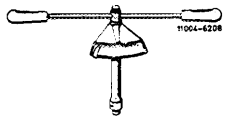
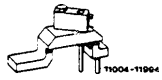
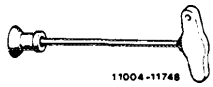
05-211 Checking and replacement of hydraulic valve clearance compensating elements

Tightening torques	Nm
Bolts for cylinder head cover	10
Bolt for camshaft timing gear	45
Bolts for camshaft bearing caps	25

Special tools

Torque wrench, double arm, 3/8" square, 8-32 Nm		001 589 51 21 00
Torque wrench with plug-in ratchet 1/2" square, 25-l 30 Nm		001589662100
Measuring bridge for residual stroke		601 589 08 21 00
Vacuum lifter for valve tappet		601589053300

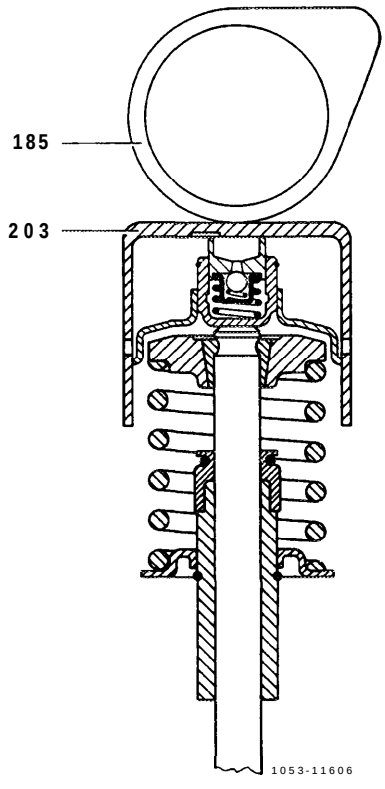
Note

Store valve tappet in upright position only (open end up).

Install removed valve tappets again at the same spot.

The basic position of valve tappets cannot be corrected.

In the event of complaints about noise, perform the following test jobs:



185 Camshaft
203 Valve tappet

Checking

1 Run engine for approx. 5 minutes at 3000/min.

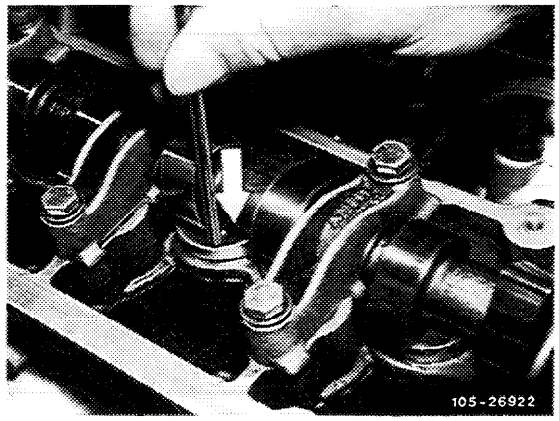
2 Remove cylinder head cover.

3 Set cam of respective valve tappet on base circle (cam tip should point upwards).

4 Use a mandrel to push against valve tappet or try to move valve tappet manually.

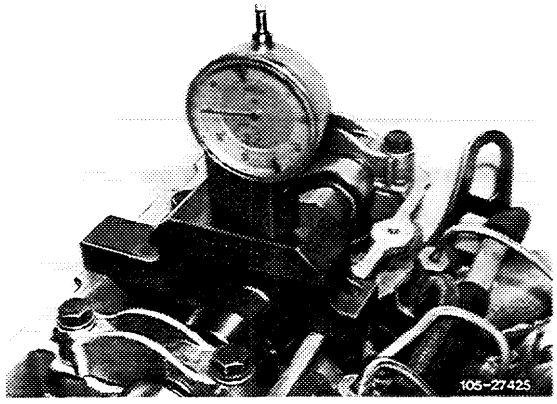
If, compared with others, the valve tappet drops quickly, or in the event of play in relation to base circle of cam, perform jobs item 6 and starting item 8.

If a valve tappet has play, or if the sinking time is too short, check basic position (item 5–7).



5 Measure and write down dimension "X" (cylinder head parting surface to valve tappet). For this purpose, place measuring bridge over valve tappet about to be checked on cylinder head parting surface.

Note: If required, measure dimension "X" on all valve tappets.



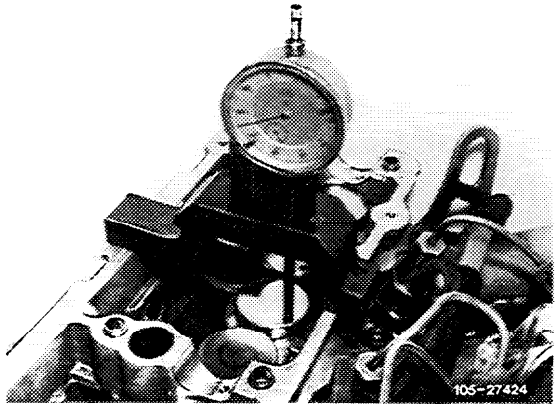
6 Remove fan and fan cover.

7 Remove camshaft (05-220).

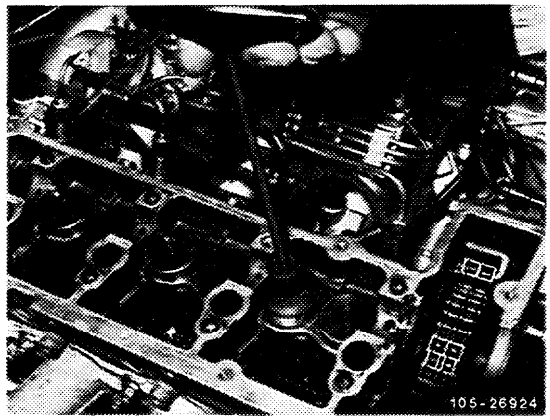
8 Measure dimension "Y" (cylinder head parting surface to valve tappet).

The difference between dimension "X" and "Y" is the initial stroke ≙ installation position.

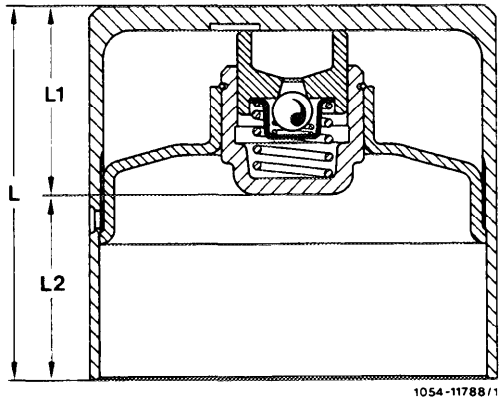
Nominal value: Value when new 0.25-l .6 mm, value with used engine 0.25-2.5 mm.



9 If valve tappet sinks quickly or if the nominal dimension is not attained or exceeded, lift out valve tappet by means of vacuum lifter.

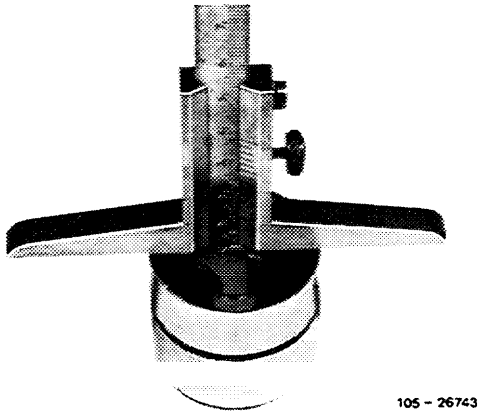


10 Measure dimension "L" on valve tappet and write down.

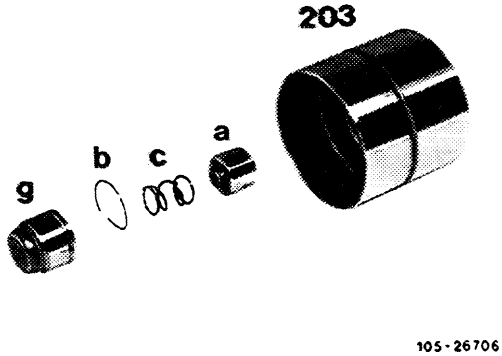


11 Measure dimension "L 2" on valve tappet.

Dimension "L I" (difference between L and L 2) should be 18-19 mm.



12 If dimension "L 1" is higher or lower, remove guide sleeve. For this purpose, pull guide sleeve (g) out of valve tappet (203) by means of rotary movements with pliers. Do not damage guide sleeve.

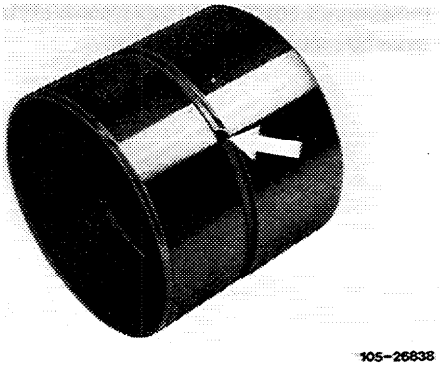


203 Valve tappet
a Thrust pin with ball and cage
b Circlip
c Compression spring
g Guide sleeve

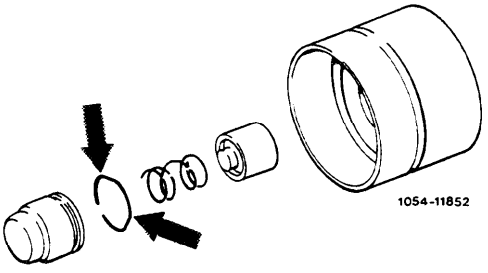
13 Pull thrust bolt (a) out of guide sleeve (g) and remove compression spring (c).

14 Blow out all components with compressed air.

Blow through valve tappet at oil feed bore (arrow).



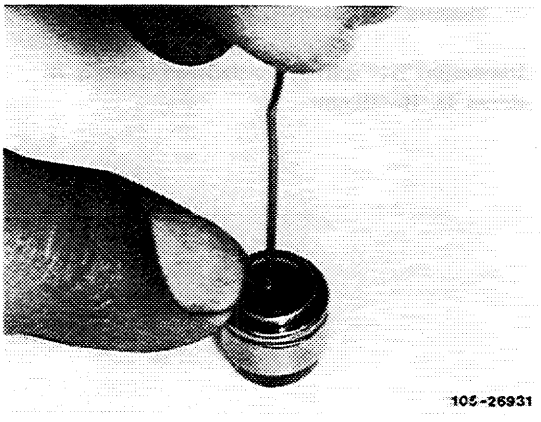
15 Remove circlip (b) from guide sleeve (g), slightly rebend at edges (arrows) and mount again on guide sleeve.



16 Assemble guide sleeve (g), compression spring (c) and thrust pin (a) in correct sequence.

17 Fill thrust pin with engine oil. Press on ball valve with a suitable pin and vent work chamber by pumping movements of thrust pin, close ball valve and add oil, if required. Then, no more oil should flow out at ball valve under slight pressure.

If oil flows out, renew complete valve tappet.



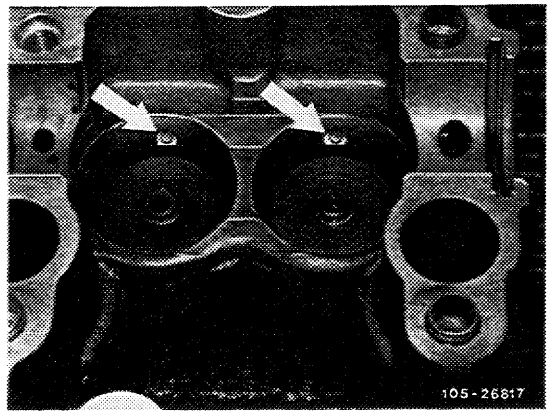
18 Fill valve tappet (203) with engine oil and install vented thrust pin with guide sleeve into valve tappet.

Push guide sleeve into valve tappet until circlip engages.

19 Check dimension "L 1", refer to item 9 and 10.

20 Check oil supply in cylinder head. For this purpose, unscrew closing plug of oil duct on cylinder head rear.

Blow with compressed air into oil duct, while checking outlet bore on seat for valve tappet for passage.



21 Lubricate valve tappet and install, pay attention to sequence.

22 Install camshaft (05–220).

23 Install cylinder head cover.

24 Install fan and fan cover.

25 Run engine at 3000/min.

05-215 Checking camshaft timing

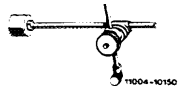
Timing at 2 mm valve lift

Engine	Camshaft code number[1])	Camshaft opens after TDC	Intake valve closes after BDC	Exhaust valve opens before BDC	Exhaust valve closes before TDC
601	05	with new timing chain			
		11°	17°	28°	15°
		with used timing chain (after approx. 20 000 km)			
		12°	18°	27°	14°

[1]) The camshaft code number is stamped into collar adjacent to TDC notch.

Tightening torque	Nm
Bolts for cylinder head cover	10

Special tools

Dial gauge holder	 11004-10150	363 589 02 21 00
Box-end wrench element, open 14 mm, 1/4" drive for coupling nut on injection line	 11004-105201	000589 77 0300

Conventional tool

Dial gauge A 1 DIN 878	e. g. Mahr, D-7300 Esslingen Order No. 810

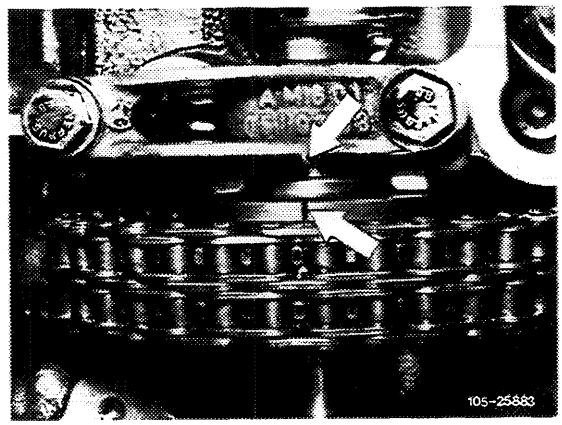
Note

During assembly jobs alignment of marks (arrows) in ignition TDC position of 1st cylinder is adequate.

In special cases, e. g. in the event of complaints about output, perform the following checkup with regard to begin of opening at intake valve of 1st cylinder.

Timing is measured at 2 mm tappet travel.

Corrections are not possible at the moment.



Checking

1 **Remove cylinder head cover.**

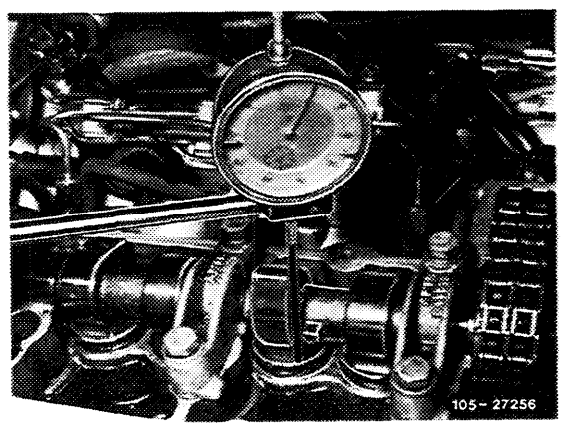
2 Remove injection nozzles (07.1-230).

3 Turn crankshaft until cam tip of 2nd cam is pointing upwards.

Attention!
Do not rotate engine on screw of camshaft timing gear. Do not rotate engine in reverse while measuring, since this would result in considerable measuring faults.

4 Tighten dial gauge holder on cylinder head (above 1st cylinder intake valve).

5 Position dial gauge with extension and fasten in such a manner that the sensor pin is seated on valve tappet (arrow) under a preload of 3 mm (small needle of dial gauge).



Turn dial of dial gauge until large needle points to ''0''.

Attention!
Sensor pin of dial gauge should be seated accurately vertical on valve tappet.

6 Continue turning crankshaft in direction of rotation of engine until small needle of dial gauge has moved back by 2 mm (valve lift) to 1 mm.

In this position, the value on balancing disk should be the same as the specified value "intake valve opens".

7 Install injection nozzles (07 l-230).

8 Install cylinder head cover.

05-220 Removal and installation of camshaft

Timing at 2 mm valve lift

Engine	Camshaft code number[1])	Intake valve open after TDC	Intake valve closes after BDC	Exhaust valve opens before BDC	Exhaust valve closes before TDC
601	05	with new timing chain			
		11°	17°	28°	15°
		with used timing chain (after approx. 20 000 km)			
		12°	18°	27°	14°

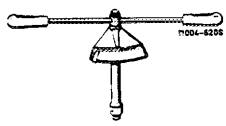
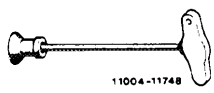
[1]) The camshaft code number is stamped into collar adjacent to TDC notch.

Data

Permissible runout of center bearing journal and of camshaft timing gear seat when mounting camshaft in outer bearing points	Camshaft code number	05
	Camshaft timing gear seat	0.020
	2nd bearing point	0.030
	3rd bearing point	0.025
Scleroscope hardness of cams	when new	64-75
	limit value	
Diameter of camshaft bearing journals		30,944–30,950

Tightening torques	Nm
Bolts for cylinder head cover	10
Bolt for camshaft timing gear on camshaft	45
Bolts for camshaft bearing caps	25

Special tools

Torque wrench with plug-in ratchet, 1/2" square, 25-l 30 Nm		001 589 66 21 00
Torque wrench, double arm, 3/8" square, 8-32 Nm		001 589 51 21 00
Vacuum lifter for valve tappet		601 589 05 33 00

Note

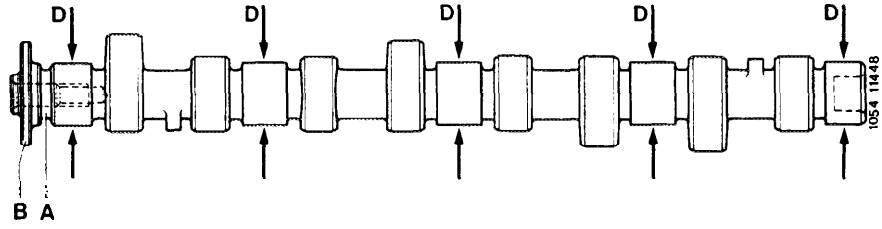
The camshaft is a chill casting and mounted in five bearings.

The diameter (D) of all five bearing points is 31 .O mm.

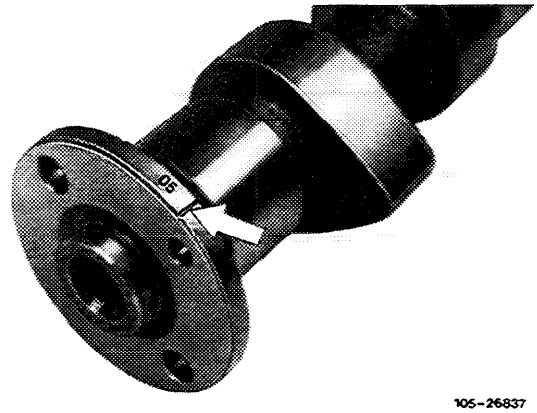
Groove (A) serves to locate the camshaft axially by means of a circlip inserted in cylinder head.

A cyl. pin on collar (B) serves to locate the camshaft timing gear.

A Groove for axial locating
B Stop for camshaft timing gear and mounting of cyl. pin
D Bearing points



The code number is stamped into flange adjacent to TDC notch (arrow).



TDC mark (arrow) and code number

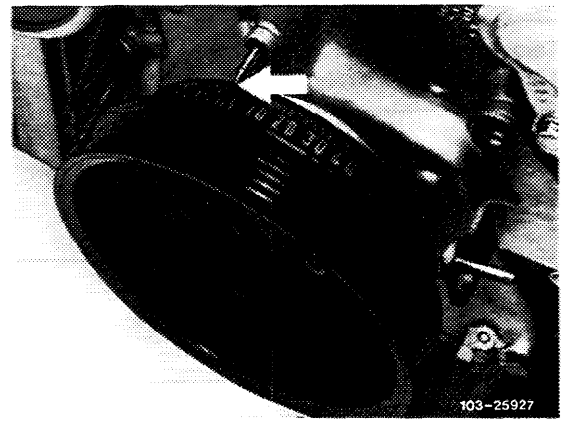
Removal

1 Remove cylinder head cover.

2 Set crankshaft to ignition TDC of 1st cylinder.

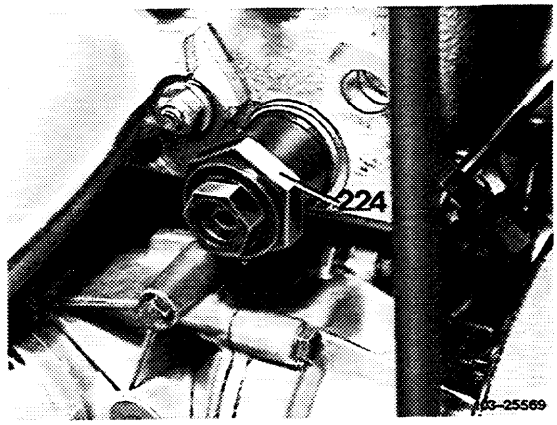
Attention!
Do not rotate engine on fastening screw of camshaft timing gear.

Do not rotate engine in reverse.

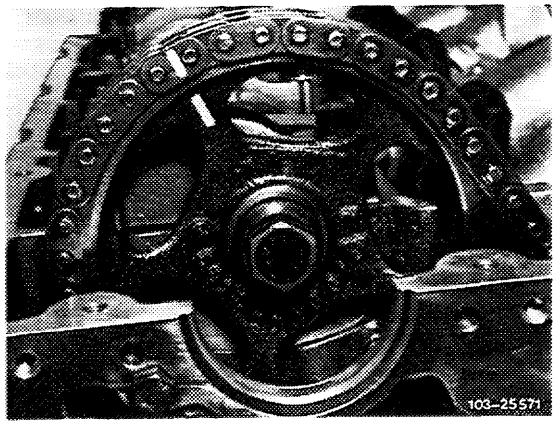


TDC mark on pulley

3 Remove chain tensioner (244) (05-340).

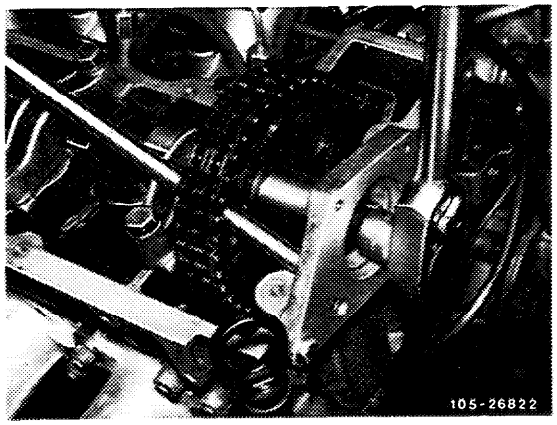


4 Mark camshaft timing gear and timing chain in relation to each other.



5 Remove camshaft timing gear.

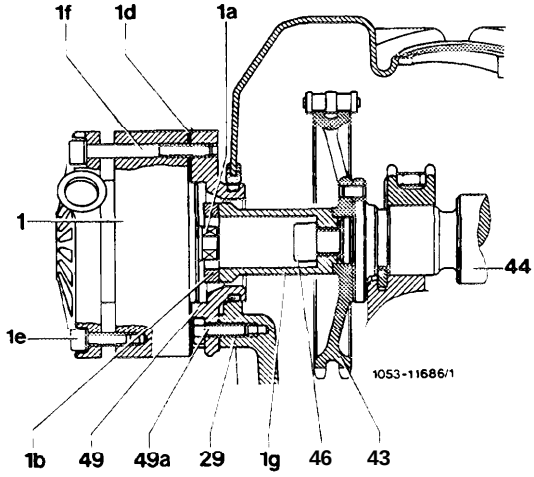
To loosen screws, apply counterhold on camshaft with a mandrel.



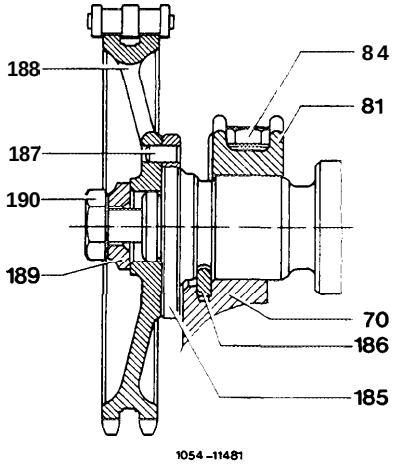
6 On vehicles with level control, the camshaft timing gear and the driver sleeve are fastened with a hex. socket screw. Remove driver sleeve. For this purpose, unscrew pressure oil pump and put aside with lines connected.

7 Uniformly loosen all camshaft bearing screws and remove camshaft bearing caps.

Note: To prevent tilting of camshaft under influence of spring-loaded valve tappets, loosen camshaft bearing screws and unscrew uniformly.



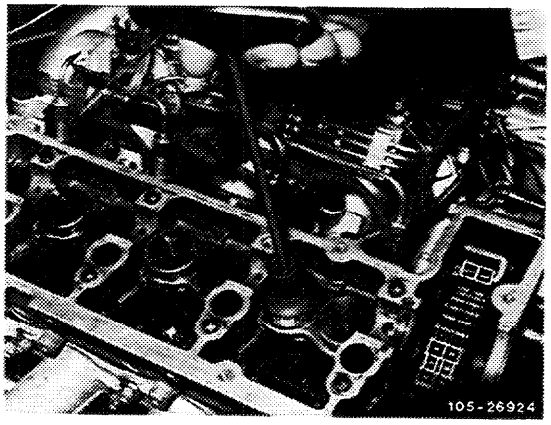
8 Remove camshaft in upward direction.



1054-11481

70 Cylinder head
81 Camshaft bearing bracket
185 Camshaft
186 Circlip for axial locating
187 Cyl. pin
188 Camshaft timing gear
189 Washer
190 Screw M 10 x 50

9 Remove circlip for axial locating (186) camshaft longitudinal alignment and check for condition.


105-26924

10 Pull out valve tappet by means of vacuum lifter 601 589 05 33 00.

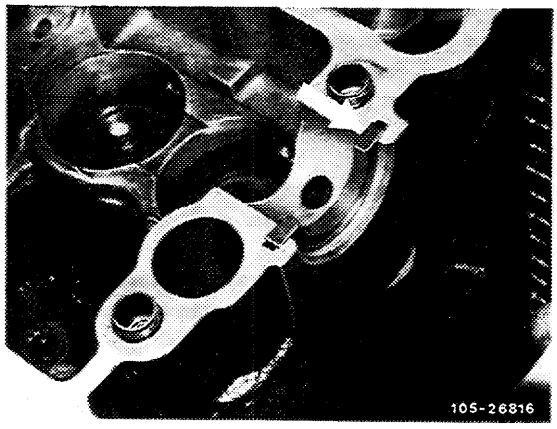
11 Check valve tappet for condition (visual checkup) and renew, if required.

Note: Install valve tappets at the same spot where they were installed before.

Installation

Note: If a new camshaft has been installed or if the cylinder head has been machined, check camshaft for easy operation.

12 Insert circlip for axial locating (arrow) in cylinder head.

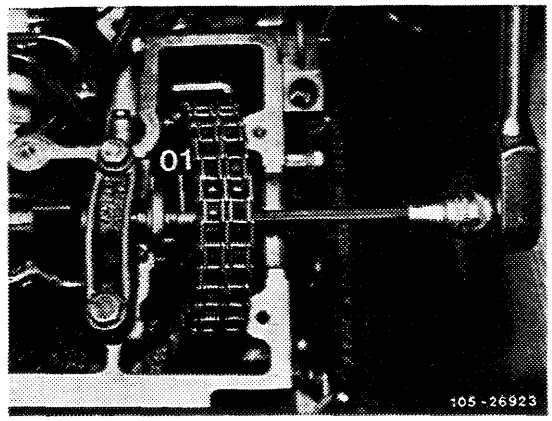

105-26816

13 Lubricate camshaft and place into cylinder head (without valve tappets).

14 Position camshaft bearing cap and tighten uniformly to 25 Nm. Pay attention to identification of bearing caps.

15 When checking for easy operation, the camshaft can be rotated by means of a hex. socket screw M 10 x 30, which is screwed in through camshaft timing gear instead of fastening screw.

If the camshaft can be rotated with an effort only, proceed as follows:



01 Hex. socket screw M 10 x 30

Loosen camshaft bearing caps individually. Then turn camshaft as required.

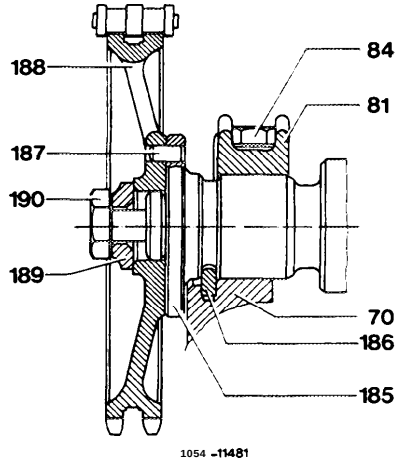
Repeat until tight bearing point has been found.

Remove camshaft and measure respective bearing point. Nominal 0.050-0.81 mm.

Check camshaft for runout.

16 Lubricate valve tappets and insert. Pay attention to sequence.

17 Lubricate camshaft and place into cylinder head, pay attention to circlip (186).

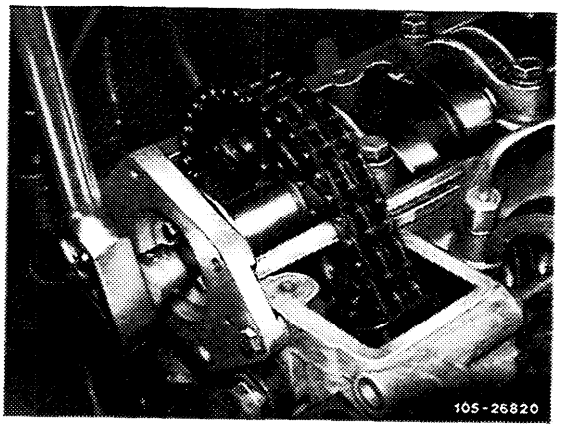


18 Install camshaft bearing caps.

Note: Be sure to tighten camshaft bearing caps uniformly, so that the camshaft is not loaded on one side only under influence of valve tappet counter-pressure.

19 Mount camshaft timing gear. Pay attention to color marks.

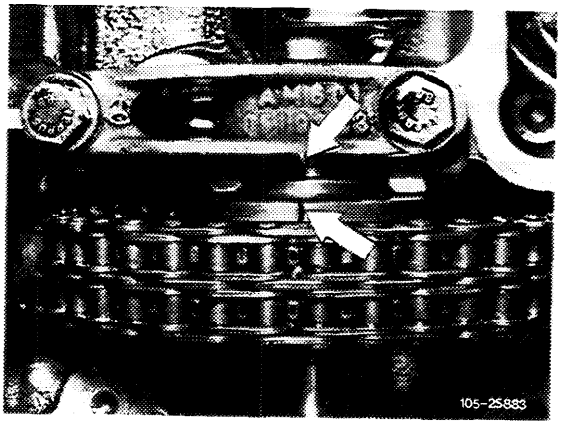
Tighten fastening screw for camshaft timing gear to 45 Nm. For this purpose, apply counterhold to camshaft timing gear by means of a screwdriver or *steel* pin.



20 Install chain tensioner.

21 On vehicles with level control, mount pressure oil pump and driver.

22 Set engine to ignition TDC of 1 st cylinder and check marks (arrows).



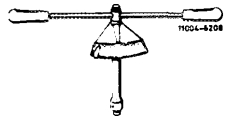
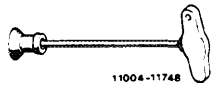
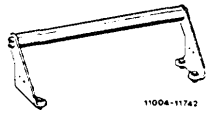
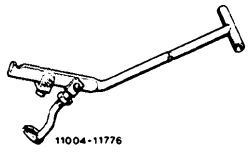
23 Mount cylinder head cover.

24 Run engine, check for leaks.

05-250 Removal and installation of valve springs

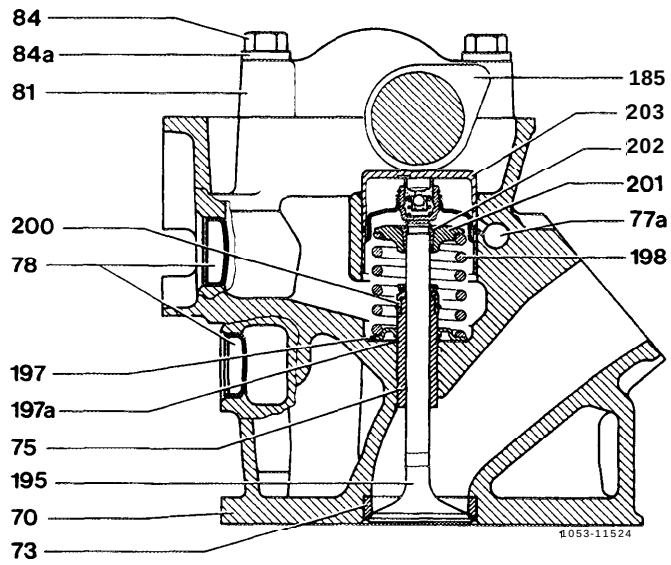
Tightening torques	Nm
Bolts for cylinder head cover	10
Screw for camshaft timing gear	45
Screws for camshaft bearing caps	25

Special tools

Torque wrench, double arm, 3/8" square, 8-32 Nm		001 589 51 21 00
Torque wrench with plug-in ratchet, 1/2" square, 25-130 Nm		001 589 66 21 00
Vacuum lifter for valve tappets		601589053300
Supporting bridge for valve spring depressor		601 589 02 59 00
Valve spring depressor for valve springs		601 5890261 00
Assembly board for clamping cylinder head		601 589 01 59 00
Magnetic lifter for valve cone halves		1165890663 00

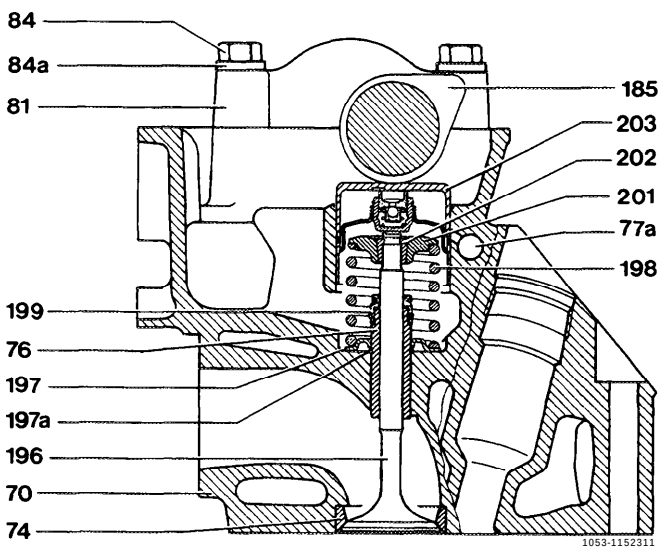
Valve arrangement intake side

70	Cylinder head
73	Valve seat ring intake
75	Valve guide intake
77a	Oil duct
78	Core hole cap
81	Camshaft bearing bracket
84	Hex. screw M 8 x 45
84a	Washer
185	Camshaft
195	intake valve
197	Thrust ring
197a	Locking ring
198	Valve spring
200	Valve stem seal intake
201	Valve spring retainer
202	Valve key
203	Valve tappet



Valve arrangement exhaust side

70	Cylinder head
74	Valve seat ring exhaust
76	Valve guide exhaust
77a	Oil duct
81	Camshaft bearing bracket
84	Hex. screw M 8 x 45
84a	Washer
185	Camshaft
196	Exhaust valve
197	Thrust ring
197a	Locking ring
198	Valve spring
199	Valve stem seal exhaust
201	Valve spring retainer
202	Valve key
203	Valve tappet



Note

Each valve has a single progressively acting valve spring (198).

For this reason, install spring only with color marks below.

Color marks:
yellow/green or purple/green

A thrust ring (197) inserted under valve springs is supported at cylinder head via torsion lock naps.

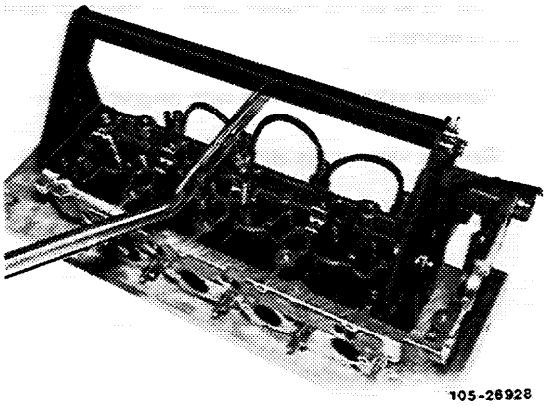
Similar to all engines, the counterbearing of the valve springs in upward direction are in the shape of valve spring retainers (201), which are fastened to the valves by means of valve cone halves (202).

With cylinder head removed, the valves can be removed as follows:

Clamp cylinder head with 4 cylinder head screws on assembly board 601 589 01 59 00.

Fasten supporting bridge 601 589 02 59 00 to cylinder head and remove valve springs by means of valve spring compressor and magnetic lifter.

Note: Install valve tappets again at the same spot from which they were removed before.



Removal

1 Remove camshaft (05–220).

2 Remove chain tensioner (05–310).

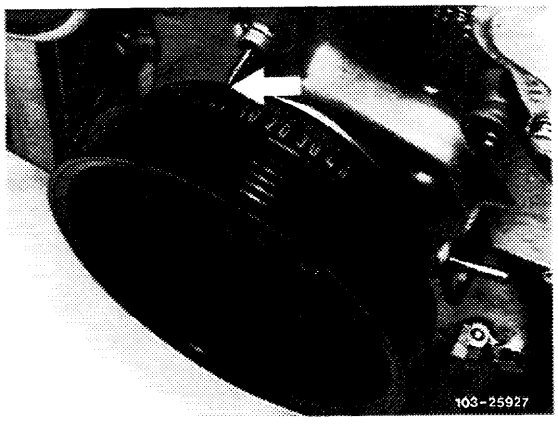
3 Remove fan and fan cover.

4 Lift out valve tappets with vacuum lifter.

5 Set piston of respective cylinder to ignition TDC.

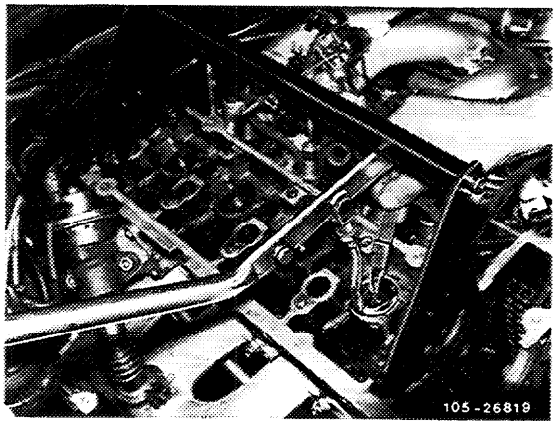
Note: For rotating engine, lift timing chain so that chain cannot be pulled in downward direction.

The pistons are in TDC position when the following marks are under TDC indicator (arrow).



Mark	Piston at TDC
TDC	1 and 4
180° (notch)	2 and 3

6 Fasten supporting bridge for valve spring depressor on cylinder head.



7 Push valve spring retainer down by means of valve spring depressor.

8 Remove valve cone halves with magnetic lifter.

9 **Remove vale springs and valve spring retainers.**

10 Check valve spring (05–260).

Installation

11 Install valve spring with color dots in downward position.

12 Lubricate valve tappets and install, pay attention to sequence.

13 Install camshaft (05–220).

14 Install chain tensioner (05–310).

15 Mount cylinder head cover.

16 Install fan and fan cover.

05--260 Checking valve springs

Valve spring data

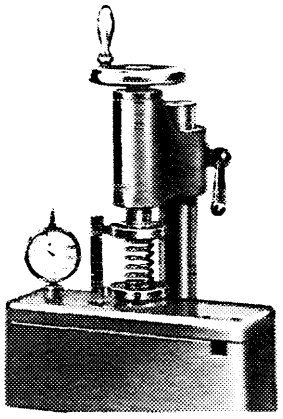
Part No.	Color code	OD mm	Wire dia. mm	Length unloaded mm	Spring force with preloaded length	when new N	limit value N
601 053 01 20	yellow/green or purple/green	33.2	4.25	50.8	27	720-770	648

Checking

1 Check valve springs with a valve spring tester or a spring test scale.

2 Check spring force at specified length.

3 If less than limit value, renew valve springs.

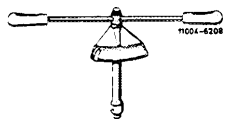
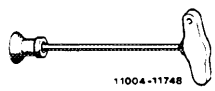
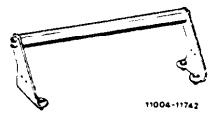
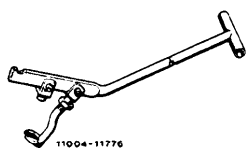
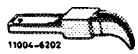
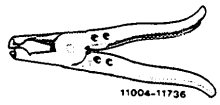


R 05/6385

05-270 Replacing valve stem seals

Tightening torques	NM
Bolts for cylinder head cover	10
Screw for camshaft timing gear	45
Screws for camshaft bearing caps	25

Special tools

Torque wrench, double arm, 3/8'' square, 8-32 Nm		001 589 51 21 00
Torque wrench with plug-in ratchet 1/2'' square, 25-l 30 Nm		001 589 66 21 00
Vacuum lifter for valve tappets		601 589 05 33 00
Support bridge for valve spring depressor		601 589 02 59 00
Valve spring depressor for valve springs		601 589 02 61 00
Magnetic lifter for valve cone halves		116589066300
Assembly mandrel for valve stem seal intake and exhaust		601 589024390
Valve sealing pliers		000 589 53 37 00

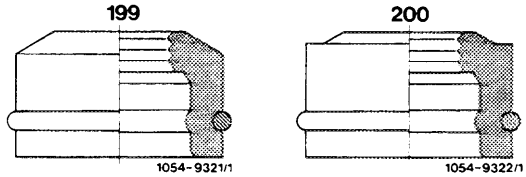
Note

The valve stem seals are supplied as a repair kit.

Different valve stem seals are installed during series production, refer to drawings.

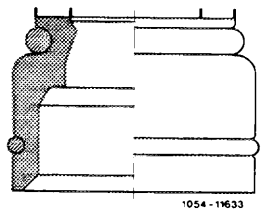
All versions are made of the same elastomere material.

I D's are different according to valve stems.



199 Valve stem seal exhaust
200 Valve stem seal intake

Another version is externally the same for intake or exhaust valves. They differ at ID and on wire rings, which are phosphated (black) on the versions named above and high-polish galvanized (yellow) at exhaust valve.



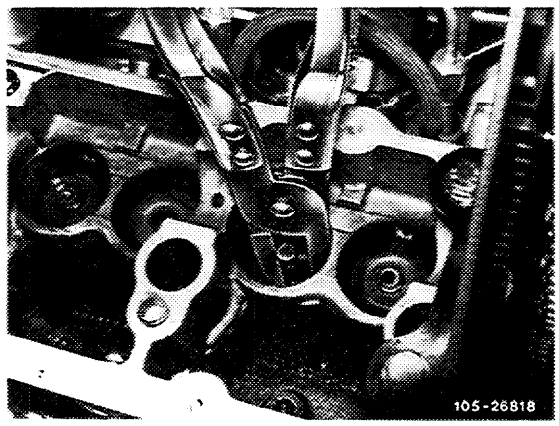
Valve stem seal

Renewing

1 **Remove valve springs (05–250).**

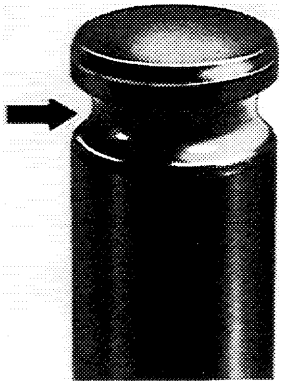
2 Pull off valve stem seals with pliers 000 589 53 37 00.

Attention!
Do not damage valve stem and valve guide.



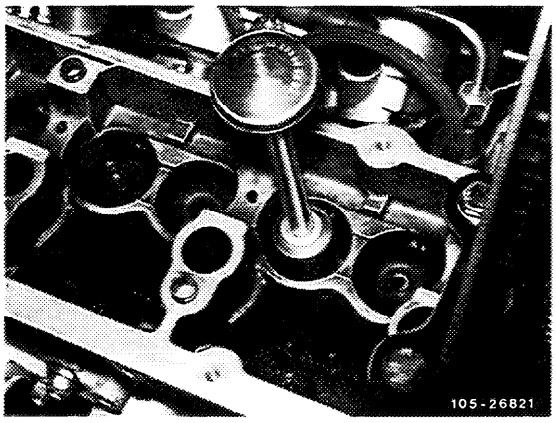
3 Deburr valve stem on groove (arrow).

4 Renew dented valve cone halves, spring retainers and thrust rings.



5 Lubricate valve stem seal and press on with assembly mandrel 601 589 02 43 00.

For this purpose, be sure to place an assembly sleeve (included in repair kit) on valve stem.



6 Install valve springs (05–250).

05–280 Checking and machining valves

Data

Engine	Valve disk dia.	Height "h" of valve disk when new limit value		Adjusting angle „α" for machining valve	Valve stem dia. D1	Valve seat plating	Sodium charge	Valve length L
Intake valve								
601	37.90 38.10	0.5-0.7		45" + 15'	7.970 7.955	with	without	106 106.3
Exhaust valve								
601	34.90 35.10	0,5–0.6		45° + 15'	8.960 8.945	with	without	106.5 106.3

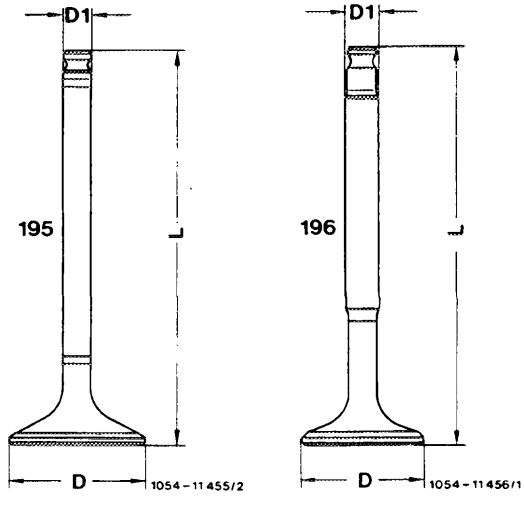
Width of valve seat	Intake 2.5	Exhaust 3.5
Permissible runout on valve stem and valve seat max.	0.03	

Conventional tools

Valve cone grinding machine or valve cone machining tool	e. g. Krupp, D-5309 Meckenheim Model VS e. g. Hunger, D-6000 München 70 Type VKDR 1, order No. 203.00.200

Identification on stem end

Engine	Intake valve	Exhaust valve
601	E 601 02	A 601 02

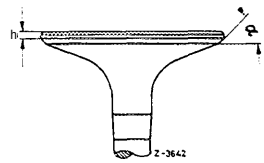


195 Intake valve
196 Exhaust valve

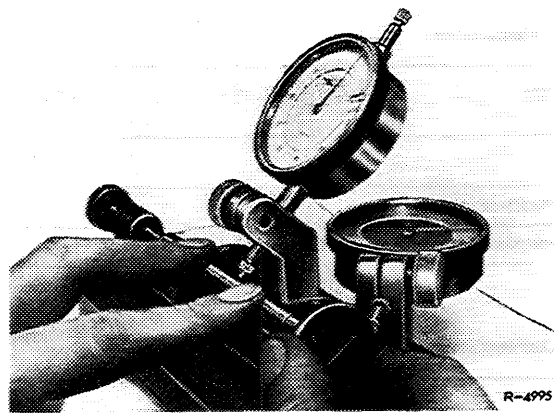
Checking and machining

1 Clean valves and check visually.

Renew valves with burnt valve disk, with insufficient height "h" of valve disk and with worn or scored valve stem.



2 Measure runout on valve stem. If runout exceeds 0.03 mm, renew valve.

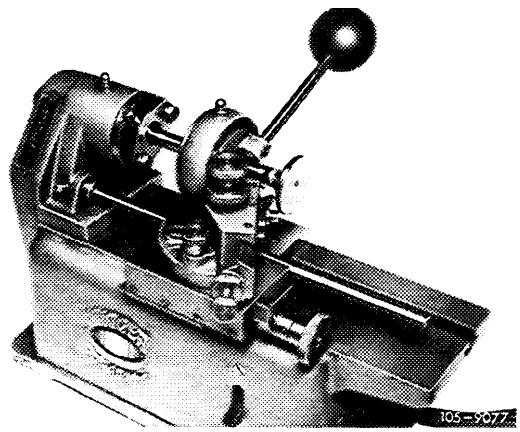


3 Machine valve seat.

Pay attention to operating instructions of machining unit and adjusting angle 45° + 15'.

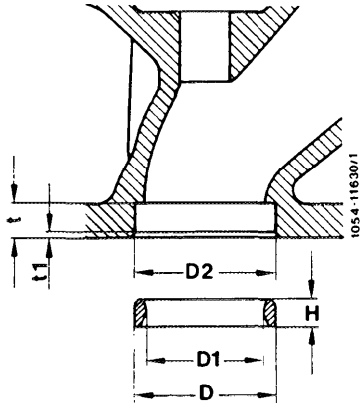
4 Measure runout on valve seat and height "h" of valve disk.

Renew valve, if limit values are not attained.



Data

		Intake	Exhaust
Overlap of valve seat rings in cylinder head		0.068-O. 100	
D 2	Normal dimension	40 .000 40.016	37 .000 37.016
	Repair stage max. up to		
D	Normal dimension	40.100 40.084	37.100 37.084
	Roughing dimension Repair stage		
D 1		33.400 33.600	30.400 30.600
H	Normal dimension and repair stages	6.97 7.00	6.97 7.00
t		9.35 9.25	
t l		2.37 2.25	2.44 2.25



Special tools

Check plug 8 mm dia. for intake valve guide		102 589 00 23 00
Check plug 9 mm dia. for exhaust valve guide		117589032300

Conventional tools

Cylinder head clamping device	e. g. Hunger, D-8000 Miinchen 70 Order No. 221.60.000
Ring seat turning tool, size 2	e. g. Hunger, D-8000 Miinchen 70 Order No. 220.03.110
Valve seat machining tool, type VDSNL 1/45/30	e. g. Hunger, D-8000 Miinchen 70 Order No. 236.03.308
Test set for valves	e. g. Hunger, D-8000 Miinchen 70 Order No. 2 16.93.300
Internal measuring instrument (measuring range 25-60 mm)	e. g. Mahr, D-7300 Esslingen Order No. 844
External micrometer (measuring range 25-50 mm)	e. g. Mahr, D-7300 Esslingen Order No. 40 S

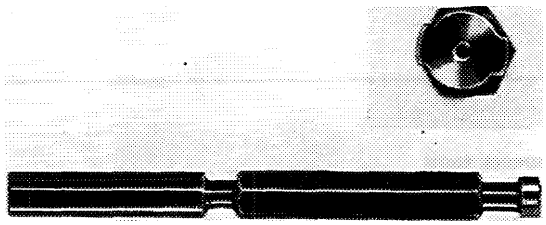
Note

For all valve seat ring versions each spare part is a repair valve seat ring with a larger OD.

Renewing

1 Unscrew old valve seat ring with ring seat turning tool.

Pay attention to operating instructions of turning tool.



105-22768

2 Check valve guides and renew, if required (05–285).

3 Measure basic bore D 1.

A new normal dimension valve seat ring can be used if the specified overlap is available.

If the minimum overlap is not attained, machine basic bore for valve seat ring.

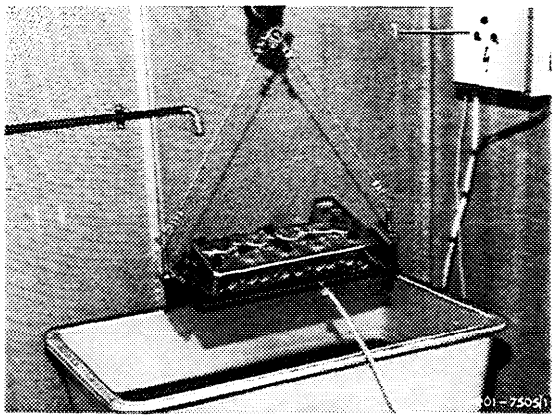
4 Machine basic bore D 1 with ring seat turning tool until the bore is just clean.

5 Measure machined basic bore.

6 Machine repair stage valve seat ring in such a manner that the specified overlap is obtained.

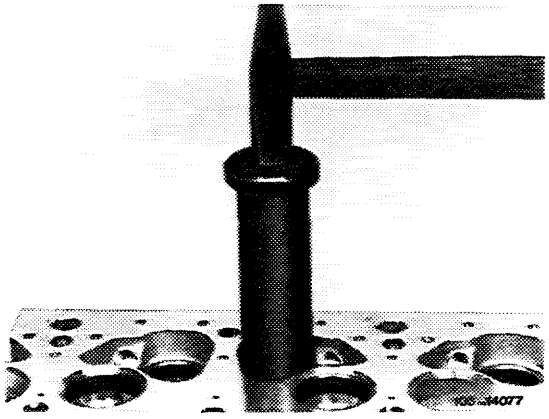
7 Heat cylinder head in water bath to approx. 80 °C.

8 Undercool valve seat ring with liquid nitrogen.



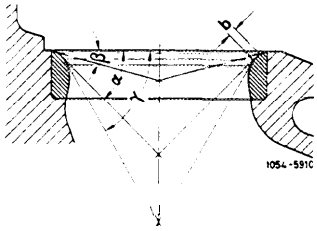
9 Knock in valve seat ring with a suitable guide mandrel.

10 Machine valve seats (05–291).



Data

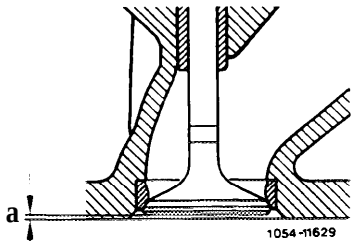
	Intake	Exhaust
Valve seat width b		
Valve seat angle α	45°	
Correction angle at top β	15°	
Correction angle bottom γ	60"	
Permissible out-of-true of valve seat	0.05	



Valve distance to cylinder head parting surface

Minimum distance a with new valves and new valve seats	Intake/Exhaust	-0.1 to -0.5
Max. distance a with refinished valve seats and reground valves	Intake	
	Exhaust	

The max. distance is reduced by the same dimension by which the cylinder head parting surface has been refinished.



Valve disk dia.	Intake	37.90 38.10
	Exhaust	34.90 35.10

Special tools

Check plug 8 mm dia. for intake valve guide		102589002300
Check plug 9 mm dia. for exhaust valve guide		117589032300

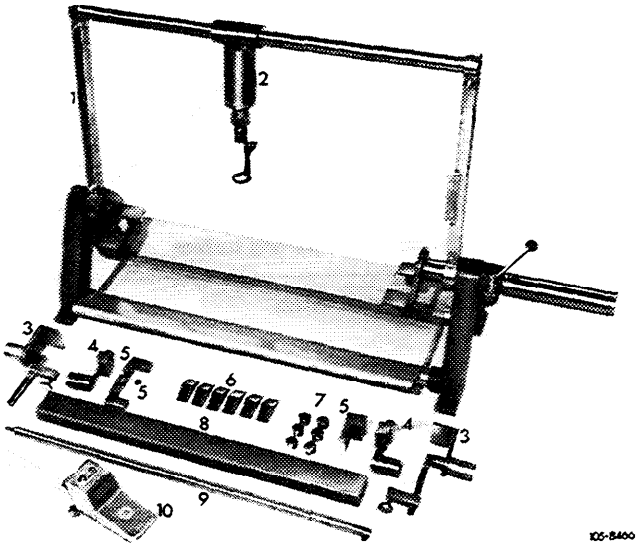
Conventional tools

Cylinder head clamping device	e.g. Hunger, D-8000 Miinchen 70 Order No. 221.60.000
Valve seat machining tool, type VDSNL 1/45/30	e. g. Hunger, D-8000 Miinchen 70 Order No. 236.03.308
Test set for valve seats	e. g. Hunger, D-8000 Miinchen 70 Order No. 216.93.300
60" correction bit No. 13 for correction angle, bottom	e. g. Hunger, D-8000 Miinchen 70 Order No. 216.64.622

Note

Clamp cylinder head into clamping device for disassembly and machining.

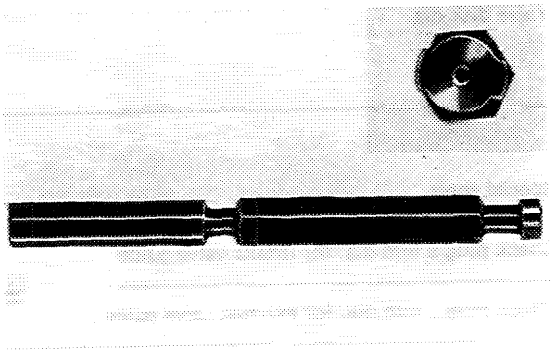
Machine valve seats with valve seat machining tool, with valve seat grinding machine or with valve seat milling cutter.



105-8400

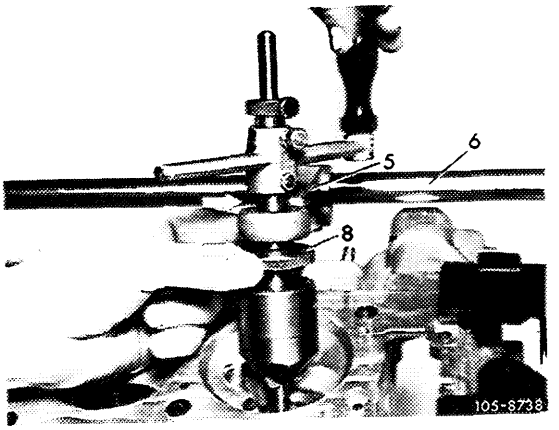
Machining valve seats

1 Check valve guides and renew, if required.


105-22768

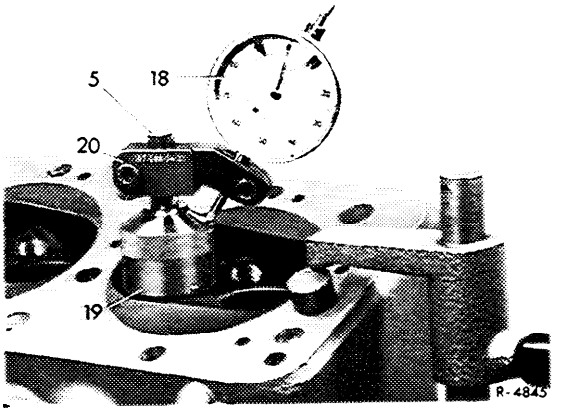
2 Machine valve seat (45° 15') (refer to operating instructions of tool manufacturer).

Attention!
Loosen pilot only after runout of valve seat has been checked (item 3).



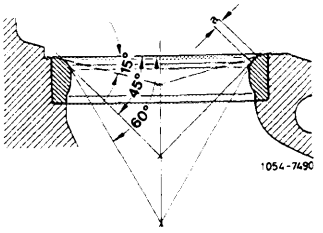
3 Check runout of valve seat.

For this purpose, slip fitted sleeve (19) with dial gauge holder (20) and dial gauge on pilot (5).



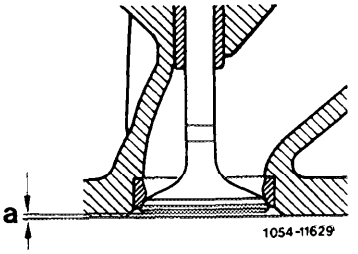
5 Pilot
18 Dial gauge
19 Fitted sleeve
20 Dial gauge holder

4 Measure valve seat width (b) and, if required, correct at top (β) with 15" and below (γ) with 60°.



5 Insert valves and measure distance a.

If required, renew valve seat ring (05–290).



05–310 Removal and installation of chain tensioner

Tightening torques	Nm
Chain tensioner in cylinder head	80
Closing plug for chain tensioner	60

Note

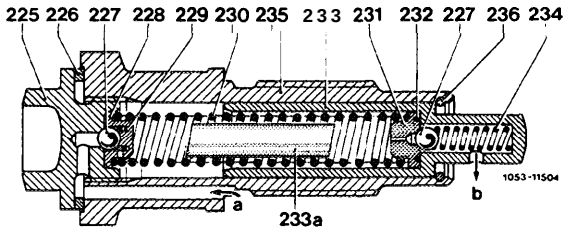
Install chain tensioner in filled condition on principle.

Suitably, completely renew chain tensioner complained about.

The hydraulic chain tensioner is supplied with pressure oil through an oil duct in cylinder head.

Check valve (227 and 228) and pressure limiting valve (227 and 231), together with compression spring (230), will keep the contact pressure of thrust pin (233) on tensioning rail approximately constant, independent of engine oil pressure.

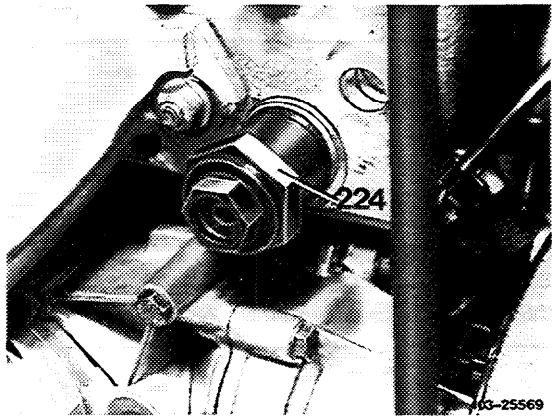
The filling pin (233a) contributes to faster venting when filling in oil.



225	Closing plug	233	Thrust pin
226	Aluminum seal A 25 x 30	233a	Filling member
227	Ball dia. 5 mm	234	Compression spring
228	Ball guide	235	Housing
229	Compression spring	236	Circlip B 16
230	Compression spring	a	Feed bore from cylinder head
231	Valve disk	b	To oil pan
232	O-ring		

Removal

1 Unscrew chain tensioner (224).



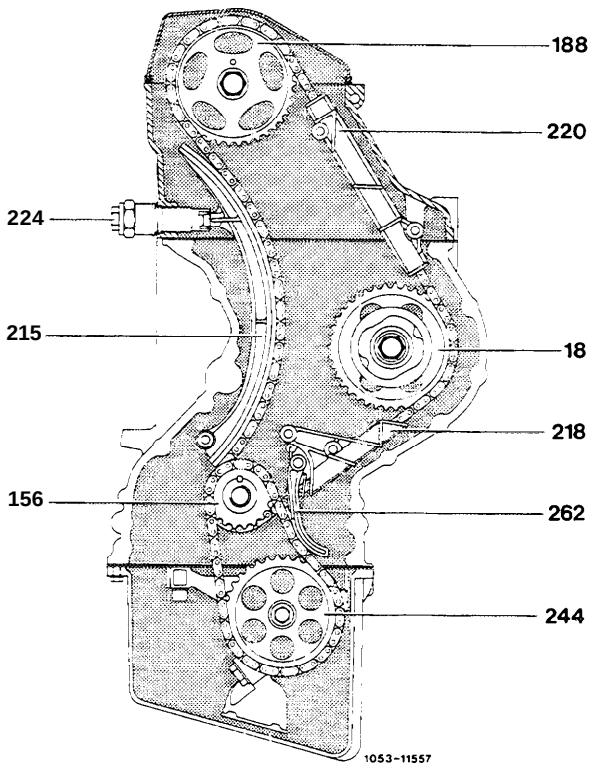
Installation

2 Fill chain tensioner. For this purpose, set chain tensioner with thrust pin in downward direction into engine oil SAE 10, with the oil extending over flange on hexagon. Press thrust bolt 7-10 times slowly down against stop with the assistance of a press or a column-type drill press.

Upon filling, compression of chain tensioner should be possible very slowly and uniformly only, and under considerable force.

3 Install chain tensioner with new sealing ring.

Thrust pin of chain tensioner should rest against lug of tensioning rail.

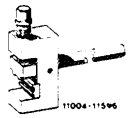
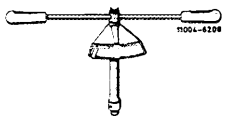


215 Tensioning rail
224 Chain tensioner

05-320 Replacing timing chain

Tightening torques	Nm
Bolts for cylinder head cover	10
Coupling nuts for injection lines (reference value)	1 O-20
Injection nozzles in prechambers	70 + 10

Special tools

Pressing-on tool		000 589 57 43 00
Torque wrench, double arm, 3/8'' square, 8-32 Nm		001 589 51 21 00
Box-end wrench element, open, 14 mm, 1/4'' drive for coupling nut on injection line		000 589 77 03 00

Note

A timing chain with connecting link is available for repairs.

If only an endless timing chain is available, the chain can be opened prior to installation (refer to item 3).

During an engine overhaul, an endless timing chain must be installed on principle.

Check sprockets for score marks and pitting.

Replacement part (repair timing chain with connecting link)

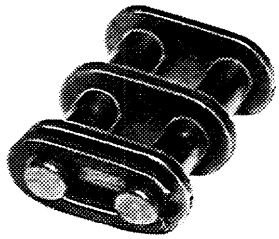
Designation	Part No.
Bushing chain with connecting link	001 997 16 94
Connecting link	000997 11 98

Repair timing chain

The connecting link is held in place by a locking spring.

The outer flanges are dyed blue.

The outer flange of connecting link is pressed on by means of pressing-on tool 000 589 57 43 00.



Connecting link with locking spring

105 - 25310

Renewing

1 Remove injection nozzles (07.1-230).

2 Remove cylinder head cover.

3 Remove chain tensioner.

4 Remove fan and fan cover.

5 Cover chain box with a cleaning rag and cut through both chain bolts on one link of timing chain by means of a grinding wheel.

6 Connect new timing chain with connecting link to old timing chain, while pushing out opened link (Fig. item 6).

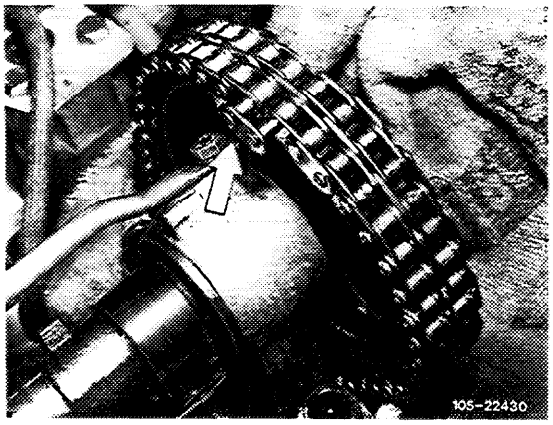
7 Slowly rotate crankshaft in rotating direction of engine, while simultaneously pulling up the old timing chain until the connecting link comes to rest against uppermost point of camshaft timing gear.

Attention!
Timing chain should remain in mesh while rotating camshaft and crankshaft timing gear.

8 Take off old timing chain and connect ends of new timing chain with a connecting link.

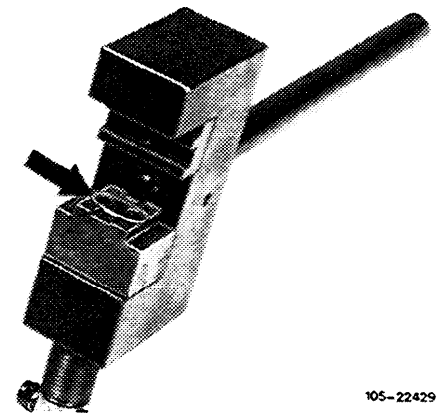
For this purpose, secure chain ends with wire on camshaft timing gear.

9 Insert connecting link from the rear into timing chain (arrow).

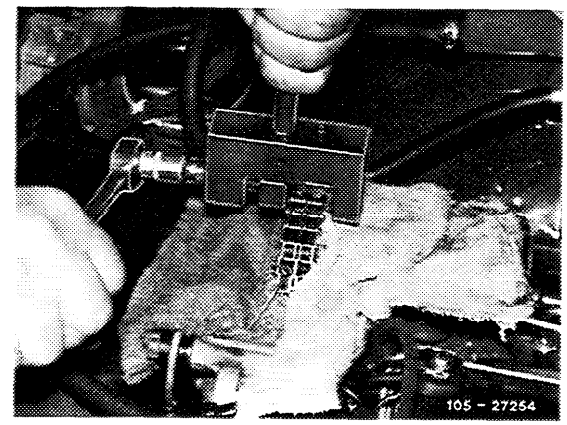


Shown on engine 615

10 Put separately enclosed outer flange of connecting link (with punched in IWIS identification) into pressing-on tool (arrow). The outer flange is held magnetically.

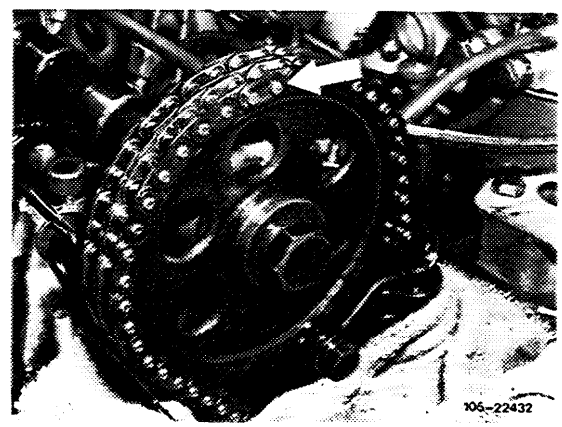


11 Place pressing-on tool on connecting link and press on flange up to stop, while holding pressing-on tool on vertical lever.



12 Force locking spring in opposite direction of engine rotation into grooves of chain pins (arrow).

13 Install chain tensioner.

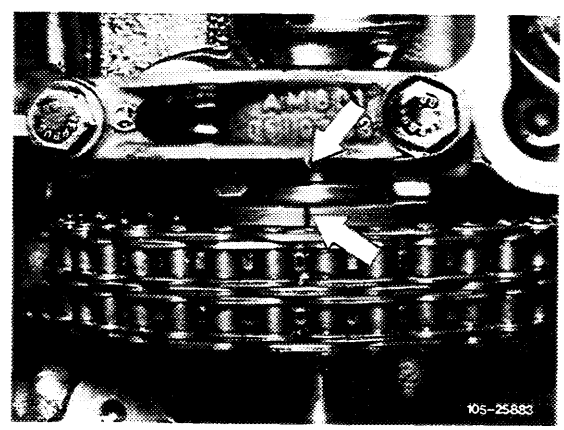


14 Rotate crankshaft and check adjusting mark in TDC position of engine.

Note: If the adjusting mark is not in order, check timing of crankshaft (05–215) and timing of injection pump (07.1-I 11).

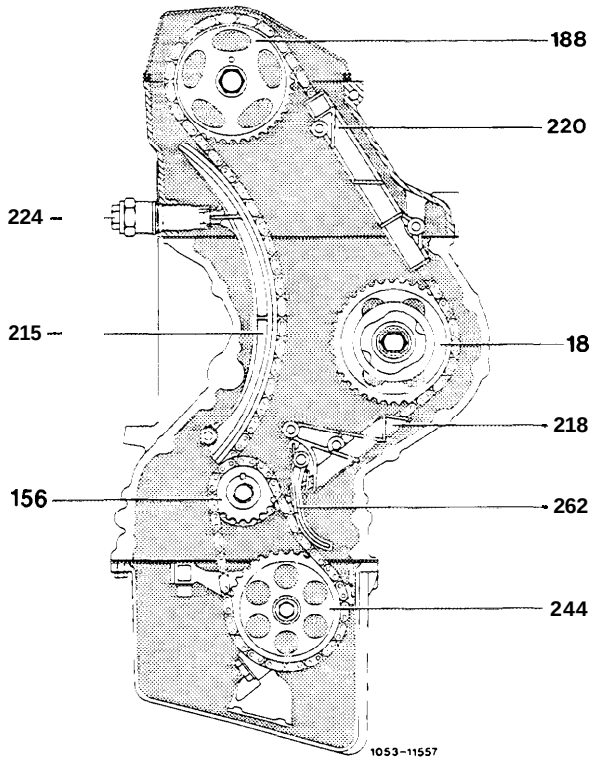
15 Install *cylinder* head cover.

16 Install fan and fan cover.



Note

The plastic coating of tensioning rail is not exchangeable.



18 Injection timer
156 Sprocket
188 Camshaft timing gear
215 Tensioning rail
218 Slide rail
220 Slide rail
224 Chain tensioner
244 Oil pump sprocket
262 Tensioning clamp

Removal

1 Remove cylinder head (01–415).

2 Remove timing housing cover (01–210).

3 Remove tensioning rail from bearing bolts.

Installation

4 Place tensioning rail on bearing bolt.

5 Install timing housing cover (01–210).

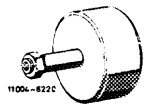
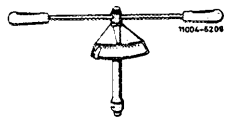
6 Install cylinder head (01-415).

7 Run engine and check for leaks.

05–341 Removal and installation of slide rails

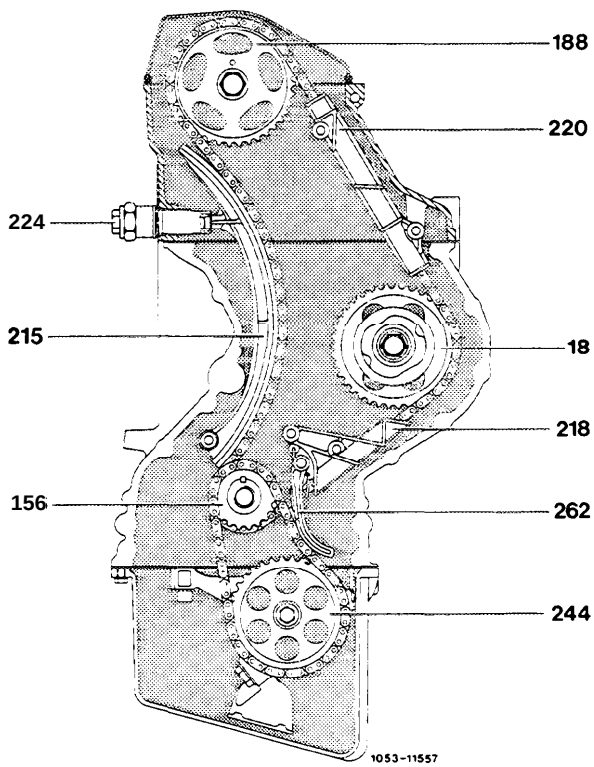
Tightening torques	Nm
Cylinder head cover	10
Screw for camshaft timing gear	45

Special tools

Impact puller for bearing bolt (basic unit)		116589203300
Threaded bolt M 6, 50 mm long for impact puller		116589013400
Torque wrench, double arm, 3/8'' square, 8-32 Nm		001 589 51 21 00
Torque wrench with plug-in ratchet, 1/2'' square, 25-130 Nm		001 589 66 21 00

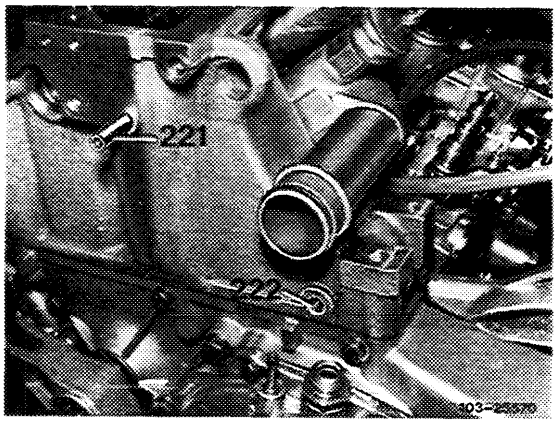
Note

Remove timing housing cover for removal and installation of slide rail (218).



18 Injection timer
156 Sprocket
166 Camshaft timing gear
215 Tensioning rail
218 Slide rail
220 Slide rail
224 Chain tensioner
244 Oil pump sprocket
262 Tensioning clamp

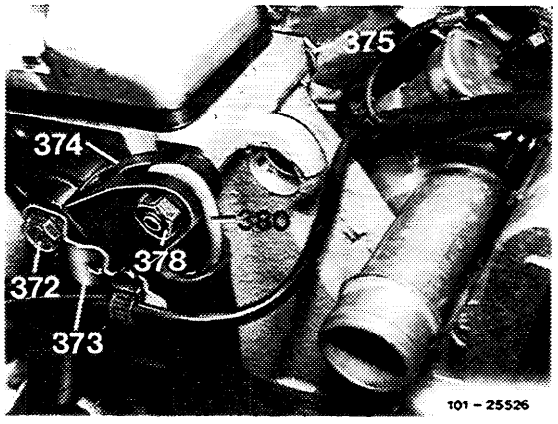
The longer bearing bolt (221), in cylinder head at top, serves for supporting slide rail as well as for spring tensioning lever of V-belt tensioning device.



A. Removal and installation of slide rail (220) in cylinder head

Removal

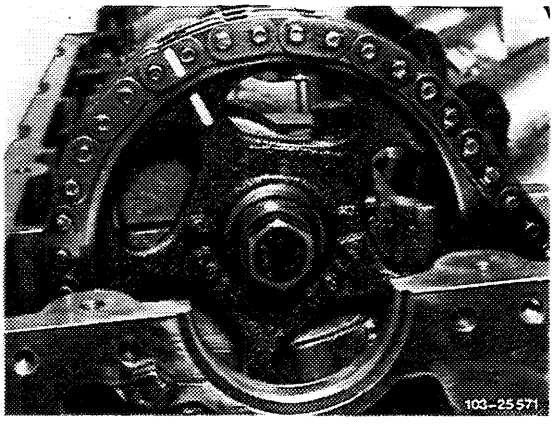
1 Slacken V-belt and remove. For this purpose, unscrew collar nut (378). Insert a mandrel into spring tensioning lever (374) and relieve hex. screw (375) against force of draw spring (380) until screw can be pushed back in direction of intake manifold. Release spring tensioning lever.



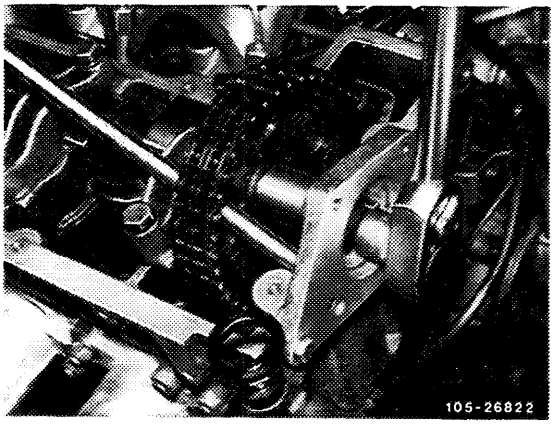
2 Unscrew screw (372) and remove holder (373) as well as spring tensioning lever (374).

3 Remove cylinder head cover.

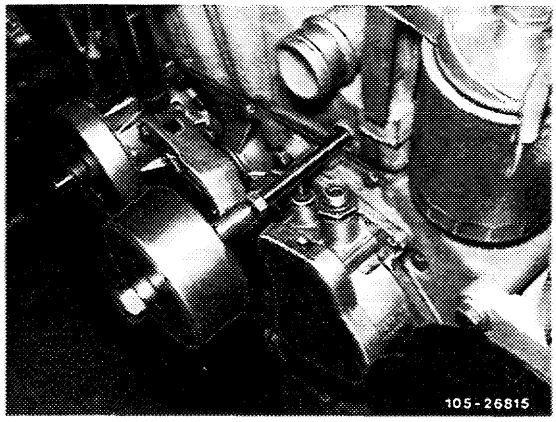
4 Mark timing chain and camshaft timing gear in relation to each other.



5 Unscrew camshaft timing gear and remove. For loosening hex. screw, apply counterhold to camshaft with a screwdriver or mandrel.



6 Knock out both bearing bolts with impact puller and remove guide rail.



Installation

7 Coat bearing bolt on collar with sealing compound.

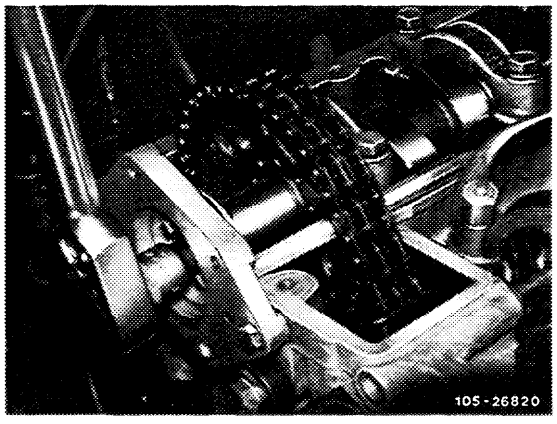
8 Insert slide rail and knock in bearing bolt with impact puller.

Apply counterhold to slide rail with screwdriver.

9 Mount camshaft timing gear. Pay attention to color marks.

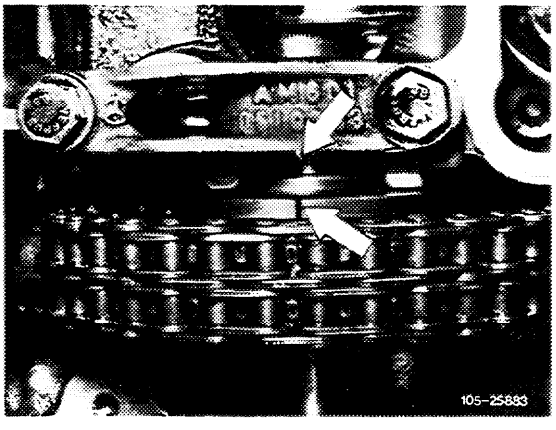
For assembly of camshaft timing gear, push back thrust bolt of chain tensioner.

Tighten fastening screw for camshaft timing gear to 45 Nm. For this purpose, apply counterhold to camshaft with a screwdriver or a mandrel.



10 Set engine to ignition TDC of 1st cylinder and check mark (arrows).

11 Mount cylinder head cover.

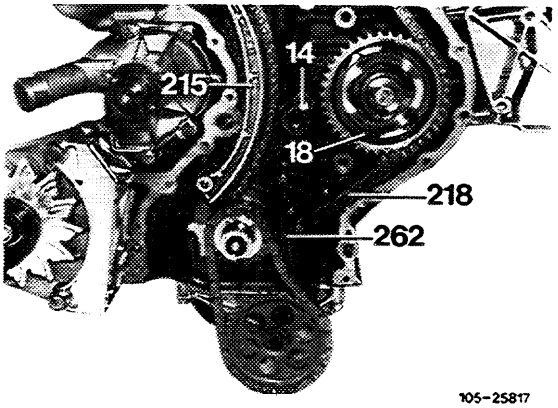


B. **Removal and installation of guide rail (218)**

1 Remove timing housing cover (01—210).

2 Pull out slide rail (218).

3 For installation proceed vice versa.

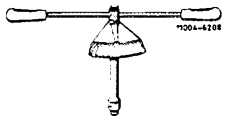


14 OH nozzle
18 Injection timer
215 Tensioning rail
218 Slide rail
262 Tensioning clamp

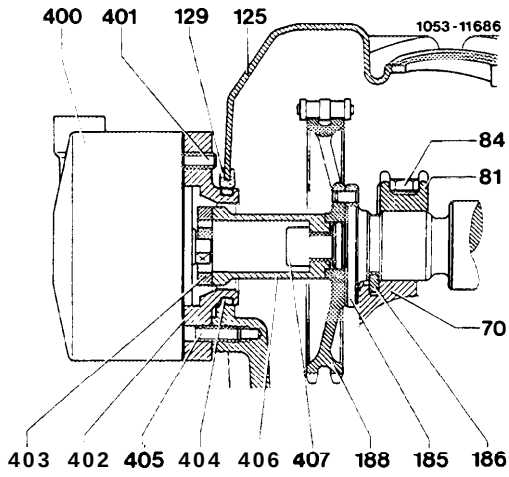
05-437 Removal and installation of drive for hydraulic oil pump

Tightening torques	Nm
Cylinder head cover	10
Hex. socket screw for camshaft timing gear	45
Hydraulic oil pump (level control) on fastening flange	15

Special tools

Torque wrench, double arm, 3/8" square, 8-32 Nm		001 589 51 21 00
Torque wrench with plug-in ratchet, 1/2" square, 25-l 30 Nm		001 589 66 21 00

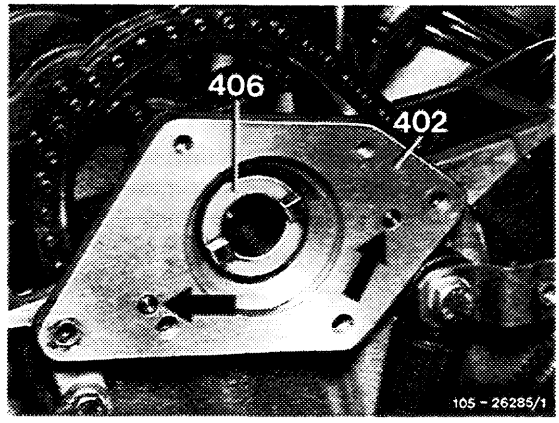
Note



70 Cylinder head
81 Camshaft bearing cap
84 Combination screw M 8 x 45
125 Cylinder head cover
129 Cylinder head cover gasket
185 Camshaft
186 Lockwasher
188 Camshaft timing gear
400 Hydraulic oil pump
401 Cyl. pin
402 Flange
403 Driven plate
404 O-ring
405 Hex. socket screw
406 Drive sleeve
407 Hex. socket screw

The hydraulic oil pump (400) is directly driven by camshaft (185) via drive sleeve (406) and is fastened to cylinder head by means of a flange (402).

The installation position of flange on cylinder head is fixed by means of two cyl. pins (arrows).



The camshaft timing gear (188) is fastened to camshaft together with drive sleeve (406) by means of a hex. socket screw (405).

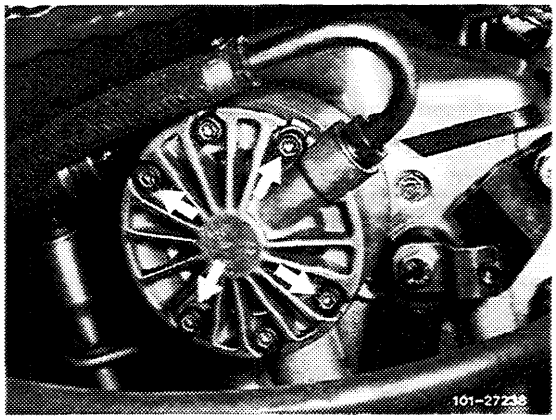
The O-ring on flange (402) seals the half bore at front on cylinder head and in cylinder head cover.

Removal

Remove cylinder head cover.

2 Unscrew hex. socket screws (arrows) and put hydraulic oil pump aside with lines connected.

Remove driven plate.



3 Unscrew hex. socket screw (405) for camshaft timing gear and drive sleeve and remove.

For loosening hex. socket screw, apply counterhold to camshaft with holding wrench.

Installation

4 For installation proceed vice versa to removal.

Tighten hex. socket screw for camshaft timing gear and drive sleeve to 45 Nm. For this purpose, apply counterhold with a screwdriver or a mandrel.