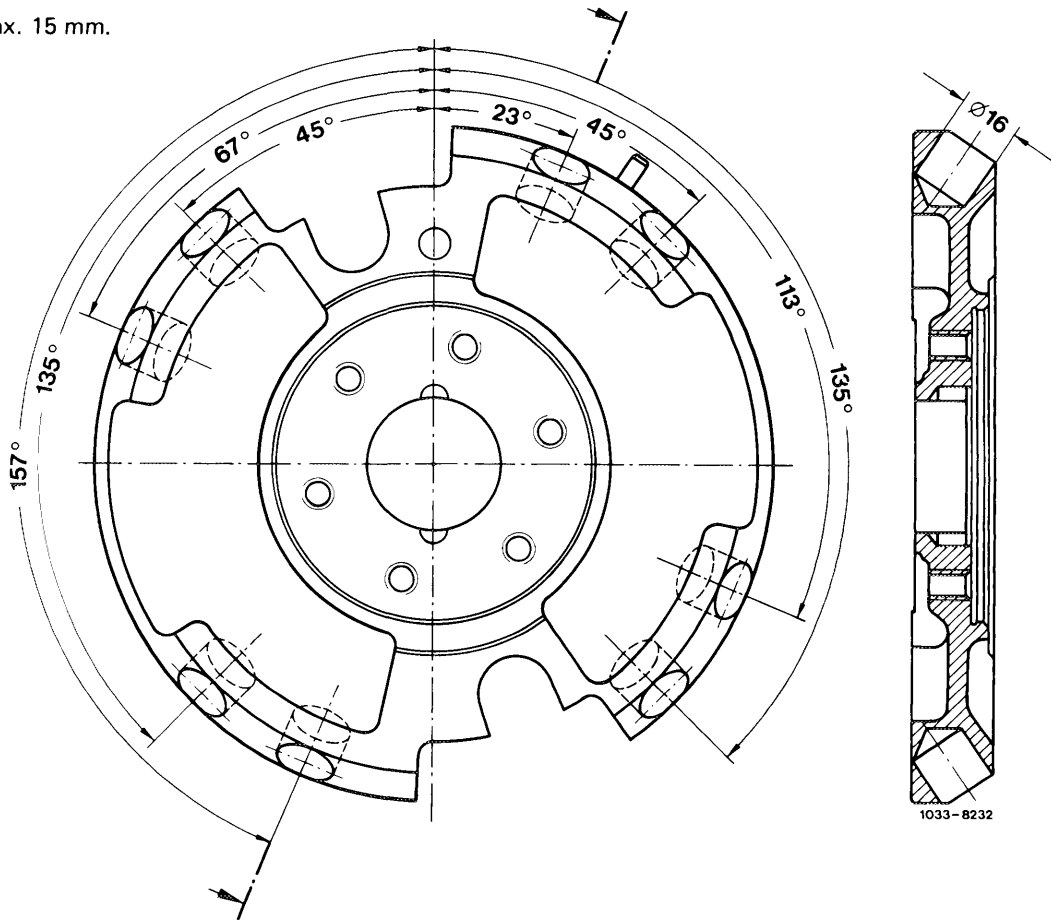


103-10549

3 Drill into new balancing disc until the discs will come to a stop on rotating fixture in any position without swinging back and forth.

Pay attention to location of balancing holes (Fig.).

Hole depth max. 15 mm.



03–345 Checking and correcting adjustment of TDC transmitter

Valve clearance	With engine cold (approx. 20 °C)	With engine warm (60 °C ± 15 °C)
Intake	0.10 ¹⁾	0.15 ¹⁾
Exhaust	0.35	0.40

¹⁾ 0.05 mm higher during lasting outside temperatures below –20 °C.

Tightening torque	Nm
Nuts for cylinder head cover	15

Special tools

Socket 27 mm, 1/2" square for rotating engine		001 589 65 09 00
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11004-6193

Measuring extension		123 589 09 63 00
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11004-7661

Locating device for adjusting slide		116 589 19 21 00
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11004-10349

Assembly mandrel for valve stem seals		617 589 00 43 00
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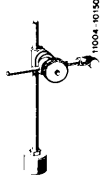
11004-6191

Valve adjusting wrench 14 mm (2 each)		615 589 00 01 00
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11004-7004

Holding wrench for valve spring retainer		615 589 00 03 00
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11004-7118

Dial gauge holder		121 589 00 21 00
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11004-10150

Magnetic dial gauge holder		116 589 12 21 00
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11004-8173

Conventional tool

Dial gauge A 1 DIN 878

e.g. made by Mahr, D-7300 Esslingen
order no. 810

Note

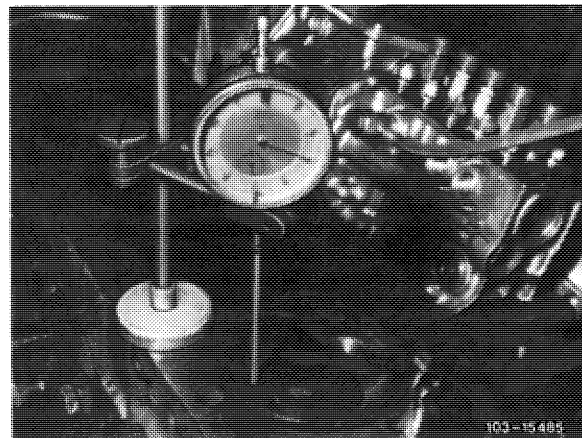
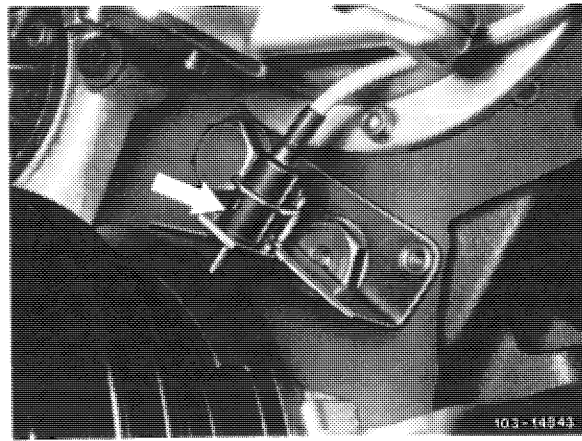
The pin in vibration damper should be accurately under TDC transmitter at crankshaft position 20° after TDC.

Check adjustment of TDC transmitter and make corrections, if required.

- a) When renewing TDC transmitter adjusting slide.
- b) When renewing crankshaft with balancing disc and vibration damper.
- c) When completing basic engines.

With the cylinder head removed, the measuring pin of the dial gauge can be set directly on piston crown. For this purpose, place magnetic dial gauge holder on cylinder crankcase parting surface.

For adjusting TDC transmitter, proceed in this case according to item 7, 14 and 17–24.



Checking

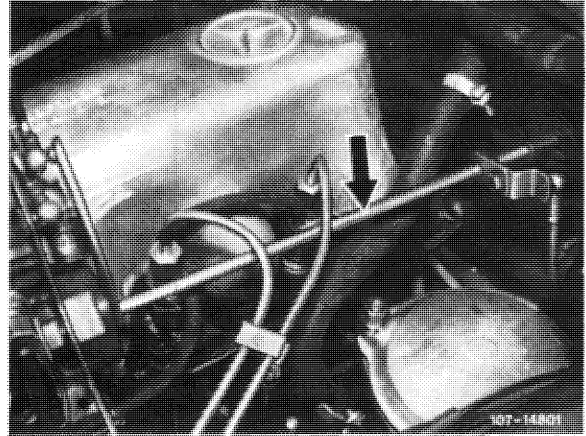
- 1 Remove fan cover. For this purpose, disconnect upper coolant hose on radiator.
- 2 Remove fan.
- 3 Remove V-belt of power-steering pump and refrigerant compressor (13–340).
- 4 Remove double diaphragm or piston-vacuum pump.

5 Disconnect regulating linkage to remove cylinder head cover. Pull out locking eye of longitudinal regulating shaft (arrow).

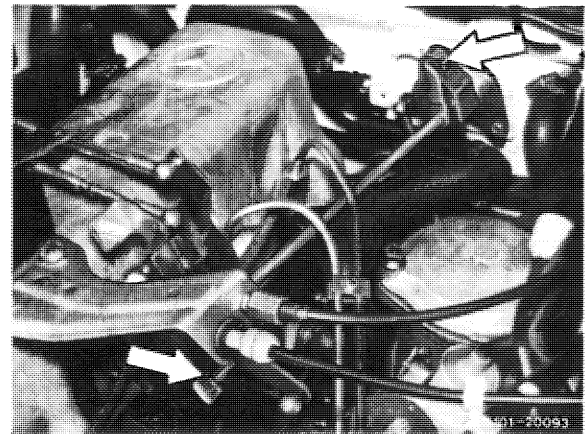
On models 116.120 and 123, pull longitudinal regulating shaft out of rubber mount in forward direction and remove in rearward direction.

On model 126.120, pull longitudinal regulating shaft out of guide lever in rearward direction and remove in forward direction.

Model 116.120

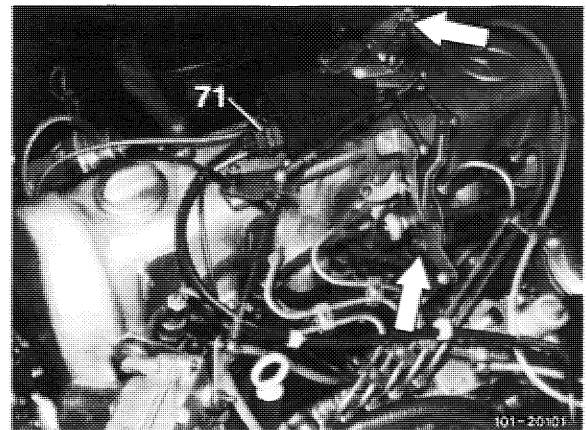


Model 123



On models 123 with automatic transmission 722.303 (W4A 040) and 126.120, pull off central plug for vacuum lines (71) or vacuum lines. Disconnect bowden wire, compress black plastic clip (arrow) and pull bowden wire out of holder in rearward direction.

Model 126.120

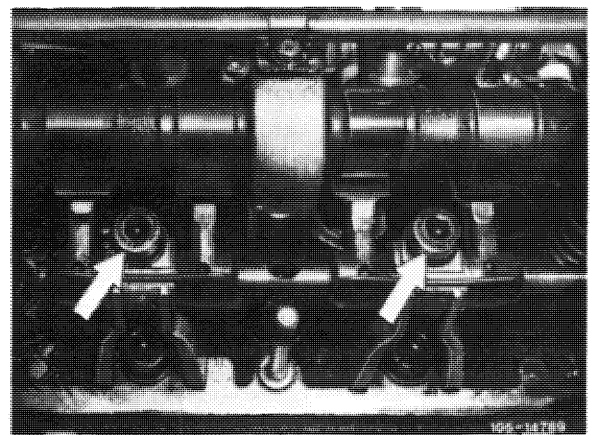


6 Remove front rocker arm group.

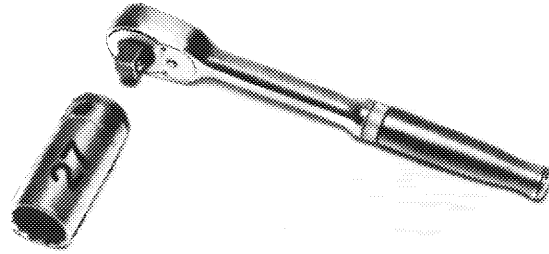
For this purpose, set camshaft in such a manner that the rocker arms are not under load.

Attention!

Do not rotate engine on camshaft, but on crankshaft by means of tool combination.

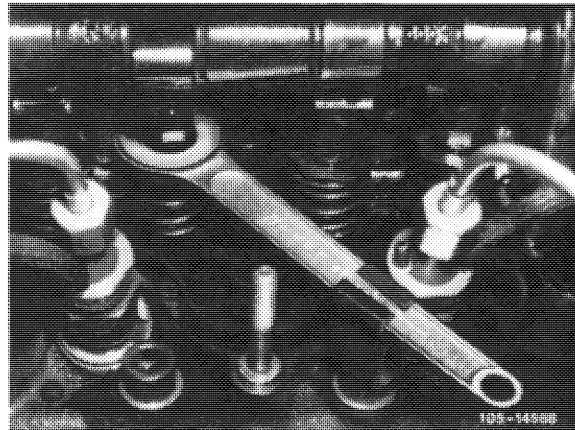


7 Set piston of 1st cylinder to TDC. Rotate crankshaft with tool combination.



1100-6492/1

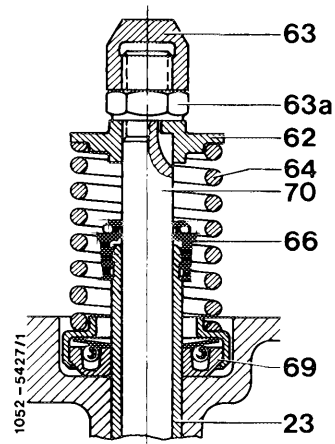
8 At intake valve of 1st cylinder, place holding wrench on hexagon of valve spring retainer.



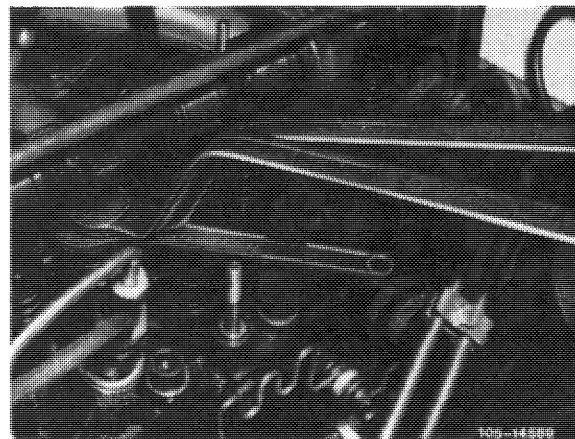
105-14599

9 Unscrew cap nut (63) with valve adjusting wrench. For this purpose, apply counterhold to counternut (63a) by means of second valve adjusting wrench.

10 Unscrew counternut (63a).



1052-5427/1



105-14599

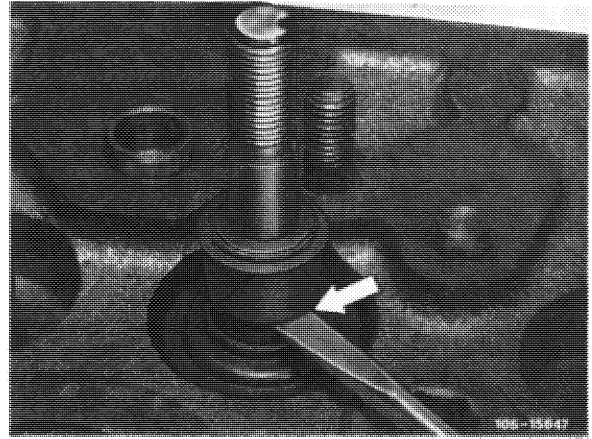
11 Remove valve spring retainer and valve spring.

12 Push off valve stem seal by means of a screwdriver or pull off by means of pliers.

Attention!

Do not damage valve stem and valve guide.

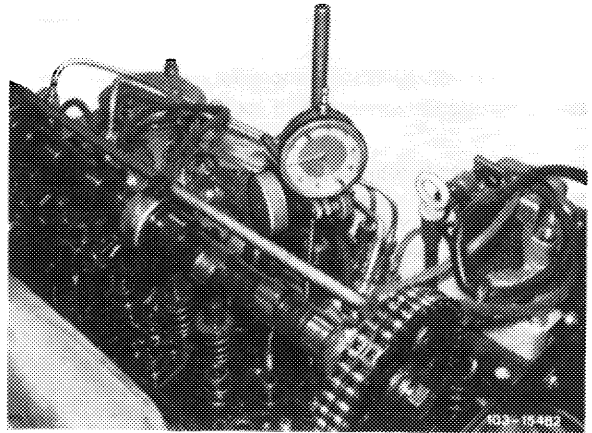
13 Push valve on piston crown.



14 Reverse crankshaft for approx. 10° by means of tool combination.

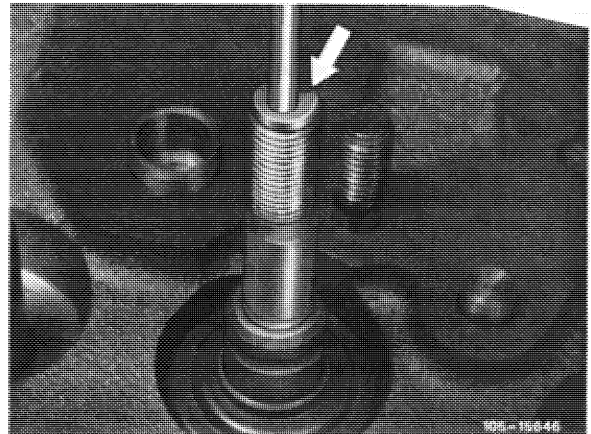
15 Screw dial gauge holder with threaded sleeve to stud in cylinder head.

16 Insert dial gauge and screw measuring extension to dial gauge.



17 Place measuring arm on valve stem with 2 mm preload.

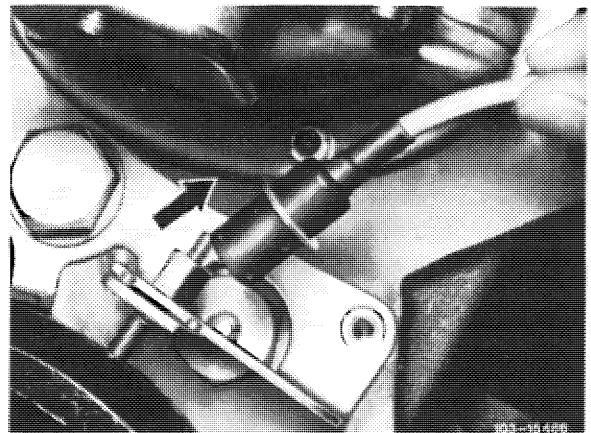
18 Slowly rotate crankshaft with tool combination in direction of rotation of engine until the large needle of the dial gauge stops (TDC position).



19 Unscrew TDC transmitter and pull out.

20 Loosen dial gauge and place measuring extension on valve stem at 5 mm preload. Rotate dial gauge scale until large needle points to zero.

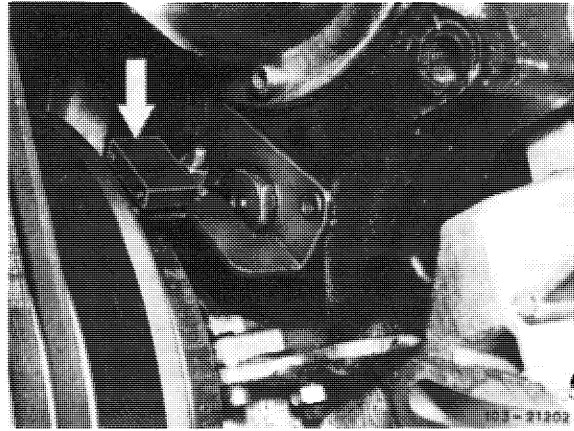
21 Slowly rotate crankshaft with tool combination in direction of rotation of engine until dial gauge has moved back by 3.63 mm.



22 Place locating device without handle (arrow) into adjusting slide.

Pin in balancing disc should enter groove of locating device.

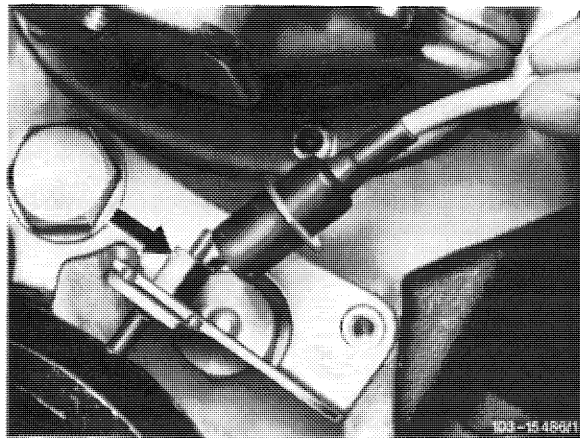
If pin is not engaging, correct position of adjusting slide.



Correcting

23 Loosen adjusting slide and displace until pin in balancing disc enters groove of locating device.

24 Screw down adjusting slide and remove locating device.

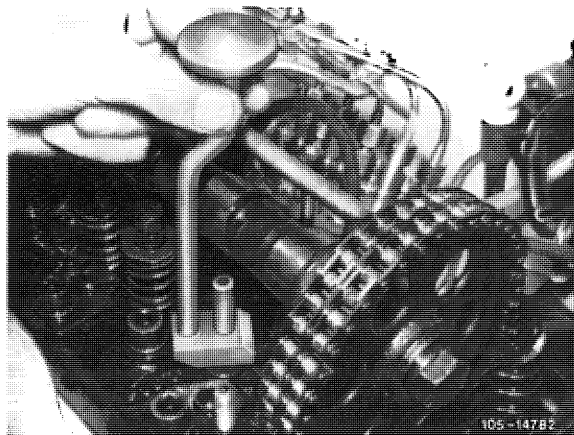


25 Insert TDC transmitter and tighten.

26 Remove dial gauge and unscrew dial gauge holder.

27 Lubricate new valve stem seal and mount with assembly mandrel. For this purpose, place an assembly sleeve on valve stem.

28 Install valve spring and rocker arm group.



29 Check valve clearance (05–210).

30 Mount cylinder head cover.

31 Install double diaphragm or piston-vacuum pump with new gasket.

32 Mount V-belt of powersteering pump and refrigerant compressor and tension (13–340).

33 Attach fan and fan cover.

03–350 Removal and installation of crankshaft sprocket

Tightening torques	Nm
Bolt M 18 x 1.5 x 45 to crankshaft	270–330
Nuts for cylinder head cover	15
Oil pan upper half to cylinder crankcase	10
Oil pan lower half to upper half	
Engine carrier to engine mount front	70
Necked-down screw for camshaft sprocket	80

Special tools

Torque wrench 150–500 Nm
3/4" square



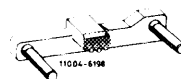
001 589 31 21 00

Socket 27 mm, 1/2" square



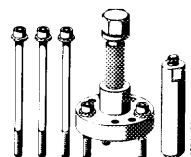
001 589 65 09 00

Detent



110 589 00 40 00

Puller for balancing disc



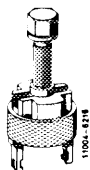
116 589 10 33 00

Puller for spacing ring



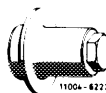
616 589 00 33 00

Puller for crankshaft sprocket



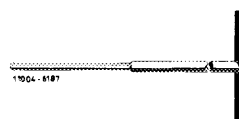
615 589 01 33 00

Installer for radial sealing ring



130 589 00 61 00

Screwdriver (Allen wrench) with tommy handle for
hex. socket screws 5 mm, 300 mm long.



116 589 02 07 00

Knocking-out mandrel

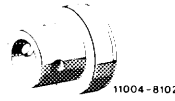


110 589 02 15 00

Knocking-in mandrel for oil
dipstick guide tube



117 589 00 31 00



Conventional tools

Engine hoist (Motordirigent) size 1.5

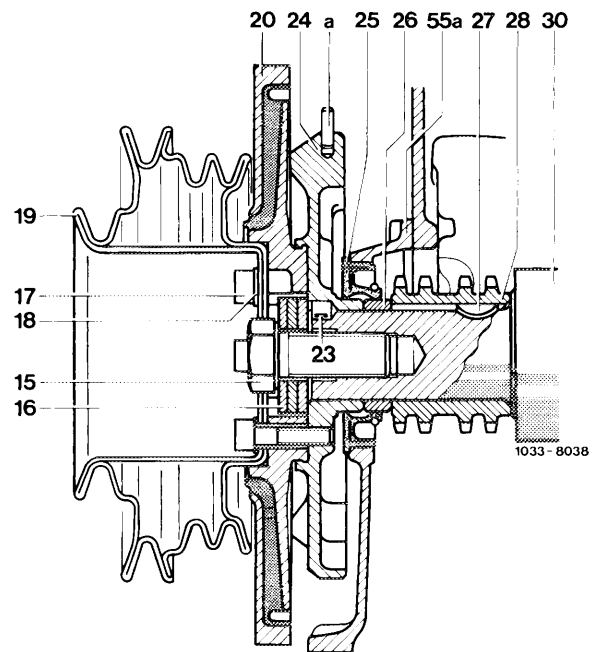
e.g. made by Bäcker, D-5630 Remscheid
order no. 3178

Adaptor 3/4" square socket to
1/2" square head

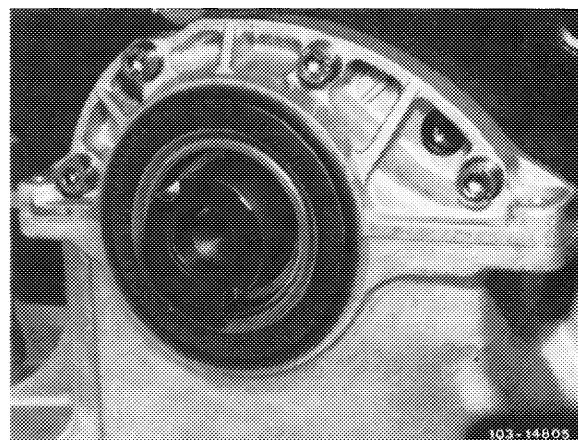
e.g. made by Hazet, D-5630 Remscheid
order nor. 1058 R-1

Removal

- 1 Remove radiator and fan.
- 2 Remove pulley, vibration damper and balancing disc (03-340).
- 3 Completely remove oil pan (01-310).
On model 126.120, remove engine.



- 4 Remove front crankshaft radial sealing ring (03-324).
- 5 Remove front cylinder crankcase housing cover (01-215).

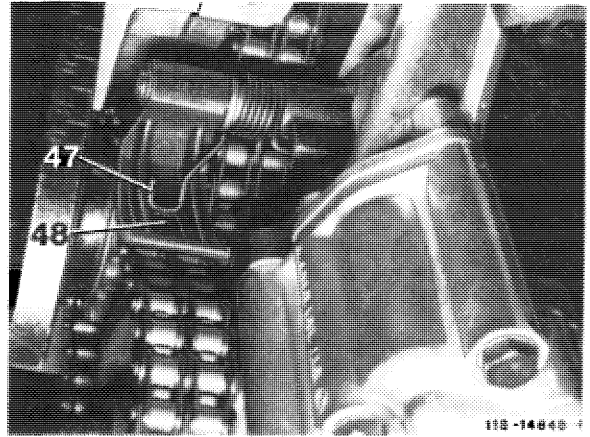


6 Unscrew fastening screw (56) of oil pump sprocket (Fig. item 9).

7 Remove torsion spring (47) from clamp (48) toward the rear.

8 Turn clamp in upward direction.

47 Torsion spring
48 Clamp

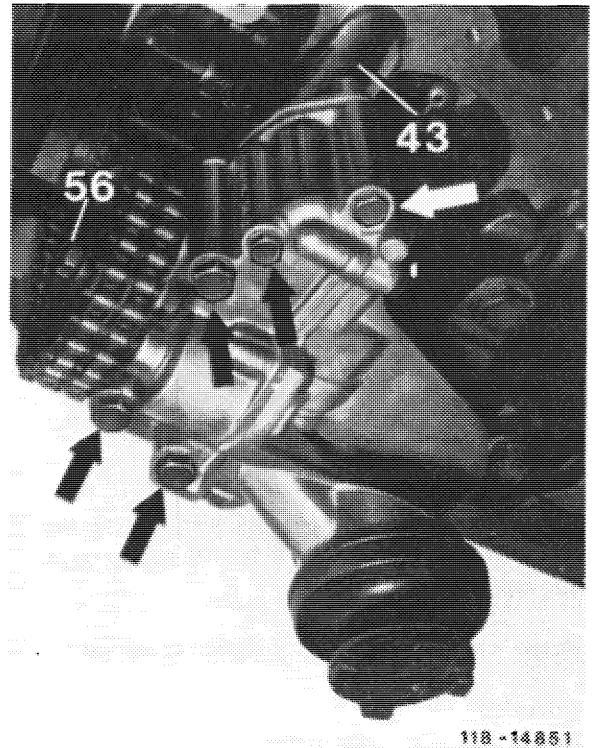


9 Remove sprocket by means of two screw-drivers.

10 Remove sprocket.

11 Remove double roller chain of oil pump.

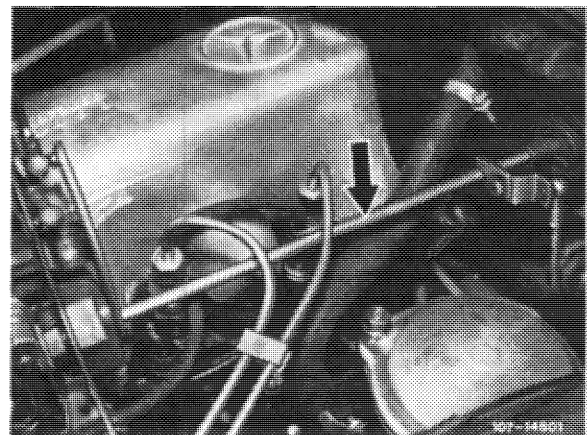
43 Flange member
56 Fastening bolt



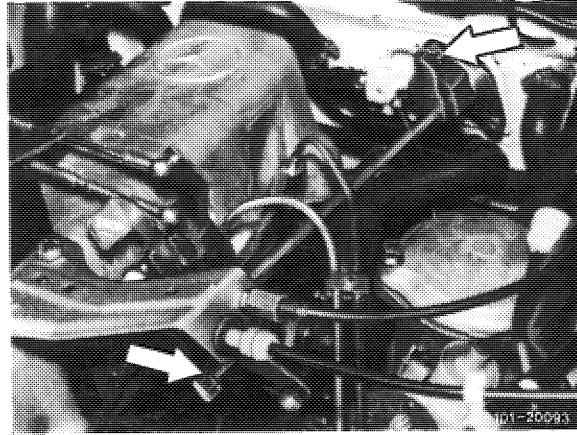
12 Disconnect regulating linkage to remove cylinder head cover. Pull out locking eye of longitudinal regulating shaft (arrow).

On models 116.120 and 123, pull longitudinal regulating shaft out of rubber mount in forward direction and remove in rearward direction.

Model 116.120

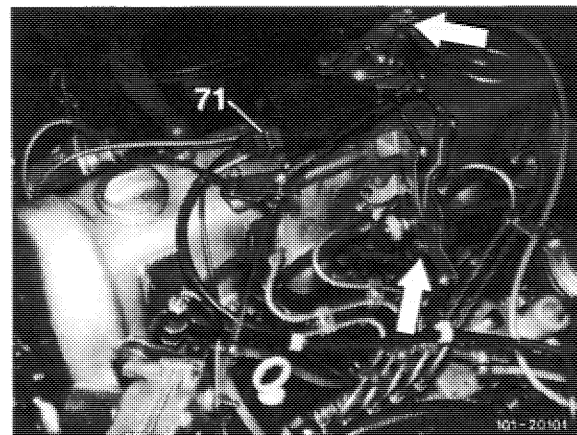


On model 126.120, pull longitudinal regulating shaft out of guide lever in rearward direction and remove in forward direction.



Model 123

On models 123 with automatic transmission 722.303 (W4A 040) and 126.120, pull out central plug for vacuum lines (71) or vacuum lines. Disconnect bowden wire, compress black plastic clip (arrow) and pull bowden wire out of holder in rearward direction.



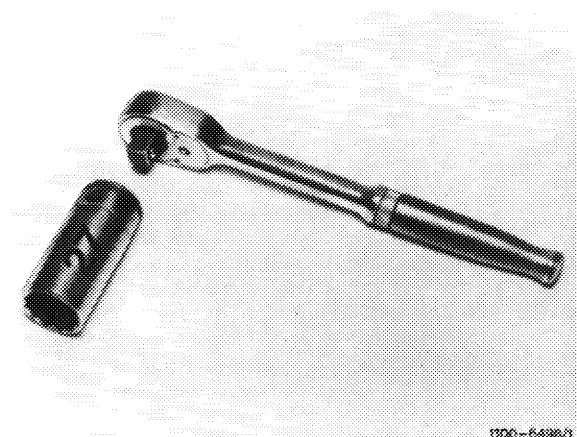
Model 126.120

13 Set engine to TDC of 1st cylinder. For this purpose, screw bolt M 18 x 1.5 x 45 with cup washers into crankshaft.

Rotate engine with tool combination at crankshaft.

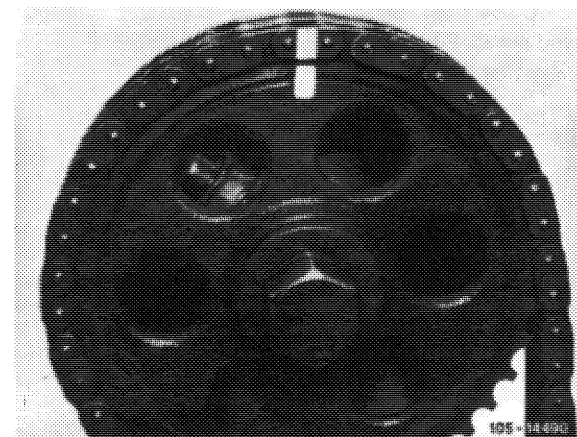
Attention!

Rotate crankshaft only in direction of rotation of engine.



14 Mark camshaft and crankshaft sprocket with paint in relation to timing chain.

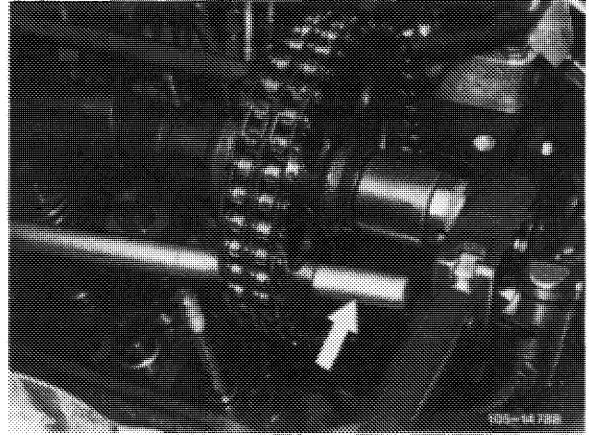
15 Remove chain tensioner (05-310).



16 Remove camshaft sprocket.

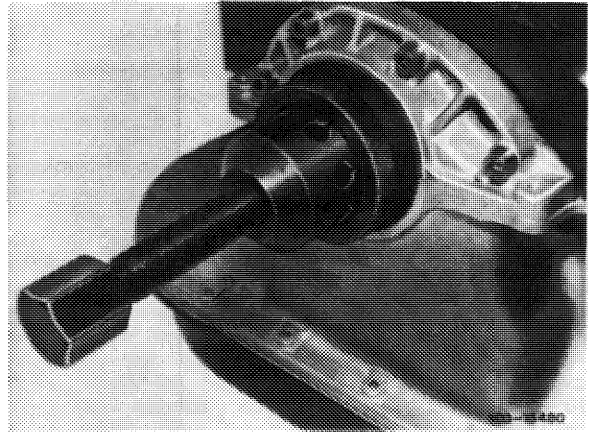
To loosen necked-down screw, apply counterhold to camshaft sprocket by means of a screwdriver or steel bolt, loosen holder for fuel lines and swivel sideways.

17 Remove timing chain from teeth of crankshaft sprocket.

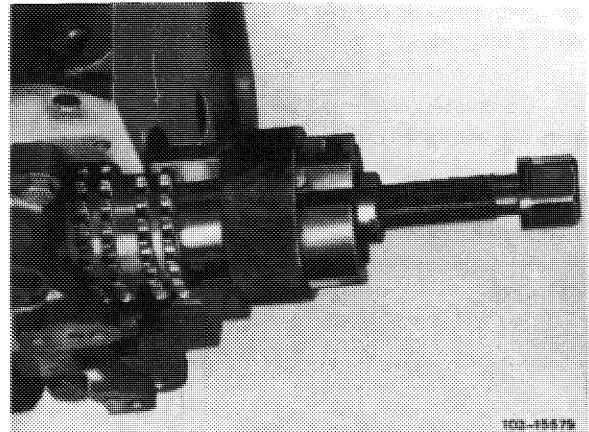


18 Unscrew bolt M 18 x 1.5 x 45.

19 Pull off spacing ring by means of puller.



20 Pull off crankshaft sprocket by means of puller.



Installation

21 Transfer color mark from old crankshaft sprocket to new sprocket.

22 Heat crankshaft sprocket on a hot plate (approx. 80 °C) and slip on crankshaft.

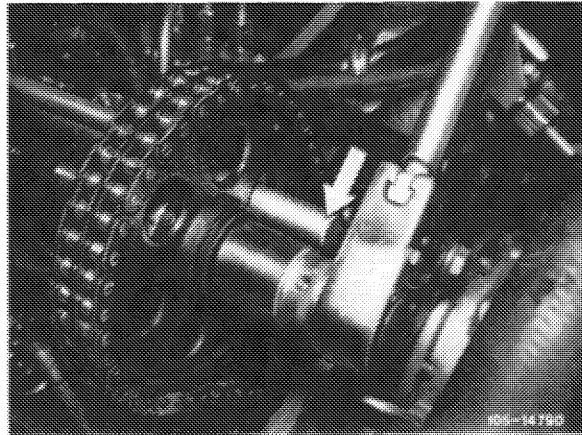
23 Knock spacing ring on crankshaft.

24 Insert timing chain and place camshaft sprocket on camshaft. Pay attention to color code.

25 Position necked-down screw for attaching camshaft sprocket and tighten to 80 Nm. For this purpose, apply counterhold to camshaft sprocket by means of a screwdriver or steel bolt.

26 Place double roller chain of oil pump on crankshaft sprocket.

27 Place oil pump sprocket into double roller chain and then slip on drive shaft. Screw-in fastening screw.



28 Set clamp on double roller chain and torsion spring on clamp.

29 Completely install oil pan. For centering of oil pan, slip sleeve on crankshaft journal.

30 Coat front cylinder crankcase housing cover on flange surfaces with sealing compound and position against cylinder crankcase. Screw-in oil pan bolts first (01–215).

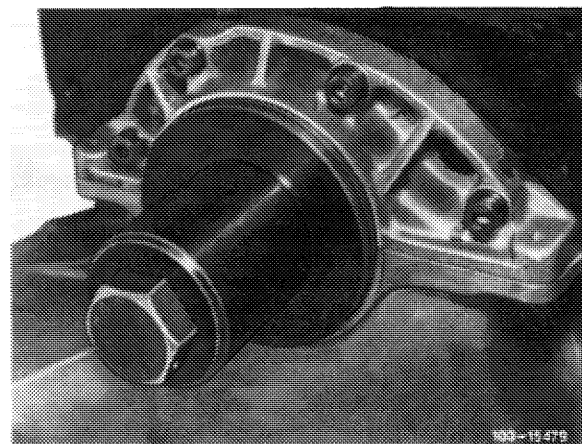
31 Install front crankshaft radial sealing ring (03–324).

32 Install pulley, vibration damper and balancing disc (03–340).

33 Rotate engine with tool combination and check adjusting marks.

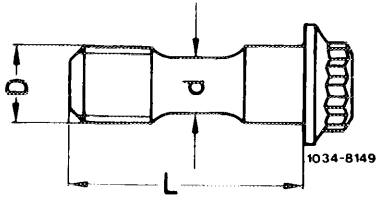
34 Install chain tensioner (05–310).

35 For further installation proceed vice versa to removal.



03-410 Removal and installation of flywheel and driven plate

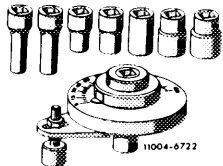
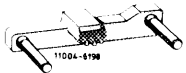
Necked-down screws

Part no.	110 990 04 19		
Thread dia. D	M 10 x 1		
Necked-down stem dia. d	when new	7.7-0.2	
	minimum dia.	7.3	
Length L	31		

Tightening torques

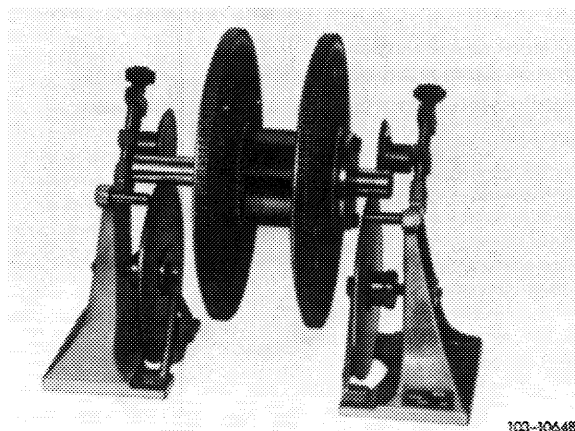
Initial torque	30-40 Nm
Angle of rotation torque	90-100°

Special tools

Angle of rotation tool		116 589 01 13 00
Detent		110 589 00 40 00

Note

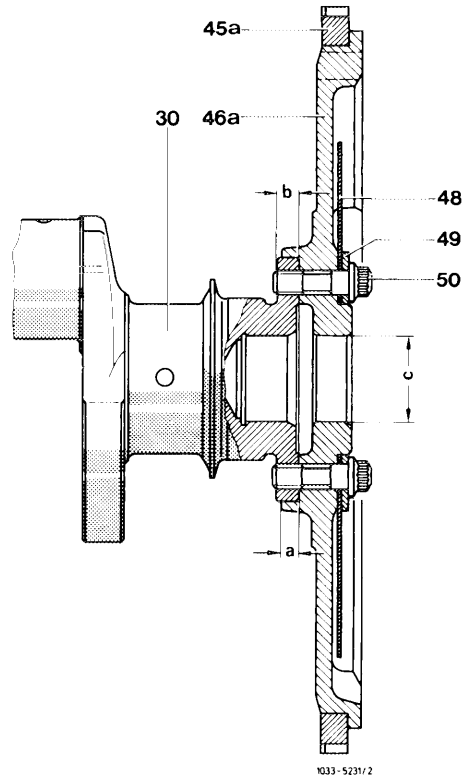
If a new flywheel is installed, set new wheel to balancing condition of removed wheel (03-440).



103-10648

Do not interchange this flywheel with flywheel of engine 110.

Engine 110: dimension a = 4.5 mm

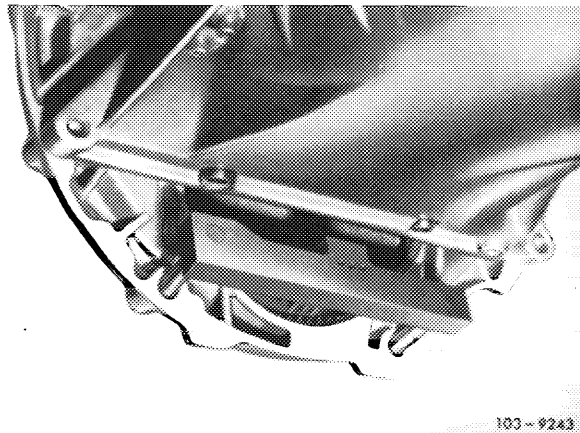


Layout flywheel and driven plate

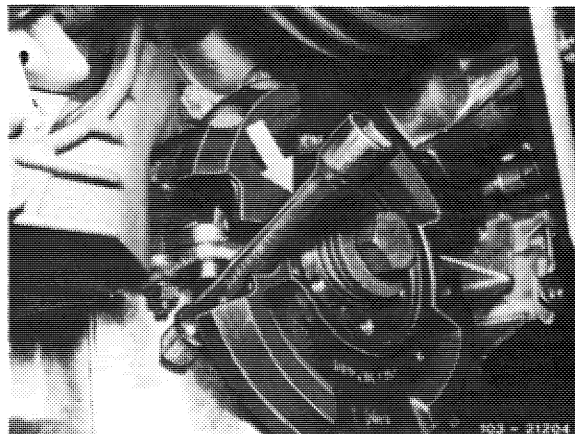
30	Crankshaft	a	7 mm
45a	Ring gear	b	10 mm
46a	Flywheel	c	35 mm dia.
48	Driven plate		
49	Spacing washer		
50	Necked-down screw		

Removal

- 1 Remove transmission.
- 2 On models 116.120 and 123 with automatic transmission 722.120 (W4B 025), position detent against flywheel as a counterhold when loosening necked-down screws.

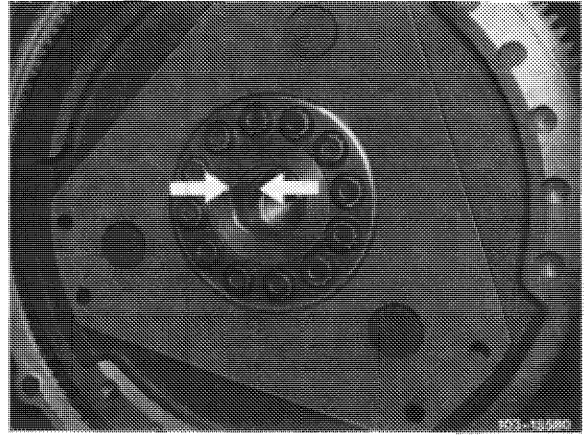


On models 126.120 and 123 with automatic transmission 722.303 (W4A 040), hold a steel bolt in one of the recesses on balancing disc for counterholding and support against cylinder crankcase (arrow).



3 Loosen necked-down screws. Remove flywheel, driven plate and spacing washer.

Note: The flywheel and crankshaft are identified by a mark (arrows).



Installation

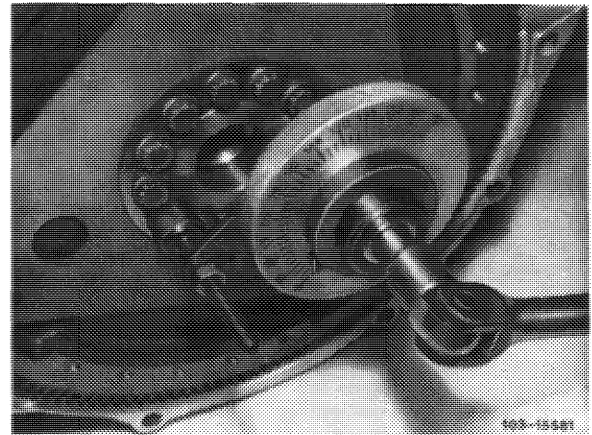
4 Measure necked-down stem dia. "d" of necked-down screws.

If the minimum dia. has been attained, replace necked-down screws.

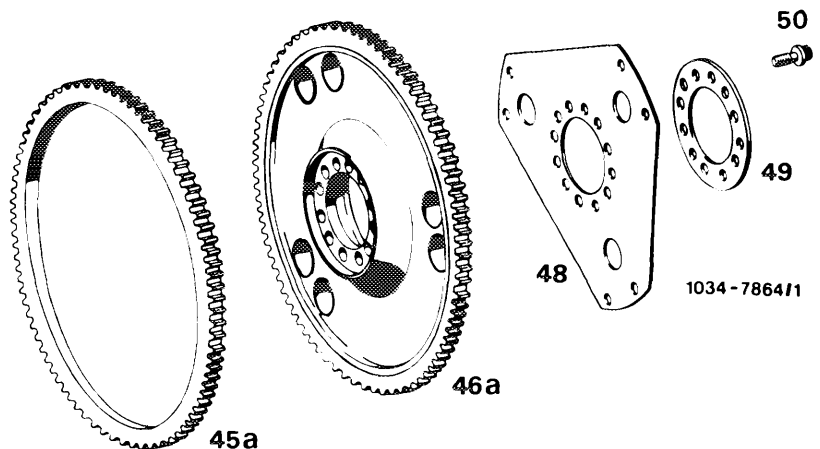
5 Position flywheel, driven plate and spacing washer on crankshaft journal in such a manner that the marks are in alignment.

6 Lubricate necked-down screws, screw-in and tighten to 30–40 Nm.

7 Tighten to angle of rotation torque of 90–100° by means of angle of rotation tool.



Flywheel and driven plate



- 45a Ring gear
- 46a Flywheel
- 48 Driven plate
- 49 Spacing washer
- 50 12 necked-down screws

Data

Lateral runout on ring gear	max. 0.4
Centering flange dia. for ring gear	268.31–268.39
Shrink-on temperature	220 °C
Annealing color	yellow

Conventional accessory

Temperature measuring chalk	e.g. from AW Faber-Castell D-8504 Stein bei Nürnberg color no. 2815/220 (white) Thermochrom
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Note

The ring gear is hardened. To protect hardness, the temperature for hardening ring gear should not exceed 220 °C at any point. This can be done reliably only by means of a hot plate or a heating oven.

An open flame may be used as an exception only. The flame should touch only the inside of the ring gear.

Following renewal of a ring gear, the flywheel need not be balanced.

Renewal

- 1 Center drill old ring gear and break up with a chisel or heat quickly and immediately remove.
- 2 Clean mounting surface of ring gear on flywheel.
- 3 Uniformly heat new ring gear on a hot plate or in a heating oven.

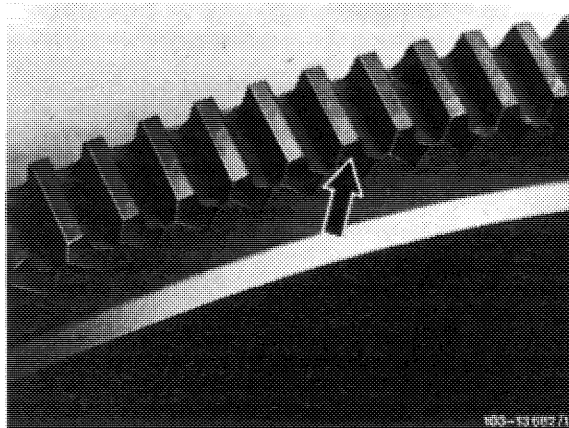
For this purpose, use temperature measuring chalk in accordance with instructions whenever possible.

4 Mount heated ring gear immediately on flywheel.

Attention!

The tooth chamfer (arrow) should face starter motor.

As a spare part, ring gears are available with chamfered teeth only.

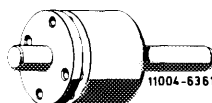


Data

Flywheel for	Balancing bores		Hole pattern dia.
	Max. depth of bore	Bore dia.	
Automatic transmission	15	11	252

Special tool

Balancing mandrel
(Flywheel for automatic and manual transmission)



617 589 00 63 00

Conventional tool

Rotating device for static balancing

e.g. made by Trebel, D-4030 Ratingen
type EO

Note

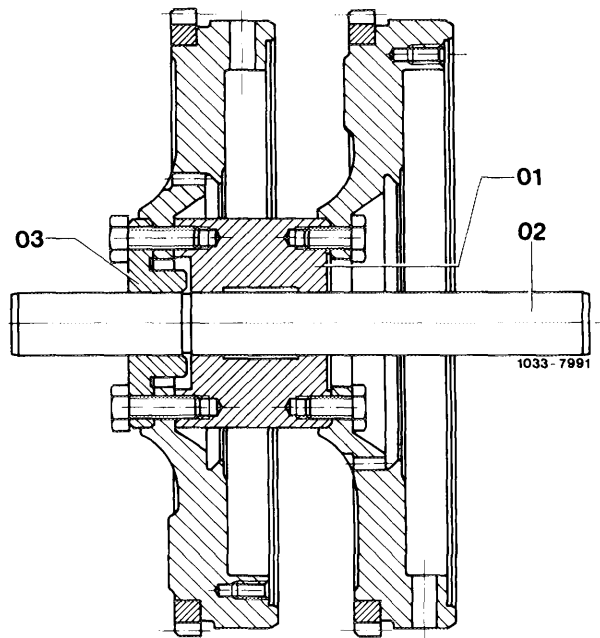
The engine is fully balanced, that is, the complete engine has been balanced on a balancing machine.

Since in the event of repairs this type of balancing cannot be performed, while on the other hand the balanced condition of the engine should be maintained as much as possible, a new flywheel must be brought to the same balancing condition as the removed flywheel.

Static balancing

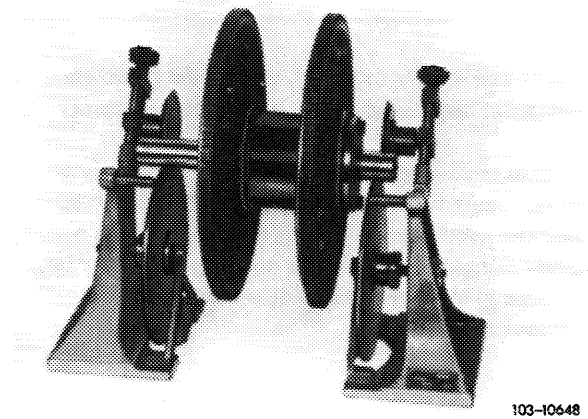
- 1 Place old and new flywheel one above the other in such a manner that all the bores are in alignment and both coupling surfaces are facing in one direction.

2 Insert balancing mandrel and screw-on new flywheel offset by accurately 180° in relation to old flywheel.



- 01 Mounting
- 02 Shaft
- 03 Centering disc

3 Permit balancing mandrel with both flywheels to swing on rotating device to stop.



4 If an unbalance is found, drill as many holes on heavy side of new flywheel as required until the flywheels will come to a rest in any position without swinging.

Attention!

The hole circle dia., the drill dia. and the max. drilling depth must be maintained.

The engine 617.950 is fully balanced, that is, the complete engine has been balanced on a balancing machine.

Since in the event of repairs, such balancing cannot be performed, while the balanced condition of the engine must be maintained as much as possible, the following rules and measures should be observed:

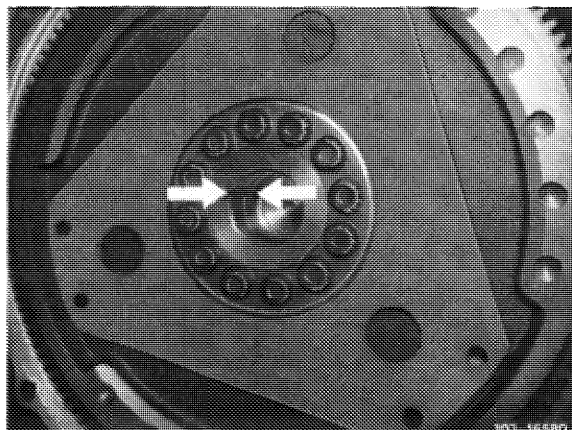
1 Spare part crankshafts are supplied without flywheel, balancing disc, pulley and vibration damper. These parts are taken from the removed crankshaft.

Spare part crankshafts are balanced to zero.

2 When exchanging the crankshaft, the mark (arrow) on flange of removed crankshaft must be placed at the same spot on new crankshaft.

3 When exchanged, flywheel and balancing disc must be balanced to balancing condition of removed parts by static balancing (03—344 and 03—440).

Do not balance vibration damper.



4 When installing new connecting rods, pay attention to weight classes. Only those connecting rods may be installed in an engine which comply with the weight class of the removed connecting rods (03—313).

5 Shortblocs are fully balanced.