Mercedes-Benz

Service

Service Manual
Engine 617.95
Turbo Diesel

Mercedes-Benz of North America, Inc.

S-6510-1927

Caution

Our service manuals contain descriptions of important assembly, adjustment and inspection jobs. Special tools required in performing certain service jobs are identified in the manual and recommended for use. Any part numbers given are only used for identification and easier differentiation between individual components, and are not intended for ordering purposes.

All procedures, illustrations and specifications contained in these manuals were based on the latest information available at the time of publication. If your Mercedes-Benz model differs from the specifications contained in the manual you select, consult your authorized Mercedes-Benz dealer.

Remember, the proper performance of service is essential for both the safety of the mechanic and the efficient operation of the vehicle. The procedures in these manuals are described in such a manner that the service may be performed safely and accurately.

However, it is always assumed that the reader is familiar with basic automotive repair procedures and Mercedes-Benz vehicles.

© Mercedes-Benz of North America, Inc., 1992

All rights reserved. Reproduction or translation in whole or part is not permitted without written authorization from the publisher.

Published by Mercedes-Benz of North America Inc.
Printed in USA

S-6510-1927 885 3.0 re

Introduction

This Service Manual is the product of existing technical publications. Special care has been taken to provide accurate information on removal, disassembly, assembly, inspection, installation, and adjusting procedures, backed with the technical data necessary to do the job.

The material in this manual is divided according to the Mercedes-Benz Component Group System as outlined on the GROUP INDEX page. This page will quickly direct the reader to the Major Component Group. Each Major Component Group begins with a JOB INDEX listing all jobs within that group.

Mercedes-Benz of North America, Inc. recommends that repairs to, and maintenance of, Mercedes-Benz automobiles be performed only by Mercedes-Benz **trained personnel** at authorized Mercedes-Benz dealerships.

The information contained in this special publication is ordinarily issued by Mercedes-Benz of North America, Inc., in conjunction with supplementary service literature and special tools supplied only to its authorized dealers. The repair and maintenance procedures outlined herein are procedures to be used by **trained Mercedes-Benz service and dealership personnel.** Supplementary service literature will not be provided with this publication, but may be contained in reprints of this Service Manual.

Please note that this manual has been compiled from various sources, some of which cover models other than the subject of this book. Always refer to the model and system identification information.

The information contained in this manual was accurate to the best of our knowledge at the time the manual was approved for publication. However, the right is reserved to make produktion, design and specification changes at any time, without notice and without obligation to give notice. Any such changes will not be contained in this manual.

Mercedes-Benz of North America, Inc. assumes no liability for any damage to person or property caused by the utilization of this publication to effect maintenance or repair work on Mercedes-Benz automobiles.

MERCEDES-BENZ OF NORTH AMERICA, INC.
Technical Publications

Group index

General, technical data	00
Crankcase and cylinder head	01
Crankshaft assembly	03
Engine timing, valves	05
Injection system	07.1
Air cleaner, exhaust gas turbocharger	09
Belt drives	13
Intake manifold, exhaust manifold, emission control system	14
Electrical system, engine	15
Engine lubrication	18
Engine cooling	20
Engine suspension	22
Throttle control	30
Fuel system	47
Exhaust system	49

Complete Service Manual coverage for late model year Mercedes -Benz vehicles requires four individual manuals:

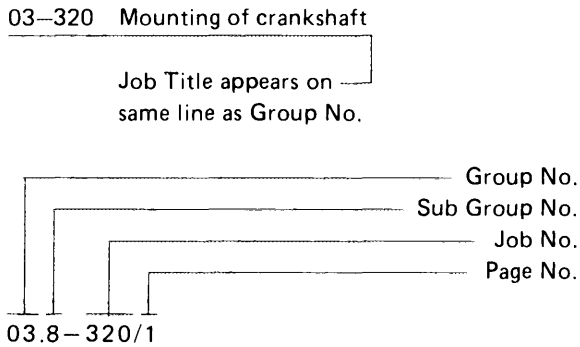
Service Manual, Engine
Service Manual, Transmission
Service Manual, Chassis and body
Service Manual, Heating and air conditioning

Throughout these manuals, the vehicles are identified by their chassis and engine numbers. These numbers are made up of the first six digits of the respective serial number. For the actual location of chassis and engine numbers, see page 00–015/1. In cases where the repair instructions apply to all versions, only the first three digits of the respective number are referenced.

For example, engine 617 applies to all 617 engines. However, engine 617.951 would only apply to the engine used in model 300 SD (1981–85).

Location of specific repair instructions

First locate the Group No. in the Group Index. Individual groups are separated by an easily visible dividing page, which is followed by the job index page. Then check the job index for the exact job required. The first page of a typical job description looks like this:



Technical data, tightening torques and tools are listed at the beginning of each job.

All dimensions are in metric units, unless otherwise indicated. Any part numbers given are only used for identification and easier differentiation between individual components, and are not intended for ordering purposes.

This manual applies to the following passenger cars, from model years 1978–85:

Model	USA Model year From	To	Chassis Type	Engine Type
300 SD	1978	1980	116.120	617.950
300 SD	1981	1985	126.120	617.951
300 TD	1981	1985	123.193	617.952
300 D	1982	1985	123.133	617.952
300 CD	1982	1985	123.153	617.952

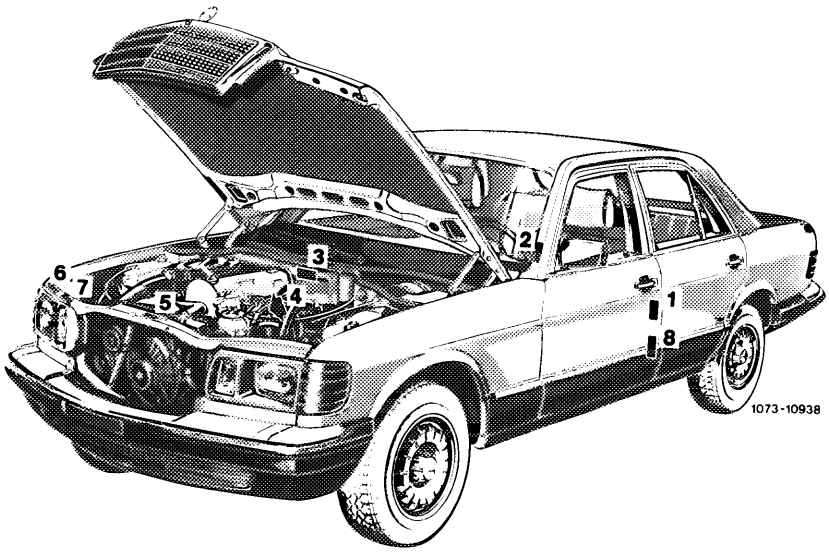
Identification of vehicle

When ordering spare parts, please quote chassis and engine numbers.

With your MERCEDES-BENZ you receive two vehicle data cards listing all major vehicle data.

Example:

Identification plates 300 SD



1 Certification tag
(left door pillar)
2 Identification tag
(left window post)
3 Chassis no.
4 Engine no.
5 Body no. and paintwork no.
6 Emission control tag
7 Information tag
California version
Vacuum line routing for emission control system
8 Emission control tag
Catalyst information

Model years 1978–84

Engine

Model	300 SD		300 TD	300 D	300 CD
Chassis type	116.120	126.120	123.193	123.133	123.153
Engine	617.950	617.951	617.952		
Operation	4-cycle diesel, MB prechamber design with turbocharger				
Number of cylinders	5				
Arrangement of cylinders	In-line, vertical				
Bore/stroke mm	90.9/92.4				
Total eff. piston displacement cc	2998				
Compression ratio	21.5 : 1				
Firing order	1–2–4–5–3				
Max. engine rpm (no load)	4900–5200				
Engine output kW/rpm SAE net bhp/rpm	85/4200 110/4200*		89/4350 170/2400		
Max. torque Nm/rpm SAE net lbf-ft./rpm	235/2400 168/2400*		250/2400 170/2400		
Crankshaft bearings	6				
Valve arrangement	Overhead				
Camshaft arrangement	I overhead camshaft				
Oil cooler	Air-to-oil cooler				
Cooling	Water circulating pump, thermostat with by-pass line, fan with viscofan clutch, finned tube radiator				
Lubrication	Pressure lubrication via gear-type pump				
Oil filter	Combination full-flow by-pass filter				
Air cleaner	Dry air cleaner with paper cartridge				

Electrical system

Battery	Voltage Capacity	12 V 88 Ah
Starter	Bosch	JF 12 V 2.3 kW
Alternator	Bosch	K1 14 V 55 A 20

* Model year 1980 120 bhp at 4350 rpm 170 lbf-ft at 2400 rpm

Model year 1985

Engine

Model		300 D, 300 CD, 300 TD	300 SD
Chassis type		123.133, 123.153, 123.193	126.120
Engine		617.952	617.951
Operation		4-cycle diesel, MB prechamber design with turbocharger and boost pressure control	
Number of cylinders		5	
Cylinder arrangement		In-line, vertical	
Bore/stroke	mm	90.9/92.4	
Total effective piston displacement	cc	2998	
Compression ratio		21.5 : 1	
Firing order		1–2–4–5–3	
Maximum speed, no load	rpm	5100 ± 100	
Engine output (SAE)	kW/rpm	Federal 92/4350 California 88/4350	
	net bhp/rpm	Federal 123/4350 California 118/4350	
Maximum torque (SAE)	Nm/rpm	Federal 250/2400 California 240/2400	
	net lbf-ft/rpm	Federal 184/2400 California 177/2400	
Crankshaft bearings		6 (multi-component friction bearings)	
Valve arrangement		Overhead	
Camshaft arrangement		1 overhead camshaft	
Oil cooler		Air-to-oil cooler	
Cooling		Water circulating pump, thermostat with bypass line, finned tube radiator, fan with viscofan clutch	
Lubrication		Pressure lubrication via gear-type pump	
Oil filter		Combined main and bypass filter	
Air cleaner		Dry air cleaner with paper cartridge	

Electrical system

Battery	Voltage Capacity	12 V 92 Ah
Starter	Bosch	JF 12 V 2.3 kW
Alternator	Bosch	910 W (14 V 65 A)

Filling capacities – all turbodiesels

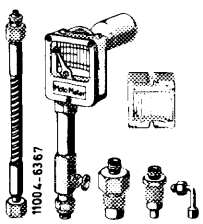
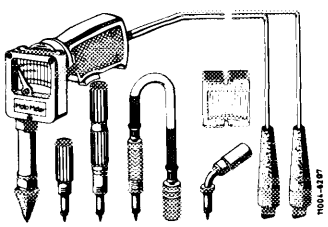
				116.120	123.133/153	123.193	126.120
Model							
Engine							
Fuel tank/reserve			approx. l	82/14	80/10.5	10/11	77/12.5
Engine	Initial filling	Engine oil	approx. l	8.5	8.5	8.5	8.5
Engine	During oil and filter change	Engine oil	approx. l	7.5	7.5	7.5	7.5
Engine	Oil pan up to marks on oil dipstick	Engine oil	max./min. l	6/4.5	6/4.5	6/4.5	6/4.5
Engine	Air-oil cooler	Engine oil	approx. l	0.7	0.7	0.7	0.7
Coolin system with heater		Coolant	approx. l	12.4	12.5	12.5	12.5
Coolant pump				maintenance-free			
Brake system		Brake fluid	approx. l	0.5	0.5	0.5	0.5
Automatic transmission		ATF Initial filling/ Oil change	approx. l	6.6/5.3	7.3/6.2	7.3/6.2	7.3/6.2
Rear axle hypoid gear oil		SAE 90	approx. l	1.0	1.0	1.0	1.3
Power steering		ATF for manual transmission oil	approx. l	1.4	1.4	1.4	1.2

01–010 Checking compression pressure

Test values for engine at operating temperature in bar gauge pressure (atü)	
Normal compression pressure	24–30
Minimum compression pressure	approx. 15
Permissible difference between the individual cylinders	max. 3

Tightening torques	Nm
Cap nuts of injection lines	25
Injection nozzles in prechambers	70–80
Pencil element glow plugs	20–30

Special tools

Compression pressure recorder with accessories		001 589 47 21 00
Screw-in fitting for heating plug bore		617 589 03 21 00
Contact handle for rotating engine (Component of compression pressure recorder 001 589 46 21 00)		001 589 46 21 08

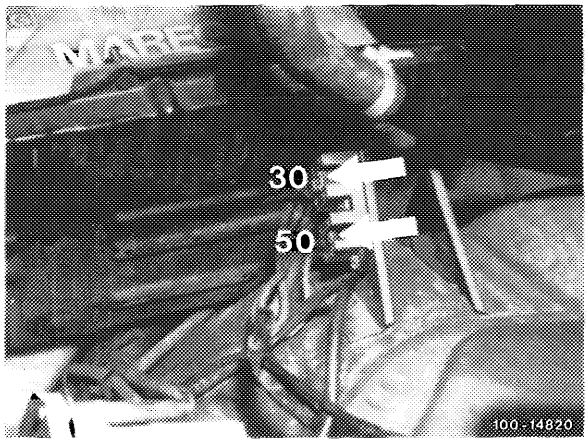
Note

Measure compression pressure at 80 °C coolant temperature. The compression pressure can be tested via heating plug bore or via prechambers. When pressure is below minimum compression pressure, check cylinders for leaks (01–015).

Checking

1 Remove heating plugs or injection nozzles.

2 Connect contact handle under battery to cable connector terminal 30 and 50.



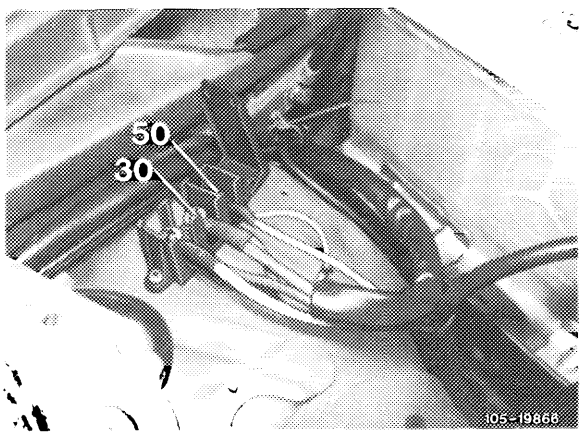
Model 116.120

The cable connector is attached at the following points:

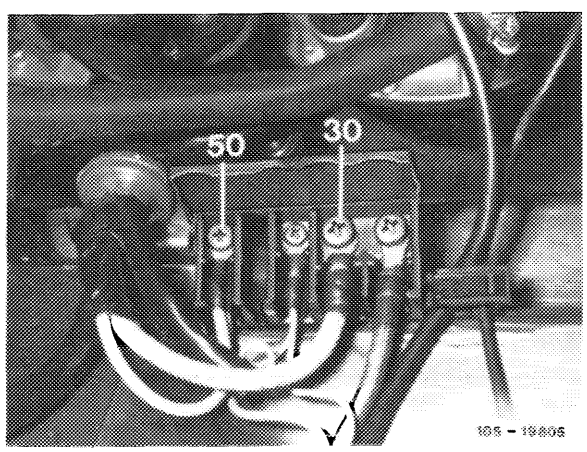
Model 116.120: Under battery.

Model 123 : On wheelhouse, right.

Model 126.120: On frame side member



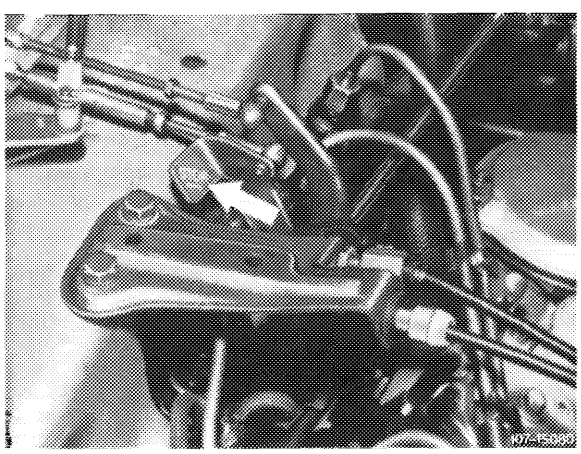
Model 123



Model 126.120

3 Rotate engine several times at transmission idle position, so that residue and soot are thrown out.

Attention!
For the above purpose, push shutoff lever (stop) in direction of engine so that the injection pump is not injecting.



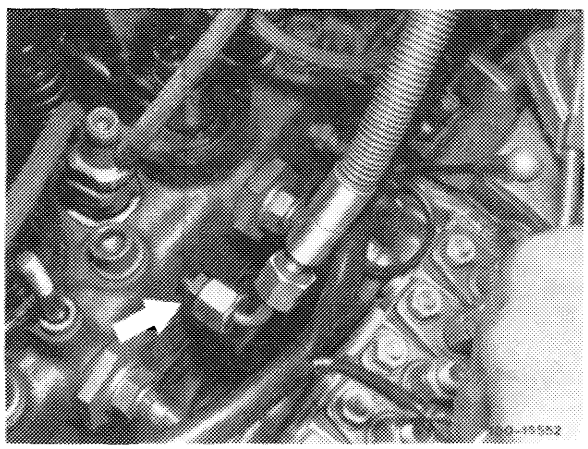
4 Enter screw fitting into glow plug bore or adaptor (component of compression pressure recorder) into prechamber.

Connect compression pressure recorder.

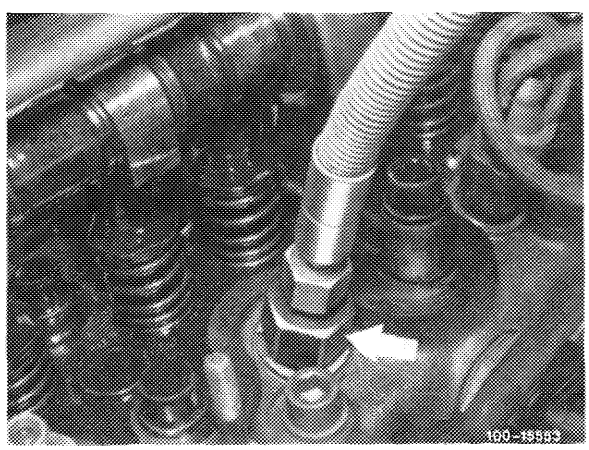


Screw fitting

100-14819



Compression pressure recorder, connected to glow plug bore

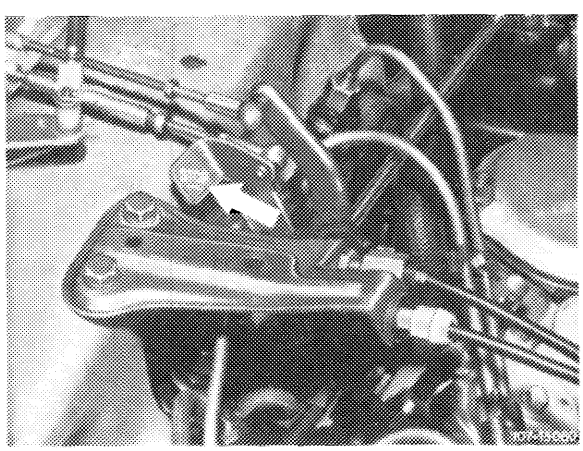


Compression pressure recorder, connected to prechamber

5 Rotate engine 8 revolutions for testing.

Attention!
For the above purpose, push shutoff lever (stop) in direction of engine so that the injection pump is not injecting.

6 Insert new nozzle reeds prior to installation of injection nozzle.

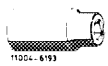


01–015 Checking cylinders for leaks

Data

Total pressure loss	max. 25 %
On valves and cylinder head gasket	max. 10 %
On pistons and piston rings	max. 20 %

Special tool

Socket 27 mm, 1/2" square socket for rotating engine		000 589 65 09 00
Screw fitting for glow plug bore		617 589 03 21 00

Conventional tool

Cylinder leak tester	e.g. made by Bosch, EFAW 210 A made by SUN, CLT 228

Checking

1 Run engine up to operating temperature.

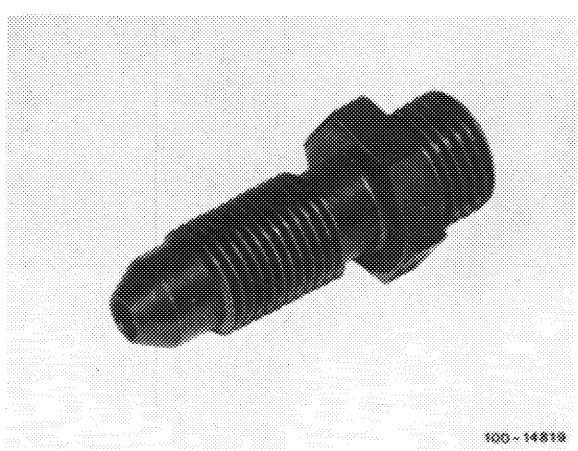
2 Unscrew pencil element glow plugs.

3 Remove air cleaner cap.

4 Remove oil filler plug.

5 Remove radiator cap and top up coolant.

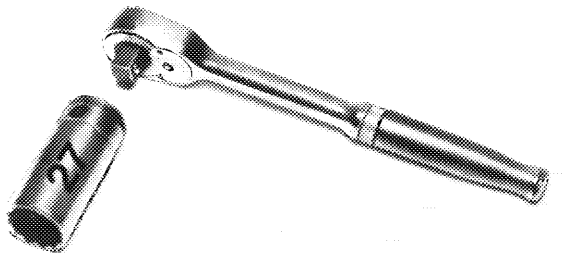
6 Enter screw fitting into glow plug bore of 1st cylinder.



7 Set piston of 1st cylinder to ignition TDC. For this purpose, rotate engine at crankshaft by means of tool combination.

8 Connect cylinder leak tester to a compressed air system. Calibrate tester.

9 Screw connecting hose of tester to screw fitting. Crankshaft should not rotate.

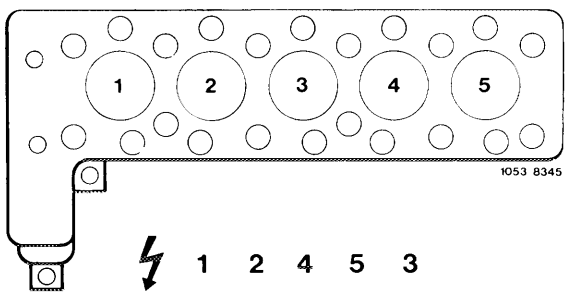


1100-6498/1

10 Read pressure loss on tester.

11 Check by listening whether pressure escapes via intake pipe, exhaust, oil filler cap, glow plug bore of adjacent cylinder or radiator cap.

12 Check all cylinders in ignition sequence.

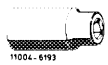
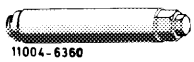


Note: There is the possibility that the piston ring gaps of individual pistons are directly one above the other, so that the test result will be misrepresented.

When in doubt, continue running vehicle and check cylinders for leaks once again later on.

Tightening torques	Nm
Cap nuts for injection lines	25
Nuts for cylinder head cover	15
Threaded ring for prechamber in cylinder head	150–180
Injection nozzle in prechamber	70–80

Special tools

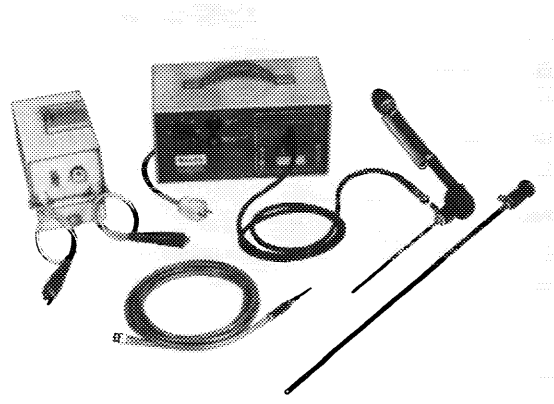
Box wrench socket, open, 17 mm, 1/2" square for injection lines	 11004-6359	000 589 68 03 00
Socket 27 mm, 1/2" square	 11004-6193	001 589 65 09 00
Socket wrench for threaded ring of prechamber	 11004-6360	615 589 00 07 00
Puller for prechambers	 11004-6365	615 589 00 33 00

Conventional tool

Cylinder illuminating lamp	Karl Storz GmbH, 7200 Tuttlingen Motoskop TW (Kaltlicht) with lens probes 103 26 CW (750 mm) and 103 26 CT (210 mm).

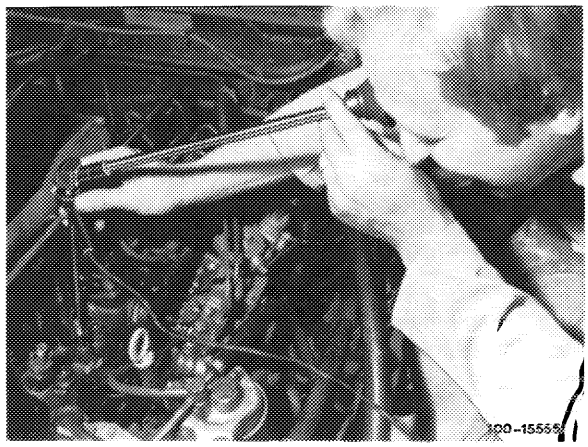
Note

A visual checkup can be made with cylinder head in place by means of a cylinder illuminating lamp. For this purpose, the prechambers must be removed (01–417).



103-15713

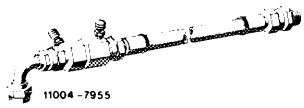
When evaluating scored or streaky cylinder walls, it is often difficult for a workshop to decide whether the damage is already extensive and requires removal or repair of the engine, or whether the evidence is harmless. The following instructions will help in making an expert and correct decision.



With regard to marks on cylinder walls, the first important difference is between "optical streaks" and "seizure streaks". As a rule, "optical streaks" are about 3 mm wide, they are produced by the piston ring gaps and do not destroy honing structure; "seizure streaks", however, obliterate honing structure.

With streaks in direction of "land" (in direction of piston pin) shaft streaks or seizures are not possible, since there is no contact between piston skirt and cylinder liner.

Special tools

Oil dipstick with millimeter scale	 11004-7663	115 589 15 21 00
Valve for interrupting oil return flow from air-oil cooler	 11004-7955	110 589 00 91 00
Telethermometer		116 589 27 21 00

Note

The oil consumption can be measured by means of oil dipstick with millimeter scale and the pertinent diagram on back of data sheet.

Since there are two oil dipsticks and different data sheets, the following instructions should be observed:

On this engine use only oil dipstick, part no. 115 589 15 21 00 (red handle).

Data sheet

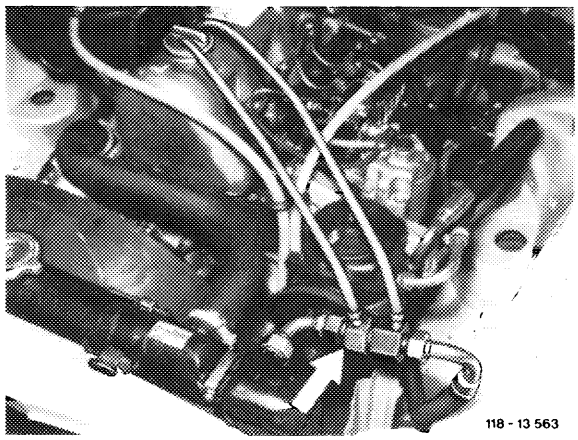
German/English, print no. 800.99.402.00 B
French/Spanish, print no. 800.99.402.01 B

The sequence for measuring consumption is described on front page of data sheet.

To avoid faulty measuring, check engine oil for dilution by fuel prior to measuring consumption.

To prevent any return flow of oil from air-oil cooler while measuring, install check valve between air-oil cooler and upper oil hose.

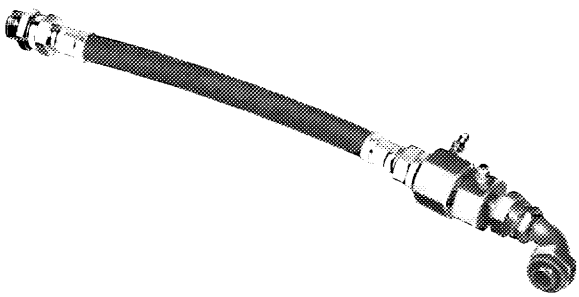
If the check valves cannot be installed due to insufficient space, mount check valves with pipe elbow and connecting line.



118 - 13 563

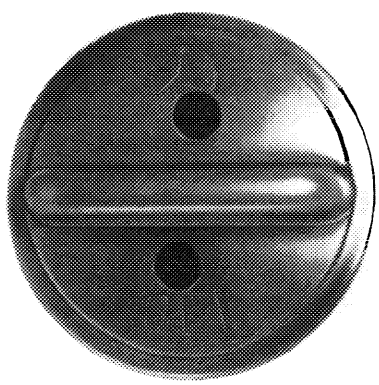
Bleed air-oil cooler prior to measuring consumption.

For this purpose, plug 2 transparent plastic hoses on bleed screws located on check valve. Remove oil filler hole plug on cylinder head cover and insert both hoses into filler hole.



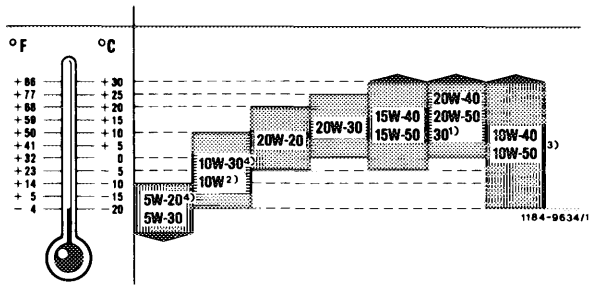
118-9657

Attention!
To prevent oil ejections it is recommended to use an oil filler plug with two bores (OD of hoses).



105-9690

Specified viscosity classes according to SAE during constant outside temperatures



1) During constant outside temperatures above + 30 °C (+ 86 °F) SAE 40 may be used.
2) Do not use.
3) All season oil
4) For oil types which are identified on pages 226.1 and 227.1 of Specifications for Service Products with footnote 1), the following applies:
SAE 5W-20 below + 10 °C
SAE 10W-30 in temperate zones all-year.

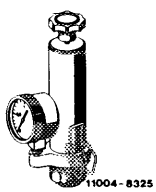
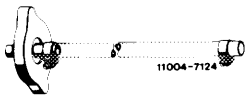
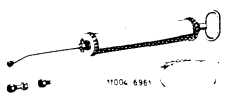
Attention!
Do not use single range oil grades of viscosity class SAE 10 for this engine.

Oil capacity in liters (for approved engine oil grades refer to Specifications for Service Products)

Engine (total capacity during initial filling)	8.5

Tightening torques	Nm
Oil drain plug to oil pan	40
Nuts for oil filter cover	20–25
Bolts for engine carrier on engine mount front	70

Special tools

Tester for cooling system and closing radiator		001 589 48 21 00
Radiator cap with hose for leak test		605 589 00 25 00
Syringe for removing oil		112 589 00 72 00

Conventional tool

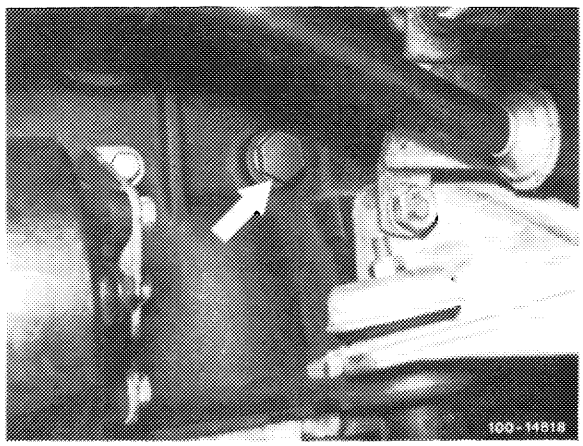
Engine hoist (Motordirigent) size 1.5	e.g. made by Bäcker, D-5630 Remscheid order no. 3178

Note

Remove and install engine with transmission.

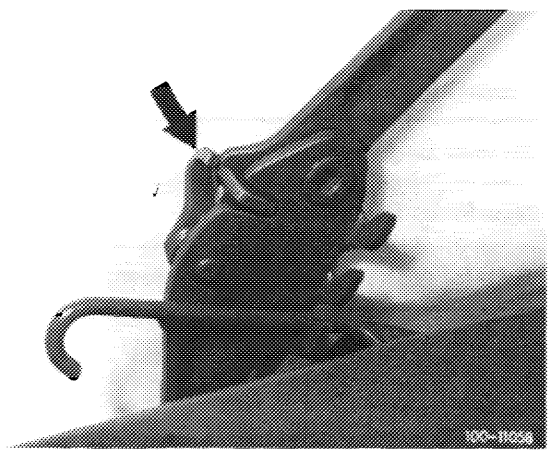
Removal

1 Completely drain coolant.



Drain plug on cylinder crankcase

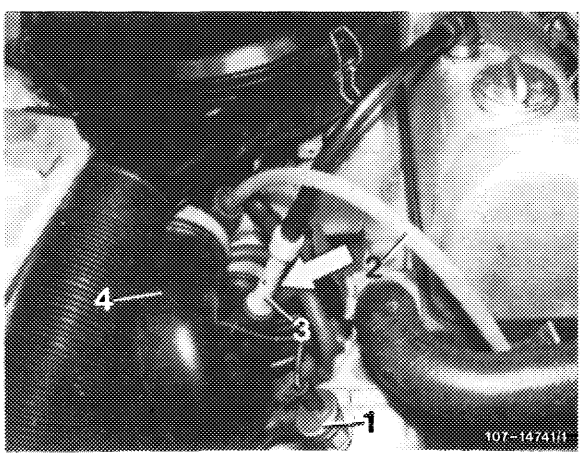
2 On model 116.120, remove engine hood.
On models 123 and 126.120 move engine hood into 90 ° position and engage detent lever (arrow).



3 Remove radiator and fan cover.

4 Remove viscofan coupling with fan.

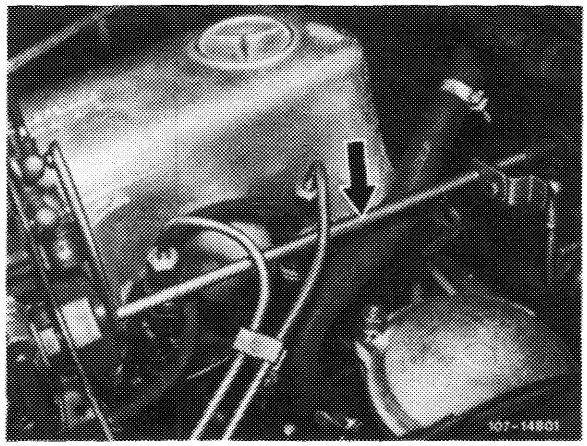
5 Remove air cleaner with intake line (4).
For this purpose, pull off engine vent line (3) and on model 116.120 with double diaphragm vacuum pump, pull off vacuum line (2) and cable on temperature switch (1).



1 Temperature switch 100 °C
2 Vacuum line
3 Vent line
4 Intake line

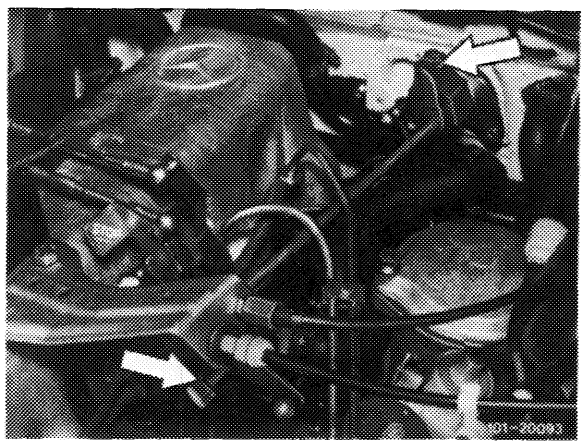
6 Disconnect regulating linkage.

7 Remove longitudinal regulating shaft while pulling out locking eye (arrow).



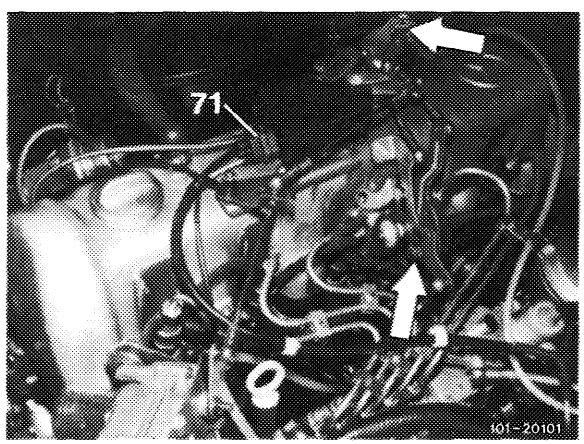
Model 116.120

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



Model 123

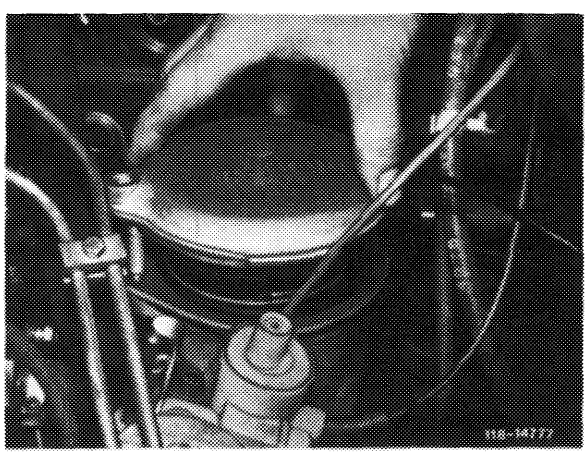
On model 126.120, pull longitudinal regulating shaft out of guide lever in rearward direction and remove in forward direction.



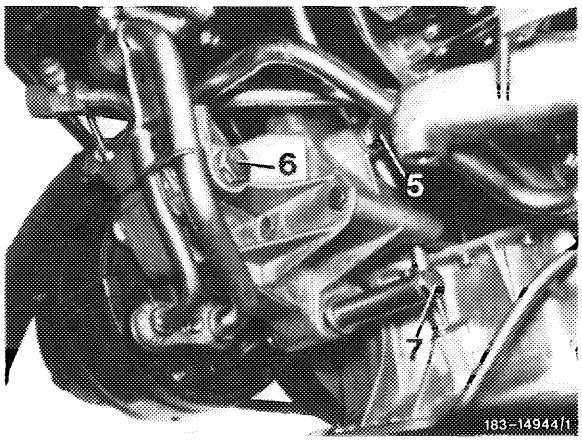
Model 126.120

8 Unscrew oil filter cover and pull up slightly.

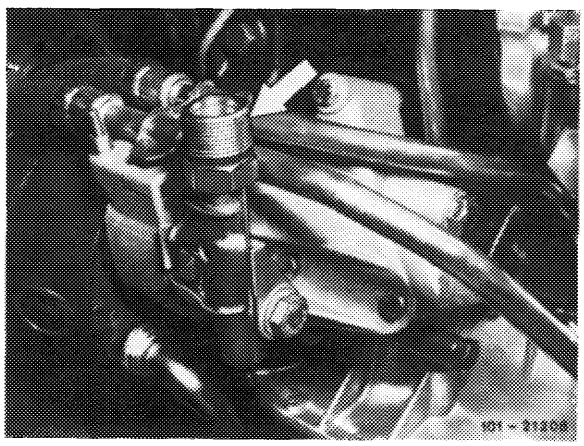
9 Draw oil from reservoir of power-steering pump and disconnect hoses.



10 On model 116.120, remove refrigerant compressor with lines connected and put aside. For this purpose, unscrew 3 screws (5, 6 and 7).

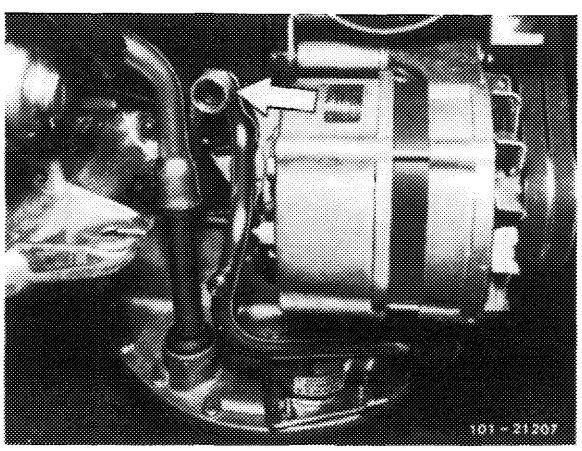


On models 123 and 126.120, drain air conditioning system and unscrew lines (arrows).



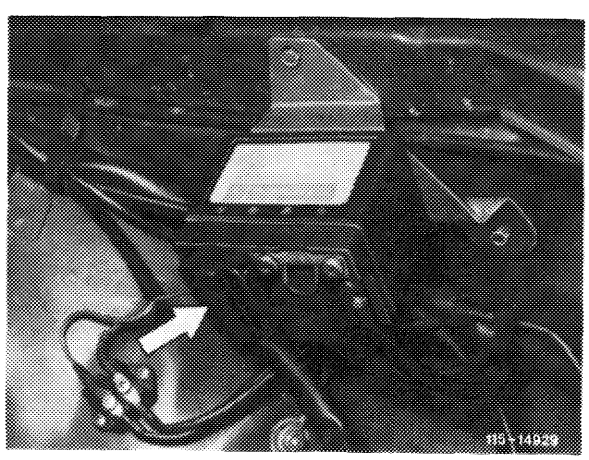
11 Disconnect heating water hoses.

12 Disconnect fuel and vacuum lines.



13 Pull cable harness for pencil element glow plugs from preglow relay.

14 Disconnect coolant temperature indicator.

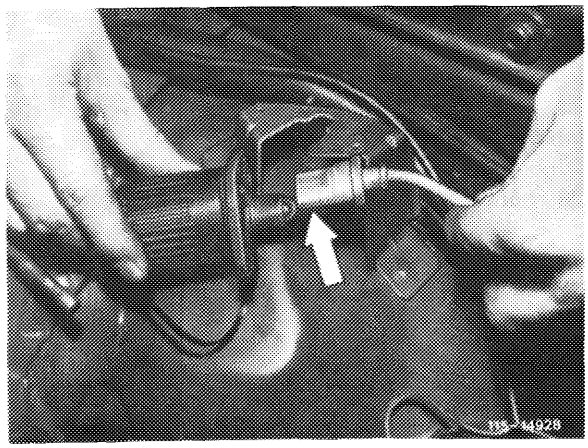


15 Disconnect TDC transmitter on test socket. Unscrew test socket for this purpose.

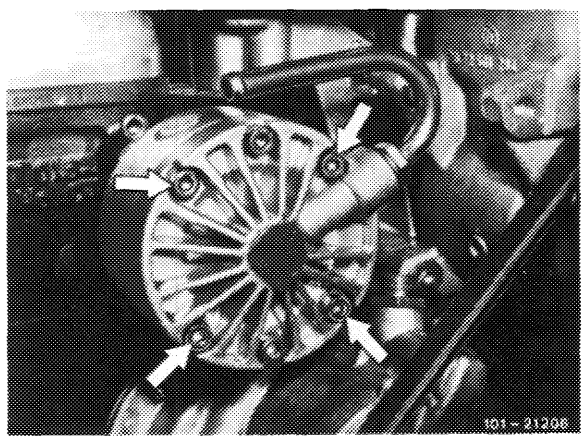
16 Pull cable plug from alternator.

17 Disconnect cable to starter on battery and on cable connector.

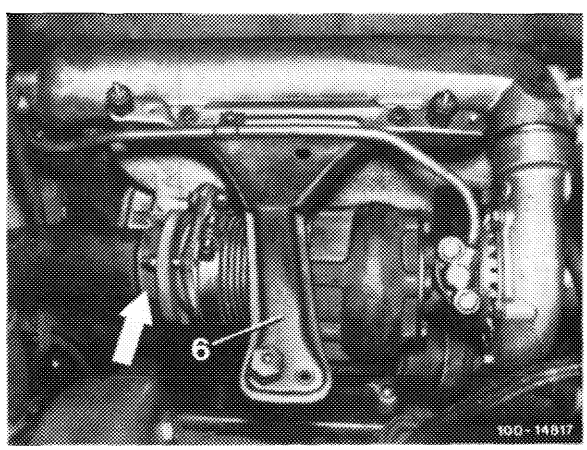
18 Unscrew oil pressure gauge on oil filter.



19 On model 123 with level control, unscrew hydraulic oil pump with lines connected and put aside. For this purpose, just loosen screws (arrows).



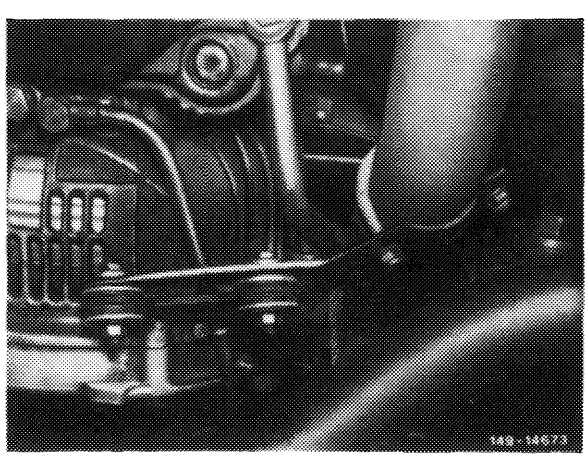
20 Unscrew exhaust on exhaust gas turbocharger.



21 Unscrew exhaust lateral support on transmission.

22 Disconnect ground connecting cable on body.

23 Unscrew bolts for engine carrier on engine mount from below.

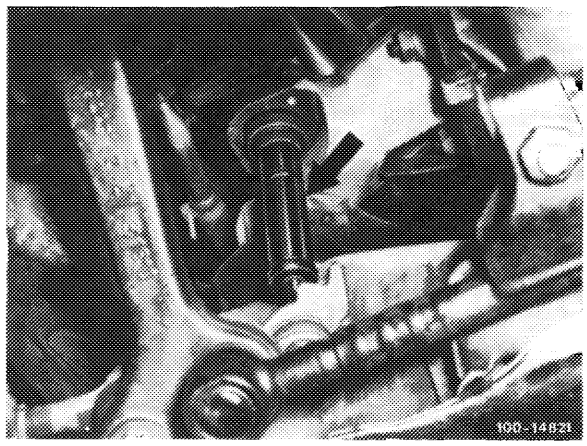


24 Unscrew both engine shock absorbers on frame cross member or console for lower contro arm.

25 Remove shielding plate in range of universal shaft intermediate bearing.

26 Loosen clamping nut of universal shaft.

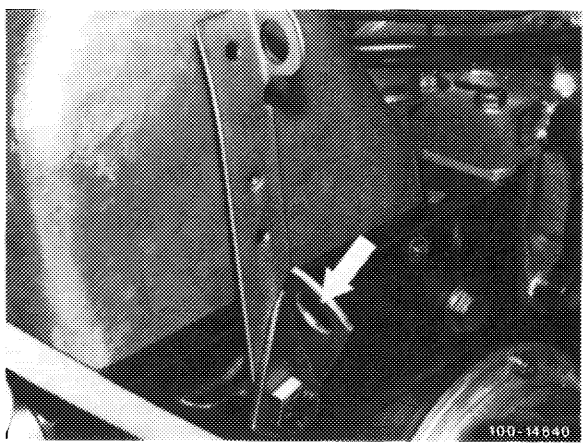
27 Unscrew universal shaft on transmission.



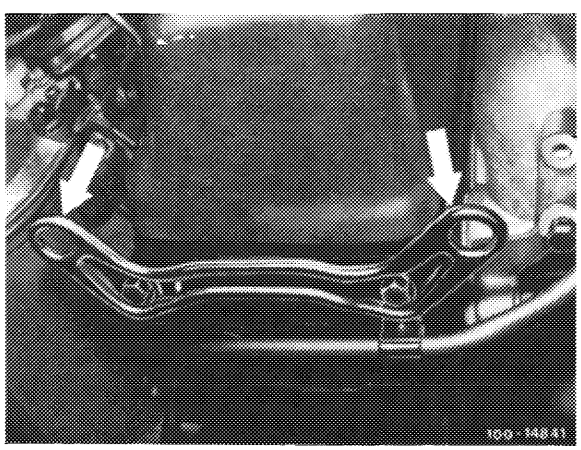
28 Loosen all connections and pull off selector rod on transmission.

29 Remove rear engine carrier with engine mount.

30 Attach ropes of engine hoist to suspension eyes.

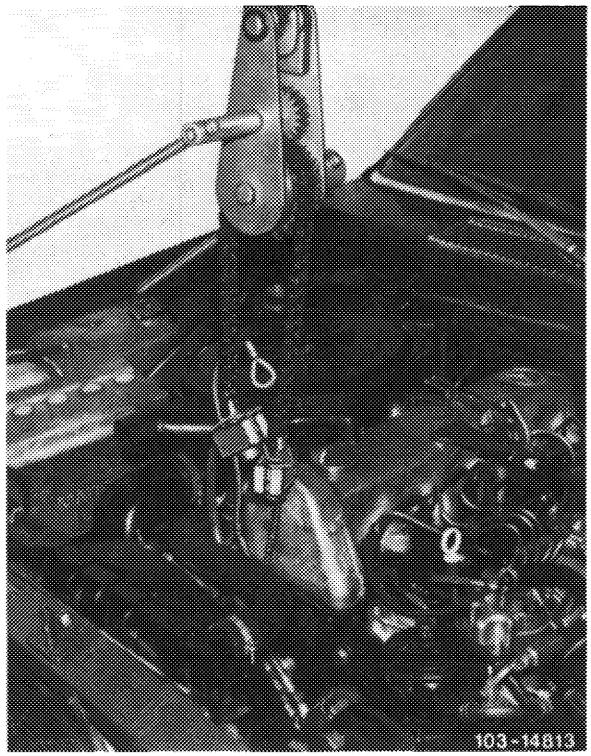


Suspension eye front



Suspension eyes rear

31 Lift out engine with transmission in a diagonal position of approx. 45°.

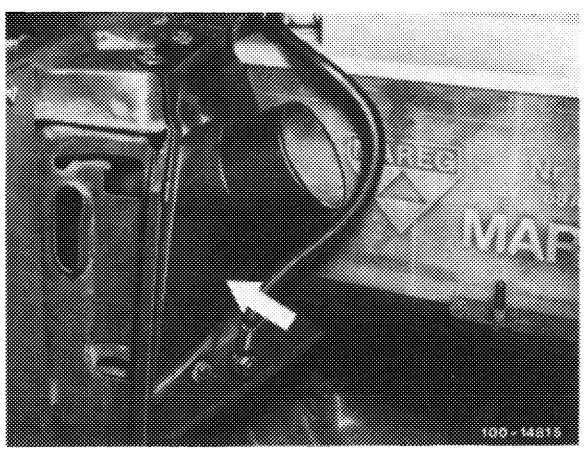


Installation

Attention!
When installing a new engine following previous bearing damage, flush oil cooler and oil hoses.

32 Check engine mounts, engine shock absorber, oil, coolant and fuel hoses and renew, if required.

33 Install engine and connect.



34 Screw-on universal shaft and adjust (41–020).

35 On model 116.120 unscrew intake scoop for inserting righthand holding spring (driving direction) on radiator.

36 Check all drain plugs for tight seat.

37 Add oil and coolant.

38 Check coolant for antifreeze (20–010).

39 Pressure-test cooling system with tester.

40 Clean air filter elements or renew.

41 Adjust idle speed (07.1–100).

42 On model 123, adjust engine stop (22–220).

A. Standard version, (USA) Federal up to 1980, (USA) California up to 1979, (J) starting 1981, (S) starting 1982

This engine has a closed, service-free crankcase breathing system.

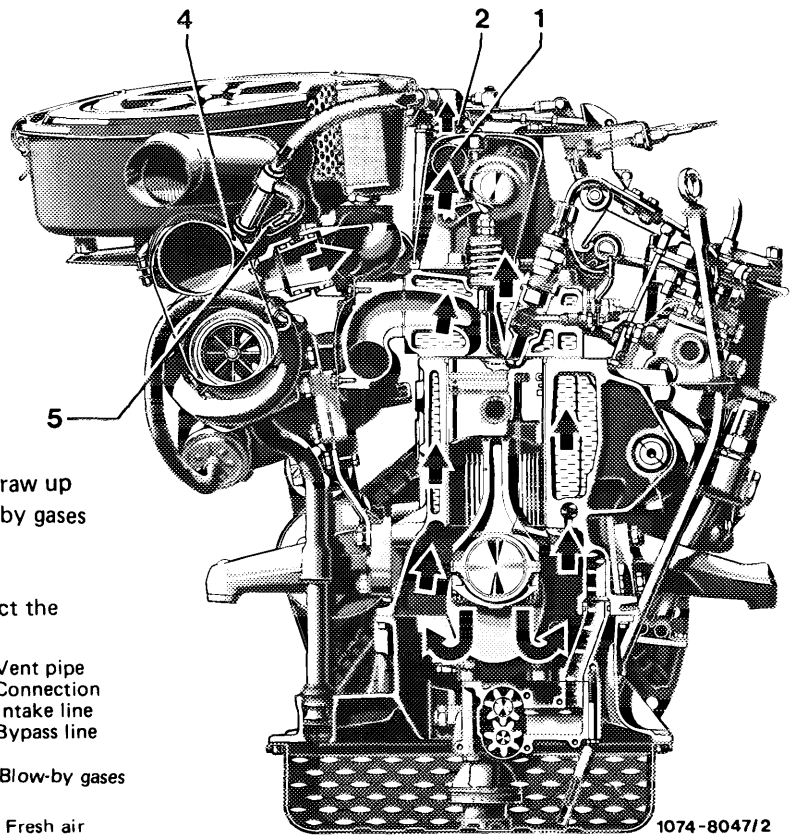
The engine blow-by gases and cylinder crankcase vapors flow through vent pipe (1) and connection (2) on cylinder head cover to intake line (4) in front of compressor.

From here, they are flowing into combustion chambers together with the intake air.

A bypass line (5) is located between clean air end of air filter and breather line.

By means of this line, the compressor can draw up clean air at high speeds in addition to blow-by gases and vapors.

The additional intake of clean air will restrict the vacuum in cylinder crankcase.



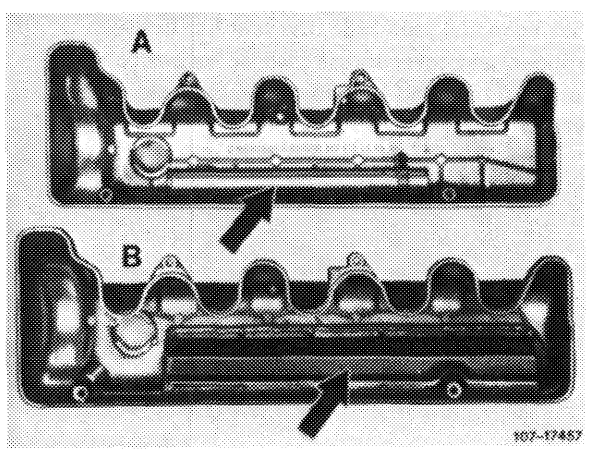
1 Vent pipe
2 Connection
4 Intake line
5 Bypass line

Blow-by gases

Fresh air

For (USA) Federal 1980 the vent pipe (A) screwed to inside of cylinder head cover has been replaced by a vent plate (B) which is riveted-on and sealed with silicone rubber. As a result, the volume of the oil separating space (damping chamber) has been enlarged.

This cylinder head cover is mounted as standard equipment and for (J) from start of series.



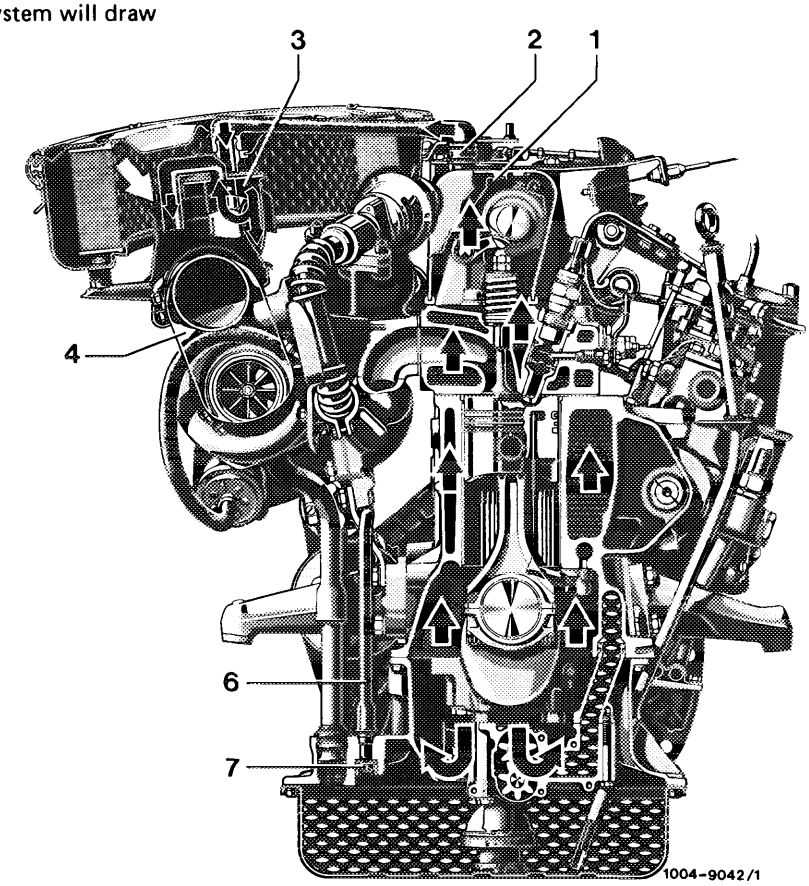
B. (USA) Federal starting 1981, (USA) California starting 1980

The complete engine breathing system requires no maintenance.

The engine blow-by gases and cylinder crankcase vapors are flowing via vent plate (1), which is revited to cylinder head cover, and connection (2) to cyclonic oil separator (3), which is located in air cleaner housing.

From there, they are flowing by way of the intake line (4) in front of compressor and together with the intake air into the combustion chambers.

The oil separated in cyclonic oil separator (3) flows through return line (6) and check valve (7) installed in oil pan upper half toward oil pan. The check valve prevents that the vacuum in intake system will draw oil vapors out of oil pan.

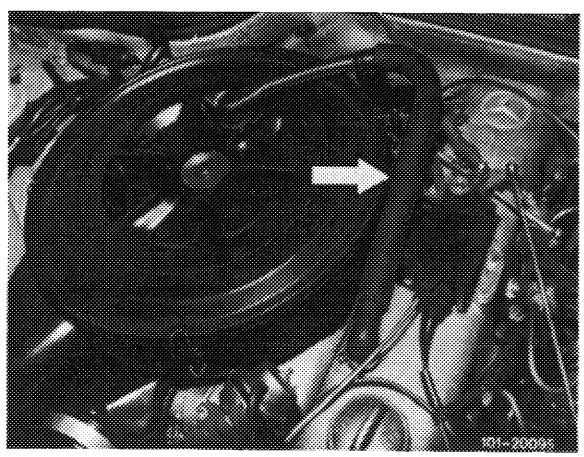


1 Vent plate
2 Connection
3 Oil separator
4 Intake line
6 Return line
7 Check valve

Fresh air

Blow-by gases

Starting model year 1981, the vent line between cylinder head cover and air cleaner has been changed from oval to round for better flow characteristics (arrow).



Coordination piston — cylinder

Version [1])	Group no.	Piston dia.	Cylinder dia.
Standard	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

Cylinder bore

Max. wear limit in forward or transverse direction		0.10
Permissible out-of-true and conicity	when new	0.014
	wear limit	0.05
Permissible deviation vertically in relation to crankshaft center line, with reference to cylinder height		0.05
Permissible roughness		0.002—0.004
Permissible waviness		50 % of roughness
Honing angle		25°
Chamfer of cylinder bores		refer to Fig.

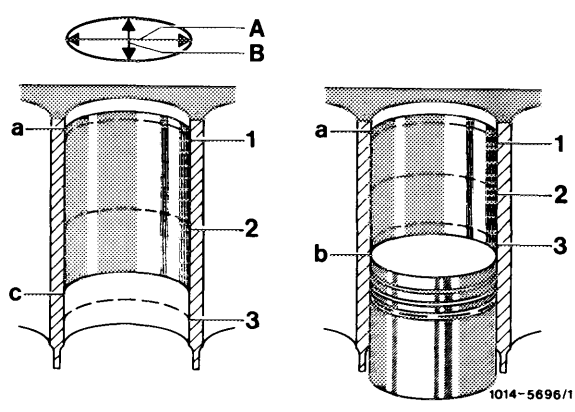
[1] These engines have no repair steps.

Note

In addition of a visual checkup, in particular in the event of complaints about "high oil consumption" measuring of cylinder bores is unavoidable.

For this purpose, measure the clean cylinder bores with internal measuring instrument at measuring points, 1, 2 and 3 in longitudinal direction A (piston pin center line) and in transverse direction B.

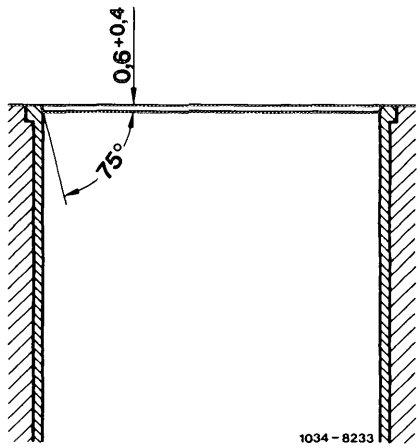
With piston installed, the measuring point 3 is barely above piston, at BDC.



a Upper reversing point of 1st piston ring
b BDC of piston
c Lower reversing point of oil scraper ring

Chamfer cylinder bores after boring.

For honing, the material allowance should not exceed 0.03 mm.



Coordination piston — cylinder

Version [1])	Group no.	Piston dia.	Cylinder dia.
Standard	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

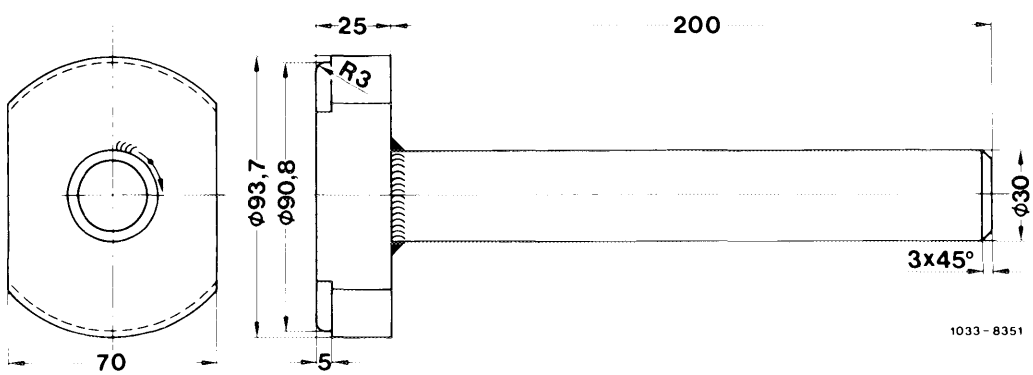
Cylinder crankcase

Basic bore in cylinder crankcase for cylinder liner	94.000 / 94.035
Permissible out-of-true of basic bore in cylinder crankcase	0.1
Roughness of cylinder crankcase parting surface	0.006—0.016

Cylinder bore

Permissible out-of-round and conicity of cylinder bore	0.014
Permissible roughness of cylinder bore	0.002—0.004
Permissible waviness of cylinder bore	50 % of roughness
Honing angle	25°
Chamfer of cylinder bores	refer to Fig.

Self-made tool



Mandrel for pressing or knocking out cylinder liners

Note

Always install approved cylinder liners only (refer to spare parts data).

Owing to different manufacturers, the cylinder liners are identified with notches at lower edge.

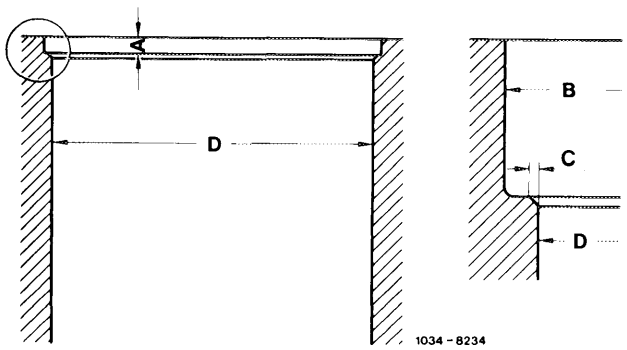
1 notch = Teves; 2 notches = Pleuco;
3 notches = Wizemann; 4 notches = Brico

Renewal

1 Press out cylinder liners with self-made mandrel and a press or knock out with a hammer.

2 Thoroughly clean basic bore.

A = 4.3–4.6 mm
B = 96.02–96.08 mm
C = 0.25–0.35 mm
D = 94.000–94.035 mm



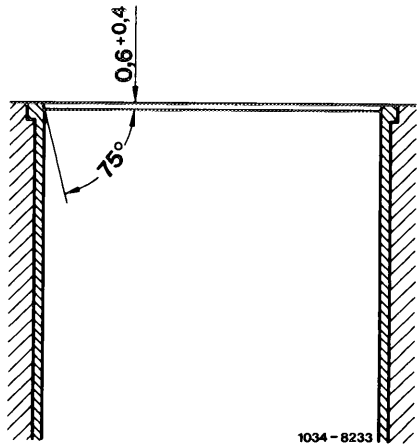
3 Measure basic bore (D) in cylinder crankcase.

If the out-of-true condition exceeds 0.1 mm, do not use cylinder crankcase any longer.

4 Position new cylinder liners. Place steel plate of pertinent size on liner flange and press-in liner with a press or knock in with a hammer.

After pressing or knocking in cylinder liner, leave for another approx. 7 seconds under press (setting pressure) or add a few setting blows with hammer.

5 Mill or grind off projecting liner flange. Remove as little as possible from cylinder crankcase parting surface. Guide milling cutter or grinding wheel centrally over cylinder bores.



6 Enlarge cylinder liner bores in two steps. For honing, leave an allowance of 0.03 mm in bores.

7 Chamfer cylinder liners.

8 Hone cylinder bores.

9 Measure cylinder bores and select pertinent pistons (02–316).

Data

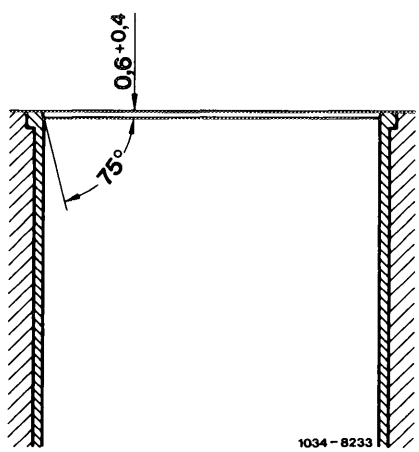
Height of cylinder crankcase when new		242.9–242.8
Minimum height following required removal of material		242.5
Permissible unevenness of parting surface	in longitudinal direction	0.10
	in transverse direction	0.05
Permissible roughness of upper parting surface		0.006–0.016
Permissible deviation in parallel of upper parting surface in relation to longitudinal direction		0.1
Pressure-test with air under water in bar gauge pressure		2.0
Chamfer of cylinder bores		refer to note

Note

Prior to facing, check piston standout. Do not exceed piston standout of 0.9 mm (03–316).

Chamfer cylinder bores after facing.

If the cylinder crankcase parting surface has been reconditioned, reset the timing (05–215).

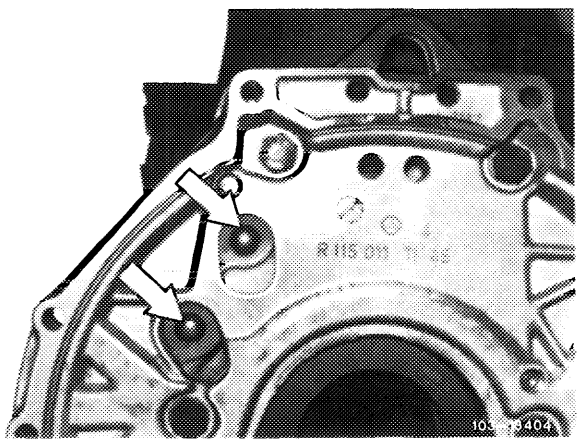


Self-made tool

Mandrel for knocking-in steel ball	refer to Fig. item 9

Note

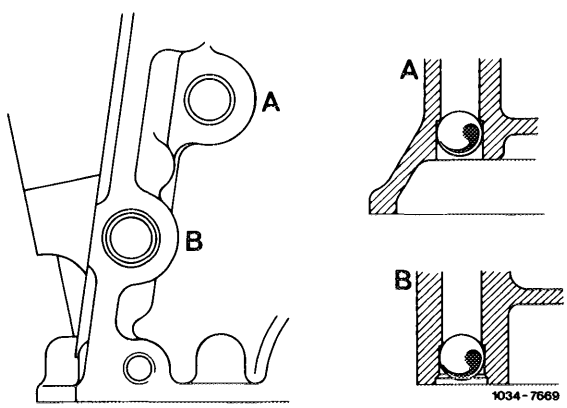
The main oil ducts in cylinder crankcase are closed at transmission end by means of a steel ball (17 mm dia.) (arrows).



During engine repairs, the steel balls must be knocked out to clean main oil ducts.

Undamaged steel balls can be used several times without refinishing ball seat.

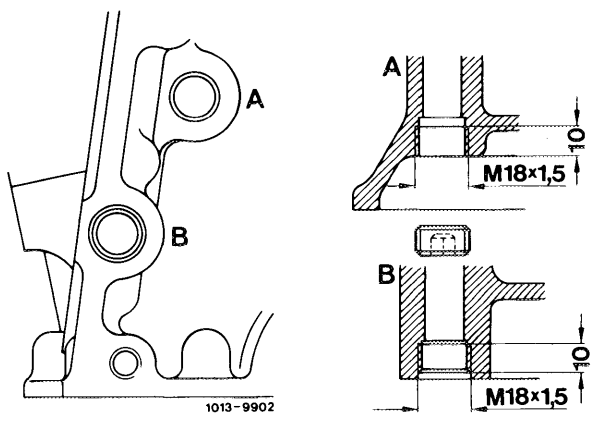
Replace damaged steel balls.



In the event of leaks, reset steel balls with knocking-in mandrel approx. 1 mm (dimension is indicated on knocking-in mandrel).

If the leaks are then not yet eliminated, knock-out the respective steel ball and replace by closing plug M 18 x 1.5, part no. 000 906 018 000.

For this purpose, cut thread M 18 x 1.5 to a depth of 10 mm as shown on drawing.



Thoroughly remove chips from oil duct.

Coat closing plug M 18 x 1.5 with sealing glue, part no. 002 989 94 71 and screw in.

Upper main oil duct

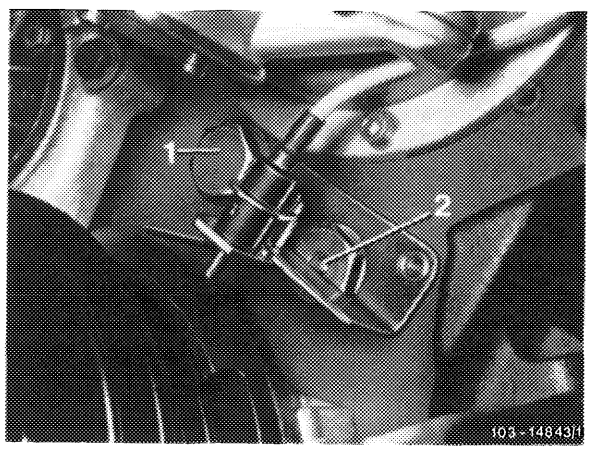
Knocking-out

1 Remove transmission and flywheel (03–410).

2 Remove radiator (20–420).

3 Unscrew closing plug (1) and adjacent hex. nut.

4 Knock out steel ball from the front by means of a round steel bolt (13 mm dia.) approx. 850 mm long.



Lower main oil duct

Knocking-out

1 Remove transmission and flywheel (03–410).

2 Remove radiator (20–420).

3 Remove pulley, vibration damper and balancing disc (03–340).

4 Unscrew closing plugs (1 and 2).

5 Remove inner slide rail in cylinder crankcase (05–340).

6 Tilt engine slightly toward the rear.

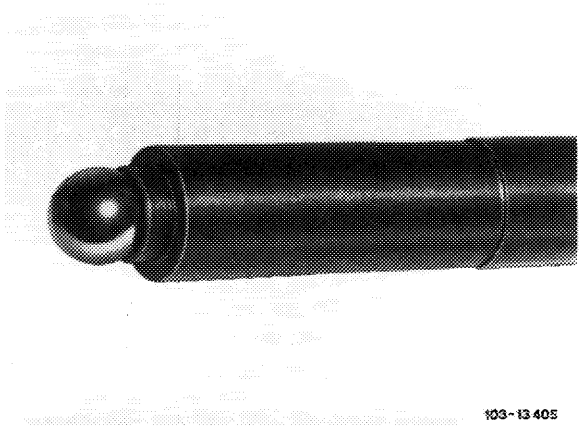
7 Knock out steel ball from the front by means of a round steel bolt (13 mm dia.) approx. 850 mm long.

Upper and lower main oil duct

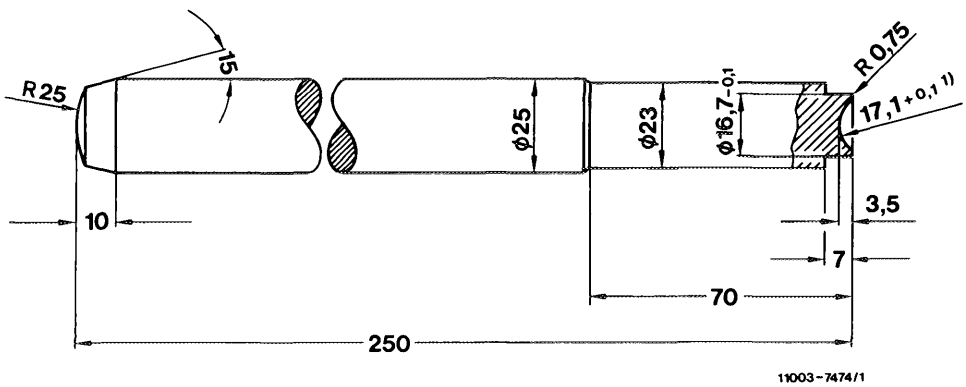
Knocking-in

8 Thoroughly clean bore in pressing-in range of steel ball.

9 Coat spherical cup on self-made knocking-in mandrel with grease and place steel ball into cup.



103-13405



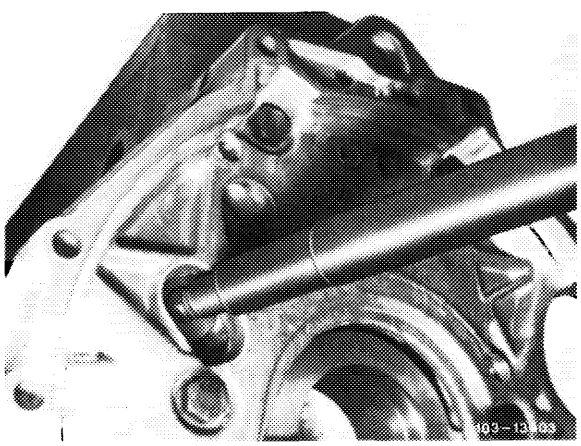
11003-7474/1

Knocking-in mandrel
Material: C 45
[1]) 17.1 + 0.1 = ball dia.

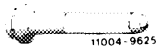
10 Position steel ball by means of knocking-in mandrel and knock in up to stop on mandrel.

11 Mount all removed parts.

12 Run engine warm and check for leaks.



Special tool

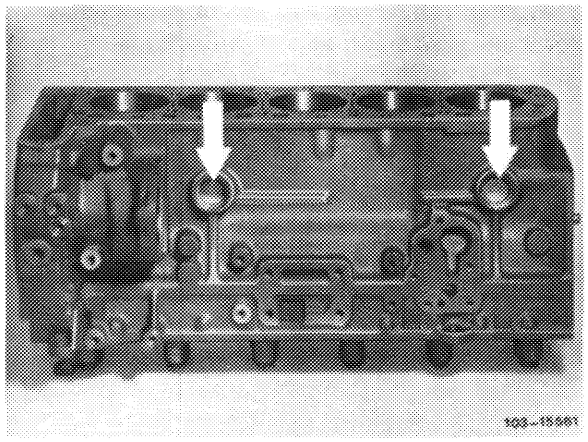
Mandrel for knocking-in core hole closing covers	 11004-9625	102 589 00 15 00

Note

Core holes in cylinder crankcase are closed with sheet metal covers (34 mm dia.).

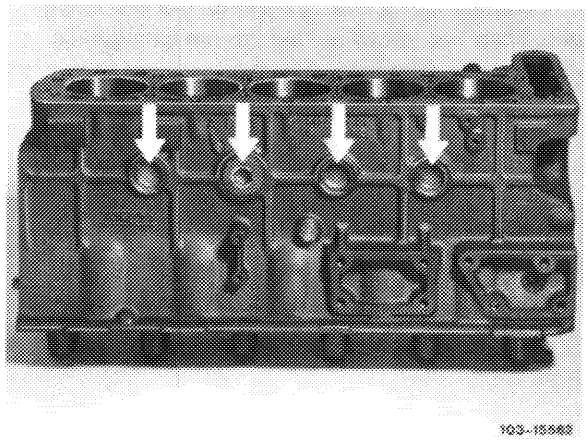
Replace leaking closing covers on principle.

At the right (driving direction) the closing plug (M 38 x 1.5) remains in place.

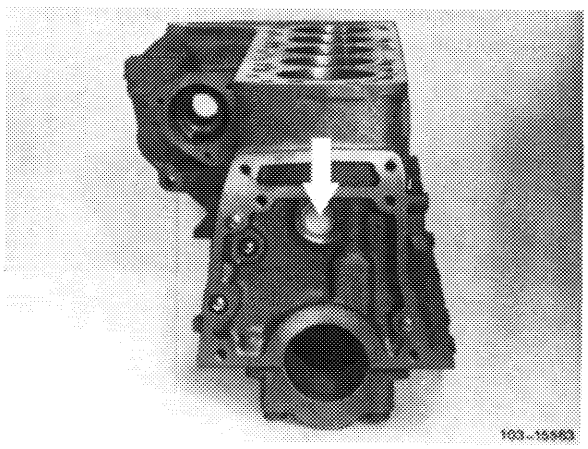


Driving direction left

This core hole can be used to insert cooling water preheater.



Driving direction right

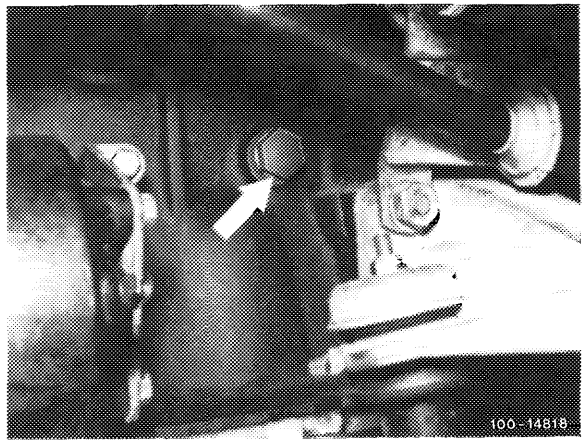


Transmission end

Replacement

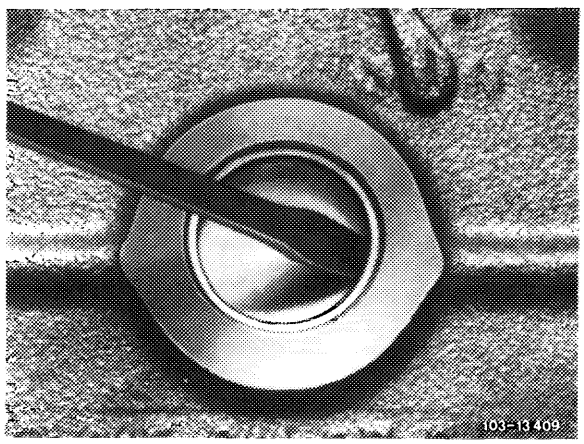
1 Completely drain coolant.

2 Remove components which obstruct access (e.g. transmission, intermediate flange, injection pump etc.).

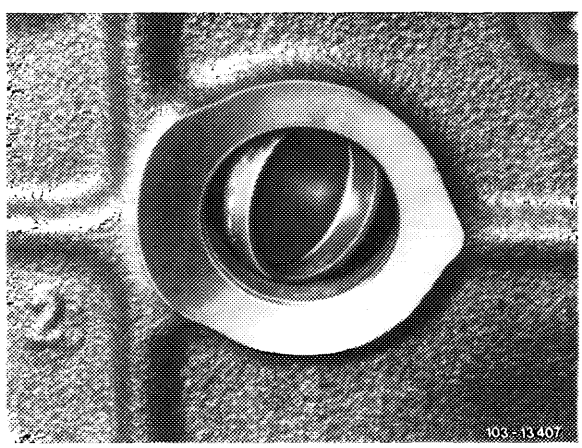


Drain plug on cylinder crankcase

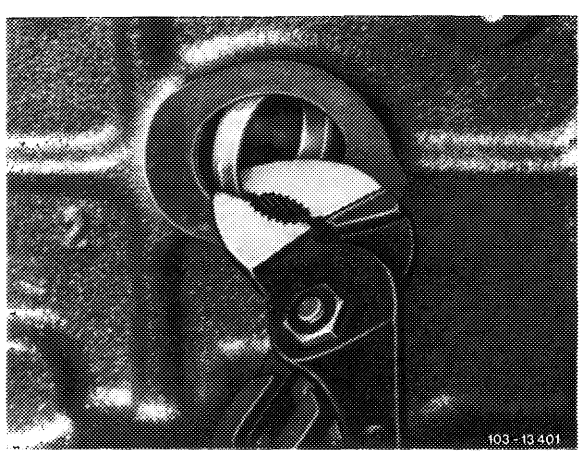
3 Position a chisel with a narrow blade or a screwdriver into deep drawn edge of closing cover.



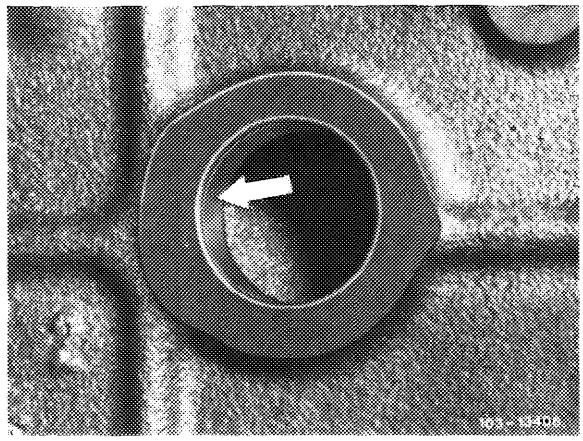
4 Carefully knock closing cover on one side down until cover has turned around its own longitudinal axis (approx. 90°).



5 Position water pump pliers against flange of projecting section and pull out closing cover.

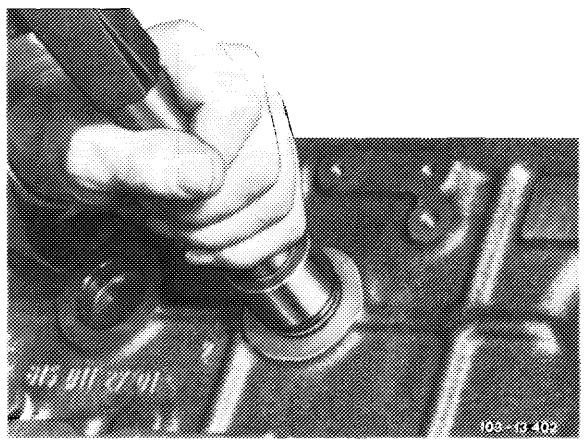


6 Thoroughly clean core hole from residue. Sealing surface should be free of grease (arrow).



7 Coat core hole with sealing glue, part no. 002 989 94 71.

8 Knock-in new closing cover by means of mandrel.



9 Attach removed components.

10 Add coolant.

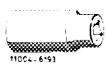
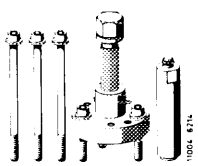
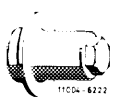
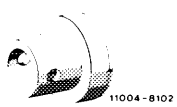
Note: The sealing glue should cure for approx. 45 minutes before adding coolant.

11 Run engine warm and check for leaks.

01–215 Removal and installation of front cylinder crankcase cover

Tightening torques		Nm
Screw M 18 x 1.5 x 45 on crankshaft		270–330
Screws M 8 x 30		35
Drain plug radiator	Model 116.120	6–10
	Model 123, 126.120	1.5–2

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
Installation tool for radial sealing ring		130 589 00 61 00
Sleeve for centering front cover and oil pan		617 589 00 14 00

Conventional tool

Connection 3/4" square socket to 1/2" square head	e.g. made by Hazet, D-5630 Remscheid order no. 1058 R-1

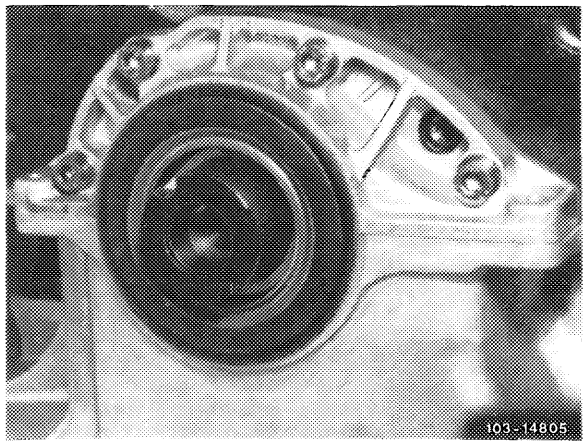
Removal

1 Remove pulley, vibration damper and balancing disc (03–340).

2 Remove front crankshaft radial sealing ring (03–324).

3 Unscrew cover and remove.

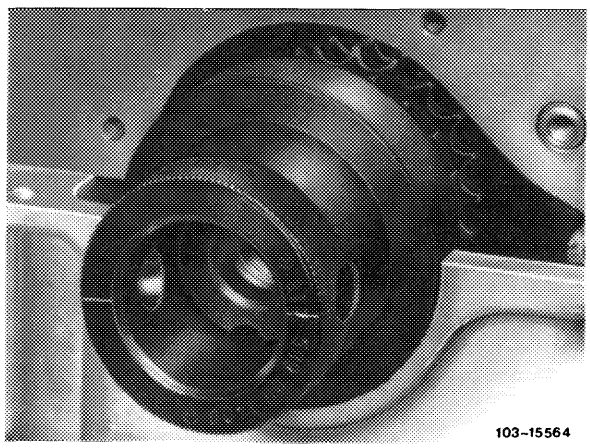
4 Thoroughly clean sealing surfaces of cover and on oil pan top.



Installation

5 Slip sleeve for centering cover on crankshaft journal.

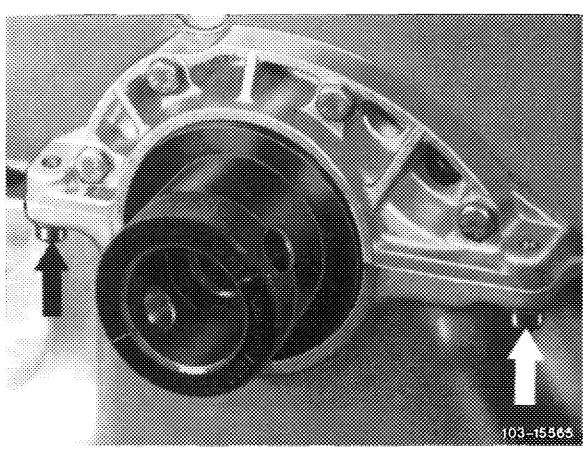
Attention!
If except for the cover, the complete oil pan has also been installed, reinstall oil pan again first. For this purpose, place sleeve on crankshaft journal.



6 Coat all sealing surfaces with sealing compound, part no. 001 989 46 20.

7 Position cover and screw down.

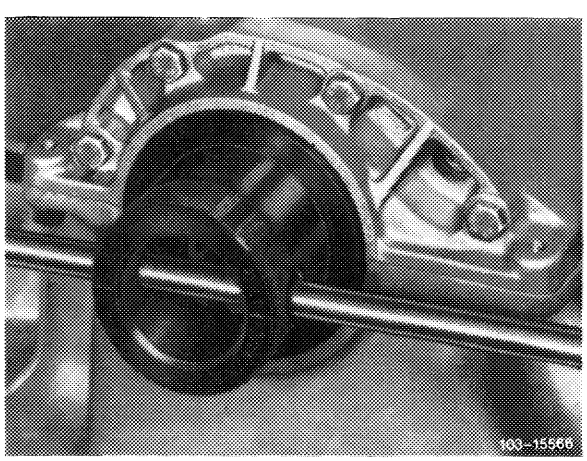
Attention!
Tighten screws in oil pan first (arrows).



8 Remove sleeve. If sleeve cannot be removed, insert mandrel into cross hole and turn out.

9 Install new crankshaft radial sealing ring (03–324).

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

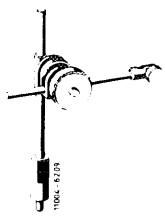
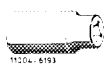


Data

Vertical runout of intermediate flange		max. 0.10

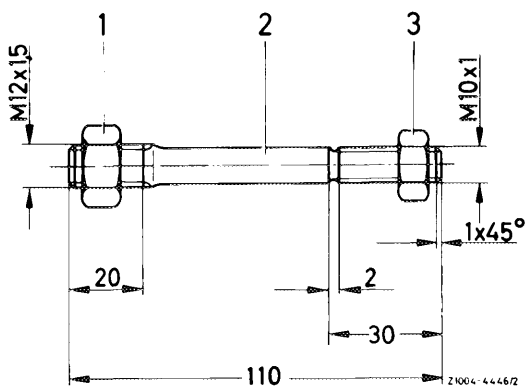
Tightening torques		Nm
Fastening screws for intermediate flange		50
Necked-down screw for driven plate and flywheel	initial torque	40
	angle of rotation torque	90–100°

Special tools

Dial gauge holder (2 each required)		363 589 02 21 00
Socket 27 mm, 1/2" square for rotating engine		001 589 65 09 00

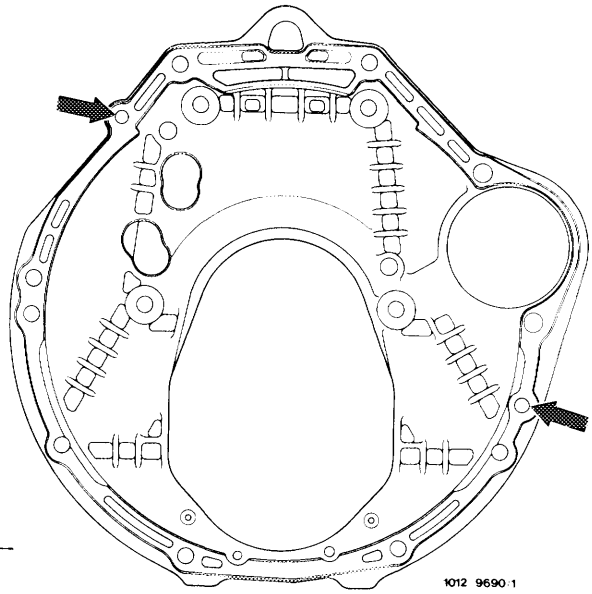
Self-made tool

Threaded bolt



The intermediate flange is provided with two additional bores for centering the fitted pins of automatic transmission 722.303 (W 4 A 040).

This intermediate flange is also installed on engines with automatic transmission 722.120 (W 4 B 025). Part no. 615 011 02 45.



Start of series: February 1980

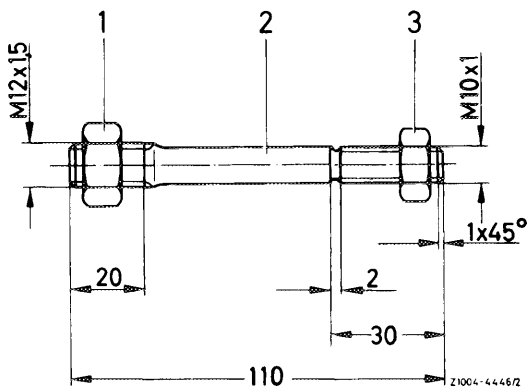
Model	Engine	Engine end no.	Chassis end no.
116.120	617.950	022432	022082
123	617.952	start of series	
126.120	617.951	start of series	

Installation and centering

1 Insert intermediate flange into fitted pins on cylinder crankcase.

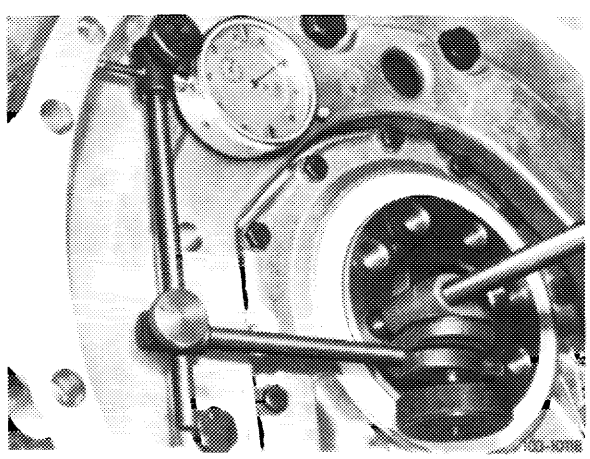
2 Slightly tighten the four fastening screws.

3 Screw threaded bolt (self-made) into crankshaft and counterlock with hex. nut.



4 Attach dial gauge holder with dial gauge to threaded bolt.

5 Position feeler pin against OD of round center.

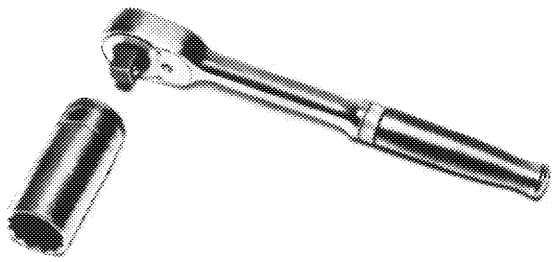


Shown on engine 116

6 Turn crankshaft with tool combination and measure vertical runout. Vertical runout should not exceed max. 0.10 mm.

Note: When turning crankshaft, make sure that feeler pin of dial gauge is not getting stuck.

7 Correct vertical runout by means of light blows against intermediate flange.



R 100/6498

8 Tighten fastening screws.

Note: If the vertical runout exceeds 0.10 mm, remove intermediate flange.

9 Drill both fitted bores in intermediate flange to 12.1 mm.

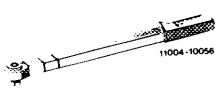
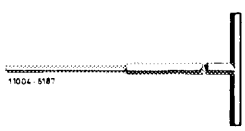
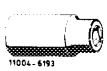
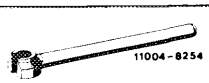
10 Repeat item 1–8.

01–310 Removal and installation of complete oil pan

Oil capacity in liters	
Oil pan	6.0
Oil filter	1.5
Air-oil cooler	approx. 0.7

Tightening torques	Nm
Oil drain plug to oil pan	40
Oil pan upper half to cylinder crankcase	10
Oil pan lower half to upper half	
Engine carrier to engine mount front	70

Special tools

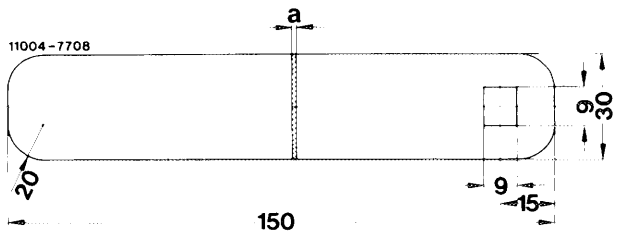
Torque wrench with plug-in ratchet, 1/2" square, 25–130 Nm		001 589 66 21 00
Torque wrench with plug-in ratchet, 1/2" square, 40–200 Nm		001 589 67 21 00
Screwdriver (Allen wrench) with tommy handle for hex. socket screws 5 mm, 300 mm long		116 589 02 07 00
Knock-out mandrel		110 589 02 15 00
Socket 27 mm, 1/2" square for rotating engine		001 589 65 09 00
Knocking-in tool for oil dipstick guide tube		117 589 00 31 00

Conventional tool

Engine hoist (Motordirigent) size 1.5	e.g. made by Bäcker, D-5630 Remscheid order no. 3178

Self-made tool

Gauge for cutting off rear radial sealing ring



Dimension a = 1.0 mm

Note

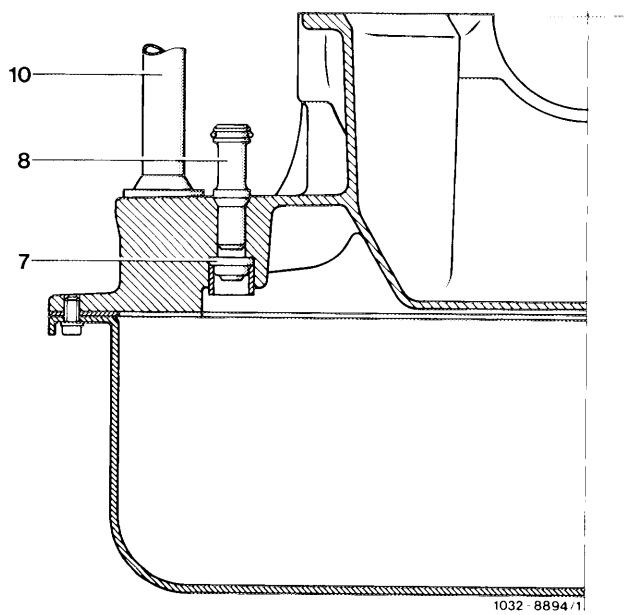
There are four oil pan upper half versions.

a) Oil pan upper half with a connection for oil return line (10) from exhaust gas turbocharger.

Installed on engines 617.950 (model 116.120) without EGR (USA) and 617.952 (model 123) with automatic transmission 722.120 (W4B025).

b) Oil pan upper half with two connections for oil return line (10) from exhaust gas turbocharger and from cyclonic oil separator (8) in air cleaner.

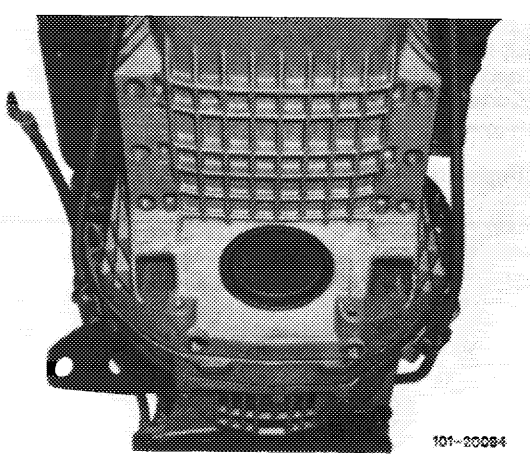
Installed in engine 617.950 (model 116.120) with EGR (USA).



7 Check valve
8 Oil return line from cyclonic oil separator
10 Oil return line from exhaust gas turbocharger

c) Oil pan upper half with integrated supporting shell and a connection for oil return line (10) from exhaust gas turbocharger.

Installed on engine 617.952 (model 123) with automat transmission 722.303 (W4A040).



d) Oil pan upper half with integrated supporting shell and two connections for oil return line (10) from exhaust gas turbocharger and from cyclonic oil separator (8) in air cleaner.

Installed on engine 617.951 (model 126.120) and 617.952 (model 123) with automatic transmission 722.303 (W4A040).

Spare part oil pan upper halves for engines with EGR (USA) are provided with check valve (7) and oil return line (8).

They can not be installed on engines without EGR.

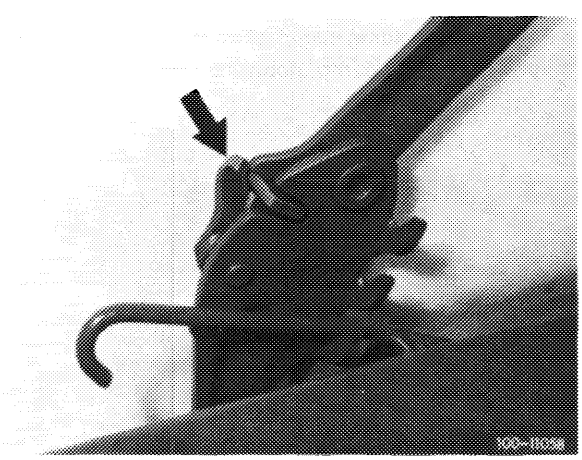
On model 126.120 with engine, remove and install (01–030).

Removal

1 Drain engine oil.

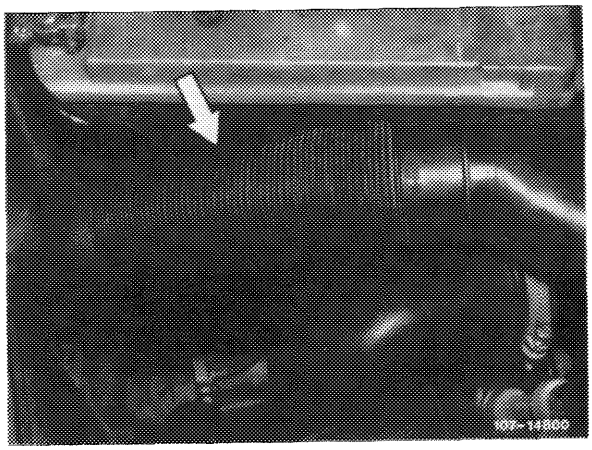
2 On model 116.120, remove engine hood.

On model 123, move engine hood into 90 ° position and engage detent lever (arrow).

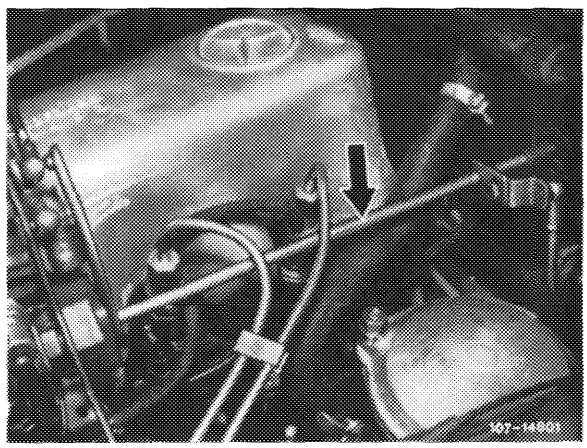


3 Remove intermediate member on air cleaner (arrow).

4 Unscrew fan cover and place over fan; loosen radiator.

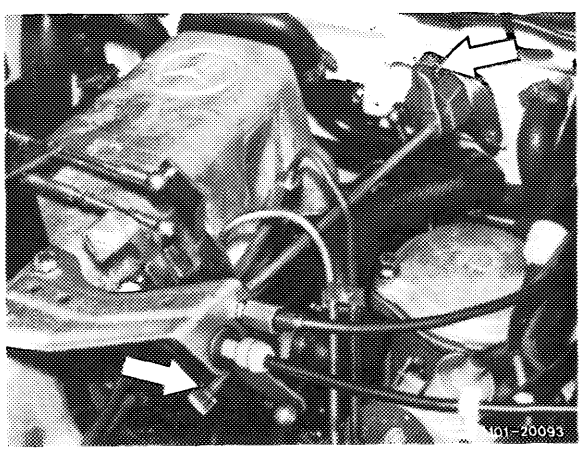


5 Remove longitudinal regulating shaft. For this purpose, pull out locking eye (arrow).



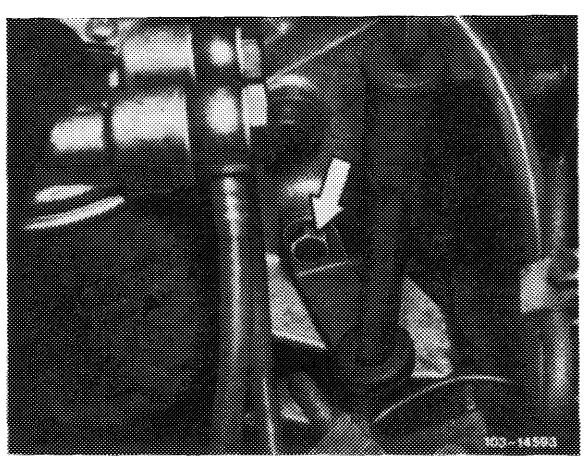
Model 116.120

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



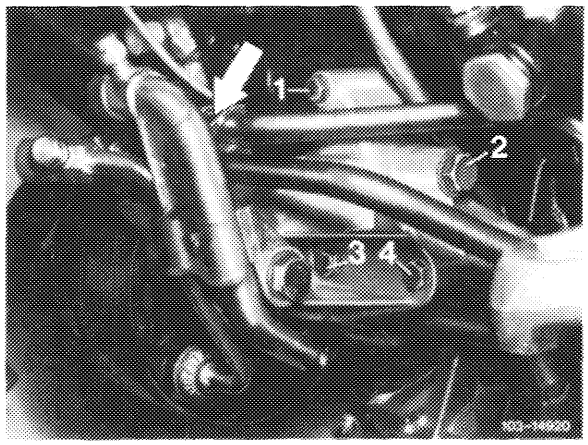
Model 123

6 Unscrew holding clamp of oil dipstick guide tube on power steering pump mounting bracket.

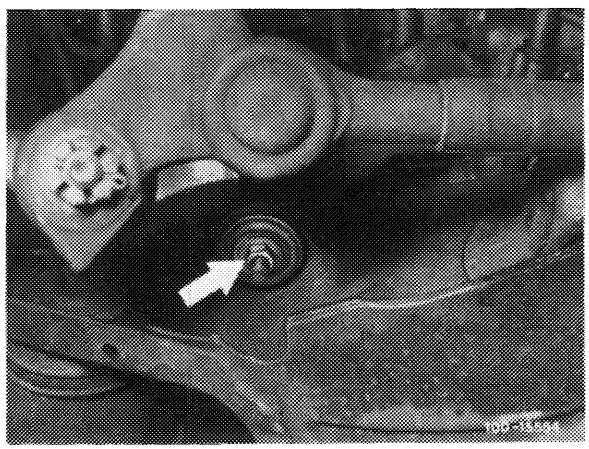


7 Slacken V-belt of refrigerant compressor and remove.

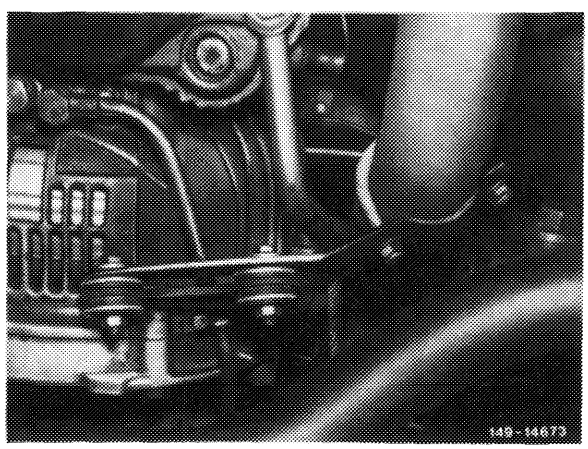
Unscrew refrigerant compressor with carrier. For this purpose, unscrew screws (1—4) and loosen clamp (arrow) of air-oil cooler lines.



8 Unscrew both engine shock-absorbers on frame cross member or console for lower control arm.

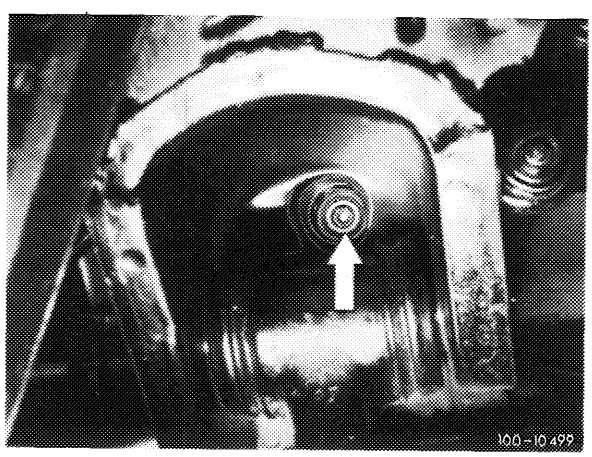


9 Loosen exhaust lateral support on transmission.



10 Unscrew fastening screws of engine carrier on engine mount from below.

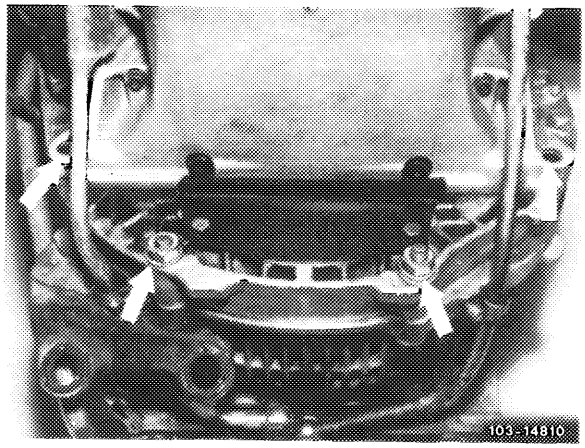
11 Unscrew oil cooler lines for automatic transmission, on transmission, on intermediate flange and on oil pan upper half.



12 Unscrew the 4 lower screws on intermediate flange (arrows).

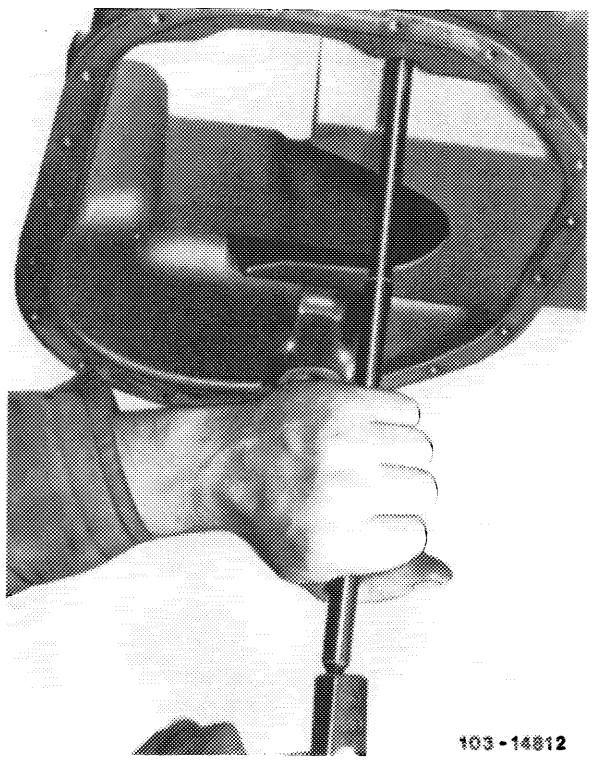
13 Unscrew cover plate on intermediate flange.

14 Unscrew oil pan lower half and remove.



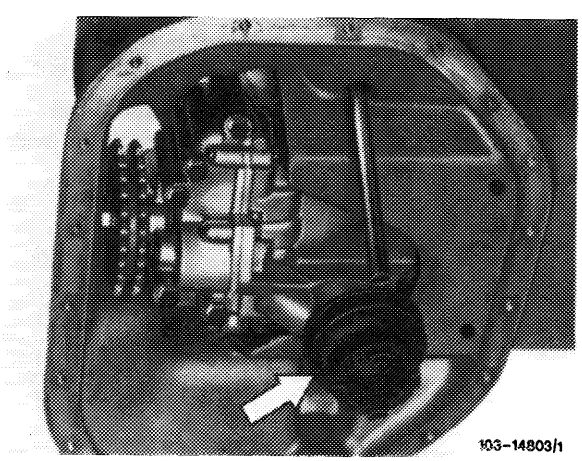
15 Knock-out oil dipstick guide tube as far as possible by means of knocking-out mandrel 9 mm dia. for valve guides.

Attention!
The oil dipstick guide tube cannot yet be pulled out.

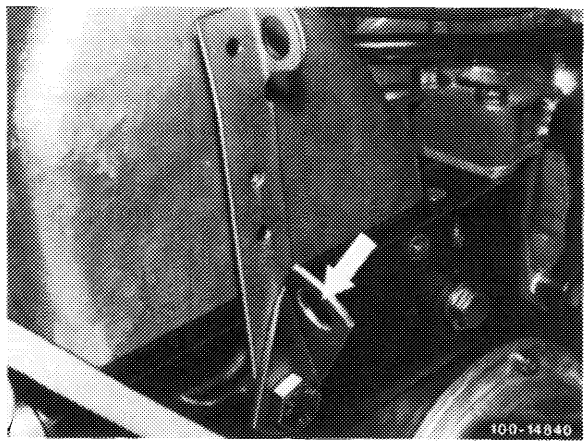


16 Pull off adaptor with strainer on oil pump (arrow).

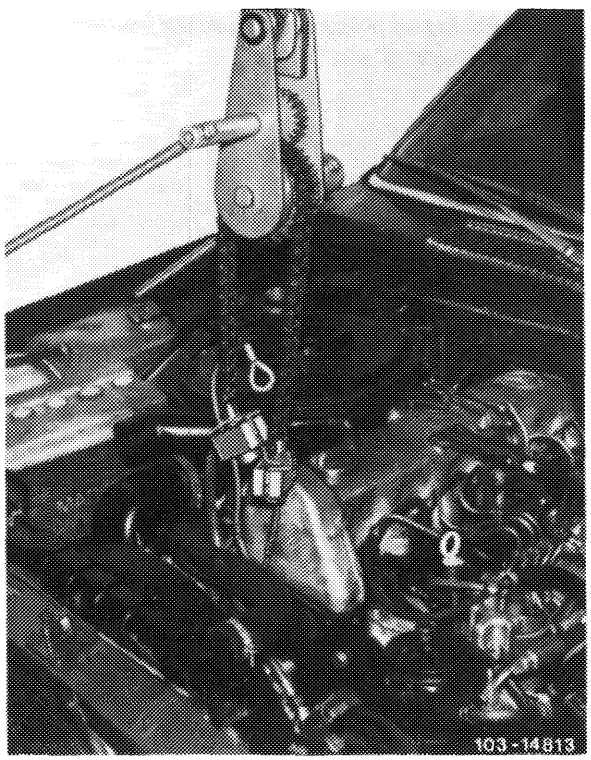
17 Unscrew oil pan upper half.



18 Attach rope of engine hoist (Motordirigent) to suspension eye at front on cylinder head (arrow).



19 Lift engine as far as possible by means of engine hoist and a crane. For this purpose, on model 123, open rear clamp on air cleaner so that it will not abut against battery while lifting.

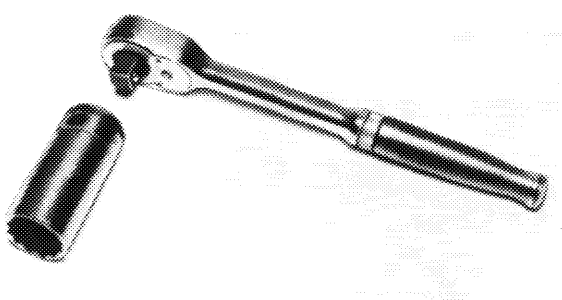


20 Pull out oil dipstick guide tube.

21 Pull oil pan in downward direction and remove in forward direction.

To remove oil pan, turn crankshaft with tool combination until oil pan upper half can be pulled past connecting rod or crankshaft webs.

22 Thoroughly clean parting surface on cylinder crankcase, on oil pan upper and lower half.

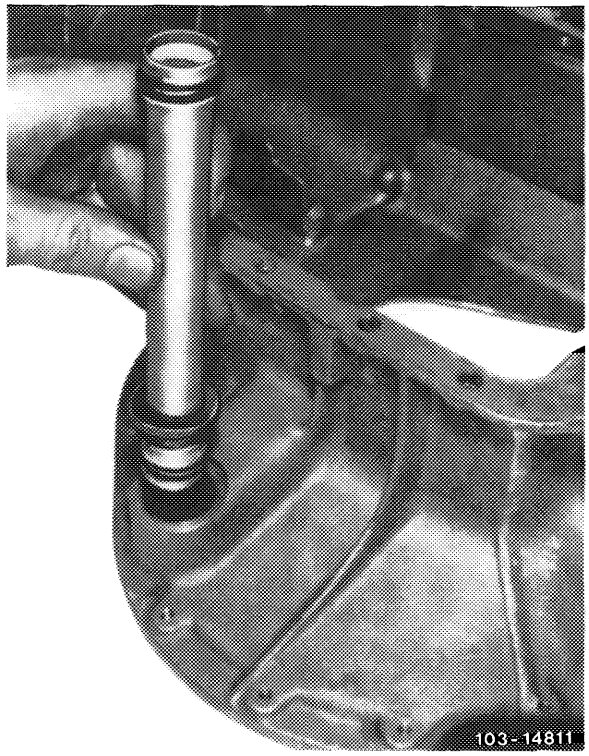


R 100/6498

Installation

Note: If a new oil pan upper half is installed, insert oil return pipe and contoured gasket first.

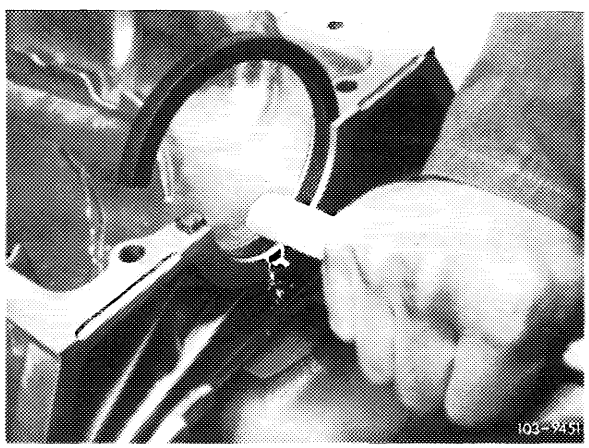
Renew damaged or porous contour gaskets and O-rings.



When removing oil return pipe, push out contoured sealing ring from oil pan first.

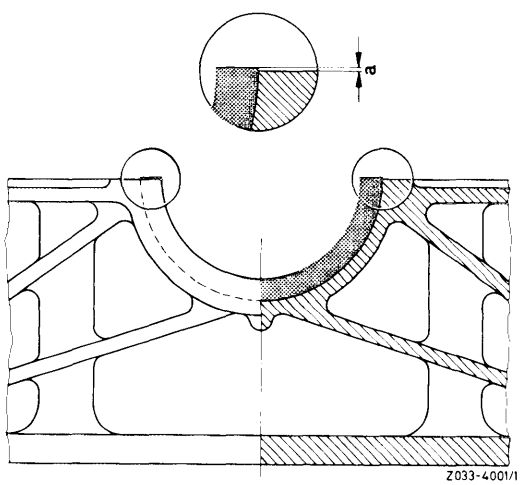
23 Renew rear radial sealing ring in oil pan according to condition.

Insert new radial sealing ring into groove and work in with a lubricated hammer handle.



24 To obtain an overlap, cut off radial sealing ring 1 mm above parting surface, using self-made gauge.

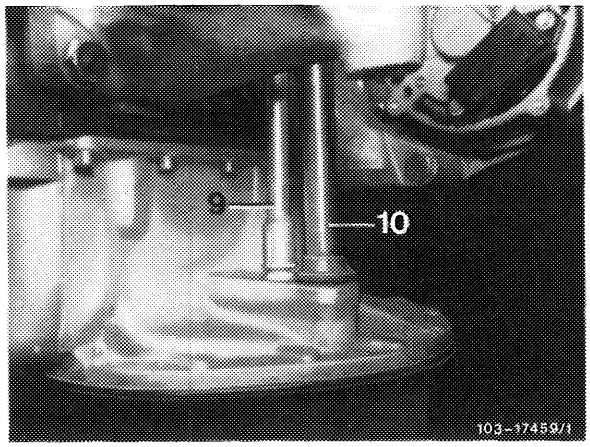
25 Provide radial sealing ring with engine oil.



Dimension a = 1.0 mm

26 Coat parting surface of oil pan top uniformly with sealing compound, part no. 001 989 46 20. Use this type of sealing compound only.

27 Position oil pan upper half, while inserting oil dipstick guide pipe, oil return pipe from exhaust gas turbocharger and from cyclonic oil separator (on engines with EGR only).



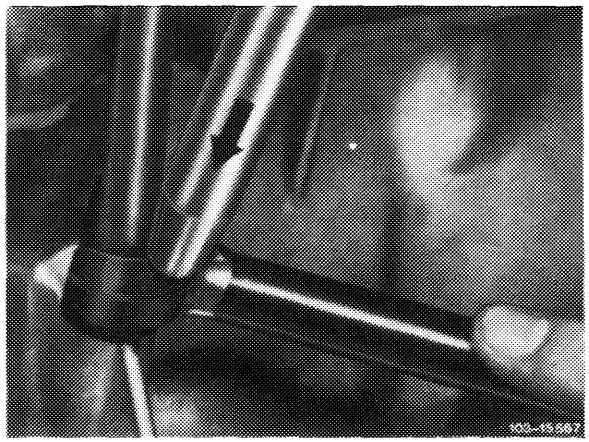
9 Oil return line from cyclonic oil separator
10 Oil return line from exhaust gas turbocharger

28 Screw down oil pan upper half.

29 Knock-in oil dipstick guide tube up to flange by means of knocking-in tool.

30 Lower engine. Pay attention to installation position of shielding plates and guide engine shock-absorbers into bores on frame cross member.

31 Insert adaptor with strainer at oil pump.



32 Screw-on oil pan lower half with new gasket.

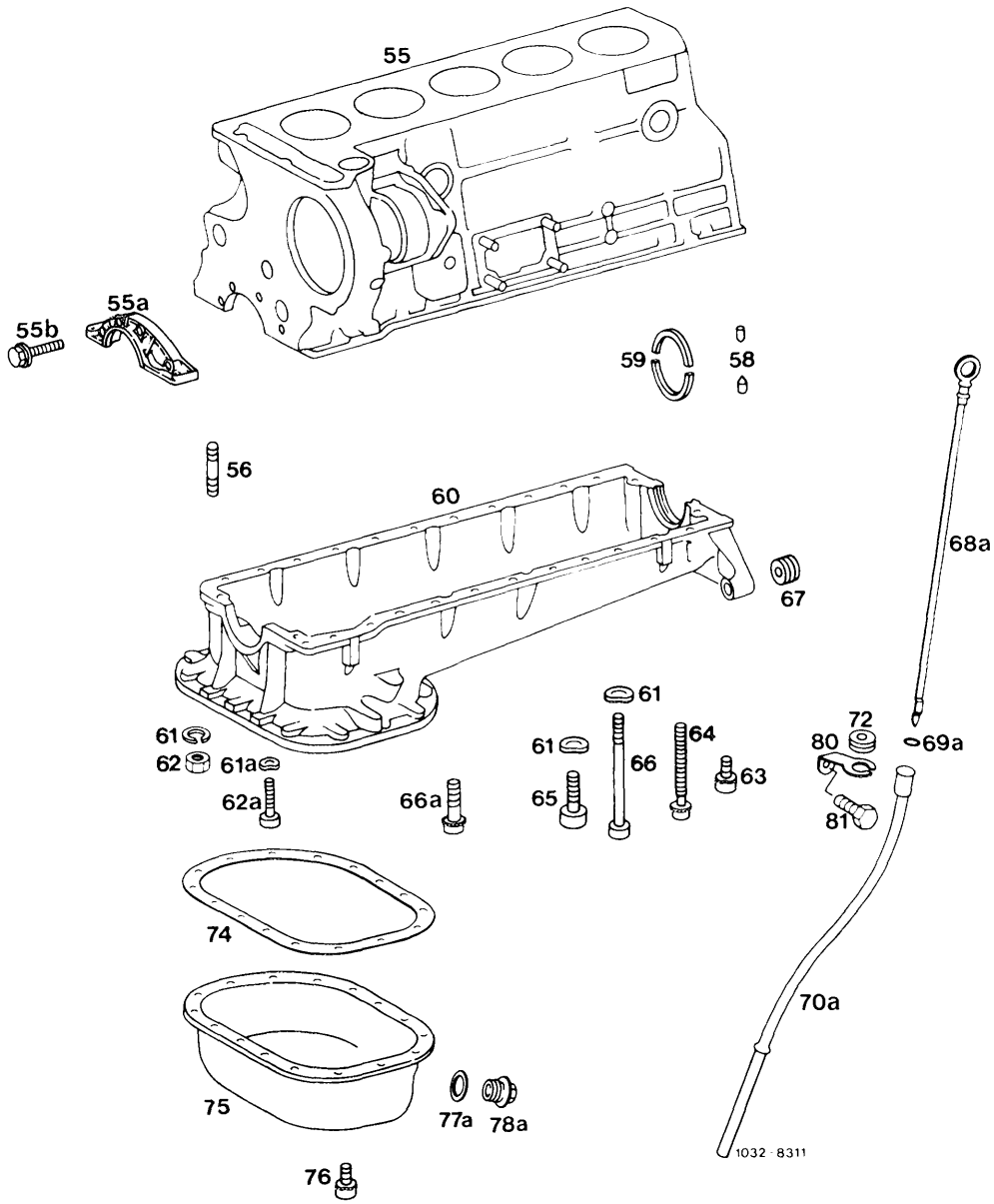
33 For further installation proceed vice versa.

34 Add engine oil.

35 Run engine and add gear oil.

36 Run engine warm and check for leaks.

Cylinder crankcase and oil pan



55 Cylinder crankcase
55a Cover
55b 4 combination screws M 6 x 25
56 2 screws M 8 x 25
58 Locking pin
59 Crankshaft radial sealing ring
60 Oil pan top
61 4 spring washers B 8
61a 2 spring washers B 6
62 2 nuts M 8
62a 2 screws M 6x20
63 16 combination screws M 6x15 (engine 617.950/952)
14 combination screws M 6x15 (engine 617.951)
64 2 combination screws M 6x60 (engine 617.950/952)
8 combination screws M 6x60 (engine 617.951)
65 4 combination screws M 6x30 (engine 617.950/952
66 2 screws M 8x95
66a 2 screws M 8x20
67 2 threaded inserts 10/14x20 (engine 617.950/952)
68a Oil dipstick
69a O-ring
70a Oil dipstick guide tube
72 Rubber grommet
74 Gasket
75 Oil pan lower half
76 Combination screw M 6x15 (19 each)
77a Sealing ring A 12x17
78a Oil drain plug M 12
80 Holder for oil dipstick guide tube
81 Screw M 8x12

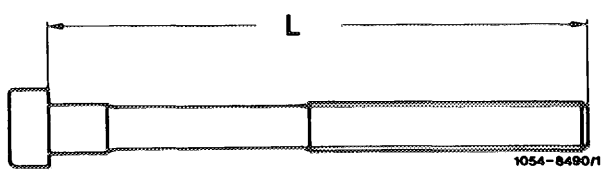
Tightening torques and angle of rotation for cylinder head bolts on cold engine

Cylinder head bolt version	Tightening steps	Nm	Angle of rotation
Hex. socket cylinder head bolts (cylinder head bolts with cylindrical shank)	Step 1	70	—
	Step 2	90	—
	Setting interval	10 min	
	Step 3	100	—
Double hex. socket cylinder head bolts (necked-down cylinder head bolts)	Step 1	40	—
	Step 2	70	—
	Setting interval	10 min	
	Step 3	—	90°
	Step 4	—	90°

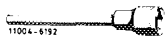
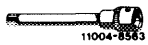
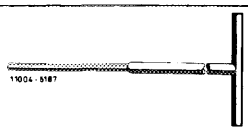
Tighten M 8—cylinder head bolts by means of Allen wrench with tommy handle.

Dimensions of double hex cylinder head bolts

Thread dia.	Length when new	Max. length (renew)
M 12	104	105.5
M 12	119	120.5
M 12	144	145.0

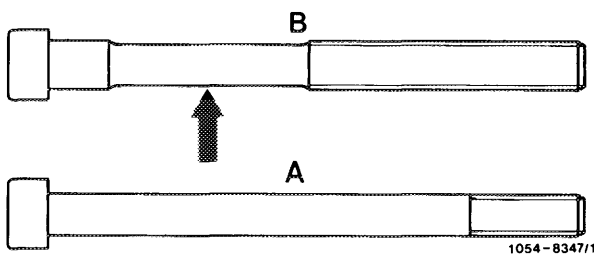


Special tools

Socket 10 mm, 1/2" square, 140 mm long for hex. socket cylinder head bolts		000 589 05 07 00
Socket 1/2" square, 140 mm long for double hex. socket cylinder head bolts		617 589 00 10 00
Screwdriver (Allen wrench) with tommy handle for hex. socket screws 6 mm, 440 mm long		116 589 03 07 00
Torque wrench with plug-in ratchet 1/2" square, 40–200 Nm		001 589 67 21 00

Notes

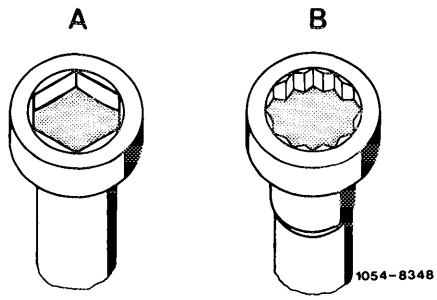
To obtain a more uniform and higher initial bolt preload, the cylinder head bolts with cylindrical shank (A) used up to now on engine 617.950 have been replaced by necked-down cylinder head bolts (B) starting February 1979. On engines 617.951/952, they are installed from start of series.



A Cylinder head bolt with cylindrical shank
B Cylinder head bolt with necked-down shaft

These cylinder head bolts have a reduced shank section (arrow) and longer threads.

In installed condition, the cylinder head bolts are identified by the double hex. socket (B), formerly hex. socket (A).

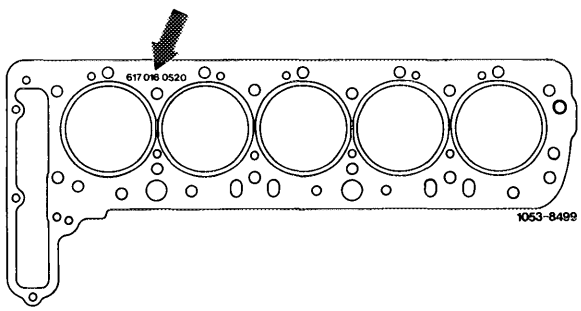


A Hex. socket cylinder head bolt
B Double hex. socket cylinder head bolt

The cylinder head gasket has been simultaneously provided with an improved impregnation and the washers have been made harder.

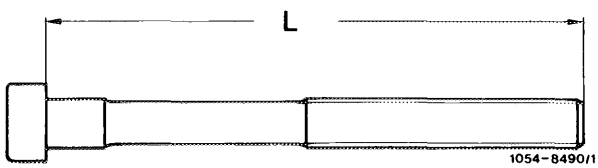
The cylinder head gasket is identified by the impressed part no., the washers by the olive-colored chromate surface.

Cylinder head gasket part no. 617 016 05 20.



The double hex. socket cylinder head bolts are tightened to an initial torque preload and an angle of rotation (refer to table).

Since these cylinder head bolts are subject to a permanent elongation upon tightening, they must be replaced as soon as the max. longitudinal dimensions shown in table below are exceeded.



Dimensions of cylinder head bolts

Thread dia.	Length when new (L)	Max. length (L) (renew)
M 12	104	105.5
M 12	119	120.5
M 12	144	145.0

Owing to the permanent elongation, the threaded bores in cylinder crankcase have been made longer and the cylinder head bolts have been shortened by 1 mm.

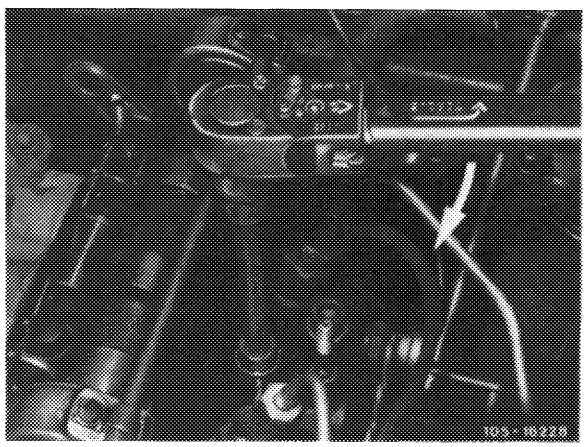
For this reason, they must not be installed in engine 617.950 with hex. socket cylinder head bolts.

The above applies also to the installation of short blocks and new cylinder crankcases.

Always use the cylinder bolt version of removed engine.

It is also not permitted to install mixed cylinder head bolts on one and the same engine.

In the event of repairs on engines with double hex. socket cylinder head bolts only the cylinder head gasket with improved impregnation and harder washers may be installed.



Tighten cylinder head bolts to initial torque preload and angle of rotation torque.

Estimate angle of rotation. For this purpose, place adjustable torque wrench **in release position** (locked) into plug-in ratchet. Position adjustable torque wrench with plug-in ratchet longitudinally in relation to engine and turn until wrench is positioned transverse to engine.

When tightening to angle of rotation torque, do not use a bending bar-torque wrench.

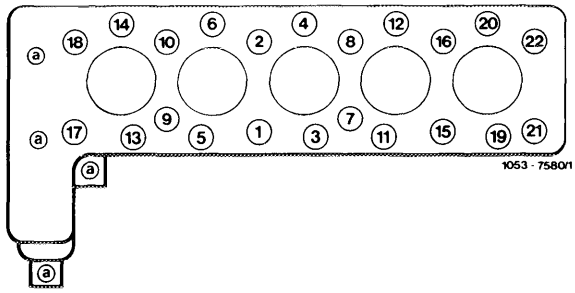
On engine 617.950 with hex. socket cylinder head bolts, the cylinder head gasket with improved impregnation and harder washers may also be installed.

Tighten hex. socket cylinder head bolts always according to torque.

When tightening according to **torque,** the former warm tightening is no longer required. Instead, a 10-minute setting interval must be maintained between tightening step 2 and 3 (refer to table). In addition, tightening step 3 has been increased by 10 Nm to 100 Nm.

Tighten cylinder head bolts in steps in sequence of tightening diagram.

Do not loosen cylinder head bolts after setting interval, but directly continue tightening.



Independent of cylinder head bolt version, retightening of cylinder head bolts is no longer required during inspection 1000—1500 km or in the event of repairs after approx. 100—1500 km.

Valve clearance	with engine cold (appr. 20 °C)	with engine warm (appr.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.

Timing at 2 mm valve lift

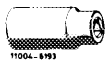
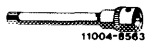
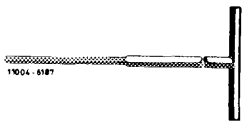
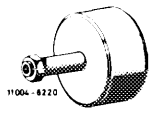
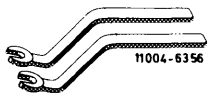
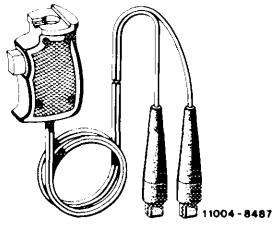
Engine	Camshaft code number[1)]	Intake valve opens after TDC	closes before BDC	Outlet valve opens before BDC	closes before TDC
617.950[2)]	00 08[4)]	with new timing chain			
		11.5°	13.5°	21°	19°
		with used timing chain (starting at approx. 20 000 km)			
		13.5°	15.5°	19°	17°
617.950[3)] 617.951 617.952	05[4)]	with new timing chain			
		9°	15°	27°	16°
		with used timing chain (starting at approx. 20 000 km)			
		11°	17°	25°	14°

[1)] The camshaft code number is punched into rear end of camshaft.
[2)] (USA) up to model year 1979
[3)] (USA) model year 1980
[4)] Camshaft made of chilled cast iron

Tightening torques		Nm
Nuts for cylinder head cover		15
Hex. socket cylinder head screws (with engine cold)	Step 1 Step 2 Setting interval Step 3	70 90 10 min 100
Hex. socket cylinder head screws (with engine cold)	Step 1 Step 2 Setting interval Step 3 Step 4	40 70 10 min 90° 90°
Necked-down screw for camshaft sprocket		80

Closing plug for chain tensioner	90
Nozzle holder in prechamber	70–80
Nuts for oil filter cover	20–25
Oil supply line to exhaust gas turbocharger	23
Screws for rocker arm bearing brackets to cylinder head	40

Special tools

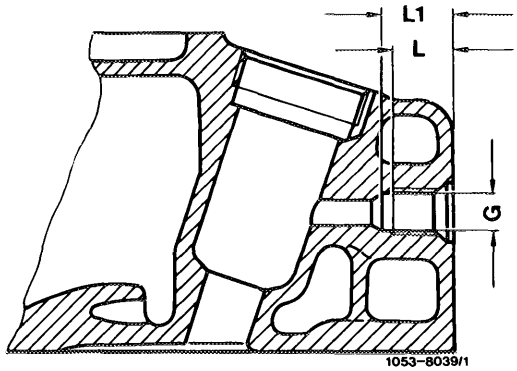
Socket 27 mm, 1/2" square socket for rotating engine		001 589 65 09 00
Socket 10 mm, 1/2" square, 140 mm long for hex. socket cylinder head bolts		000 589 05 07 00
Socket 1/2" square, 140 mm long for double hex. cylinder head bolts		617 589 00 10 00
Screwdriver (Allen wrench) with tommy handle for hex. socket screws, 6 mm, 440 mm long		116 589 03 07 00
Impact puller for bearing bolt (basic unit)		116 589 20 33 00
Threaded bolt for impact puller M 6, 50 mm long		116 589 01 34 00
Threaded bolt for impact puller, M 6, 150 mm long		116 589 02 34 00
Valve adjusting wrench 14 mm (2 each)		615 589 00 01 00
Holding wrench for valve spring retainer		615 589 00 03 00
Contact handle for rotating engine (component of compression pressure recorder 001 589 46 21 00)		001 589 46 21 08
Torque wrench with plug-in ratchet, 1/2" square, 40–200 Nm		001 589 67 21 00

Note

Remove cylinder head only from cooled-down engine. Remove together with exhaust manifold and boost air pipe.

On engine 617.950 (USA) starting 1980, threaded bore (G) and seat bore in cylinder head for quick-start pencil element glow plugs have been extended by 3 mm (L and L 1).

L 19 mm
L 1 22.5 mm



This cylinder head has been installed on engines 617. 951/952 from start of series.

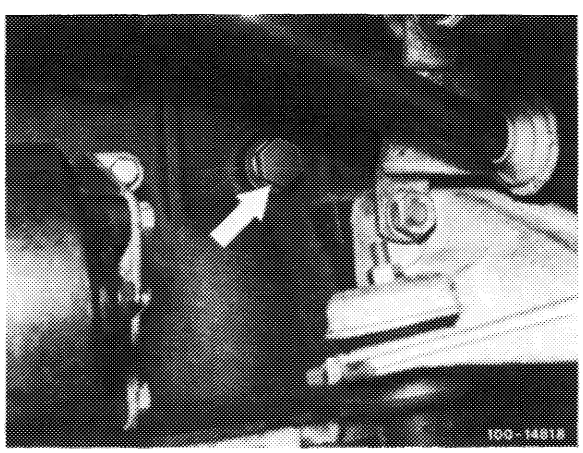
In the event of repairs, the head can also be installed on engines 617.950 made at an earlier date. On the other hand, the cylinder head with shorter thread and seat bores should not be installed on engines with quick-start system, since a part of the quick-start effect will be lost.

For these engines the cylinder head gaskets require no retightening. As a result, no retightening of cylinder head bolts is required during 1st inspection (1000–1500 km) and in the event of repair, after driving 1000–1500 km.

The cylinder head gaskets welded in-between sheeting may be removed from package only directly prior to assembly, since they are sensitive to light and ozone.

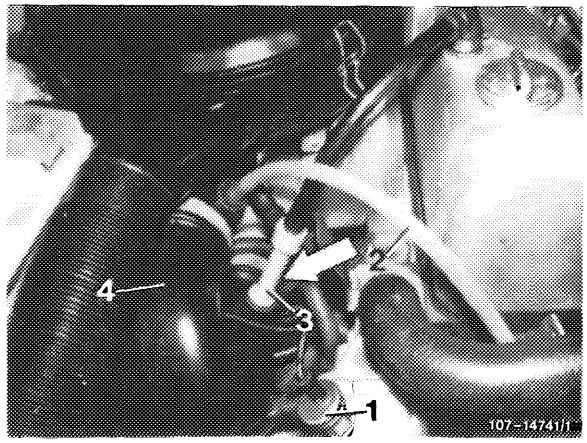
Removal

1 Completely drain coolant.



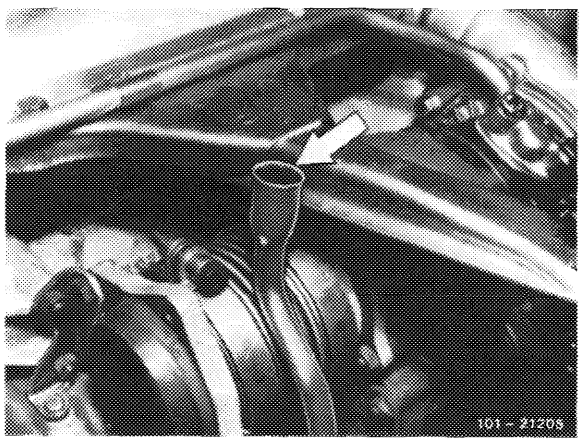
Drain plug on cylinder crankcase

2 Remove air cleaner with intake line (4). For this purpose, pull off engine vent line (3) and on model 116.120 with double diaphragm vacuum pump, pull vacuum line (2) and cable from temperature switch (1).

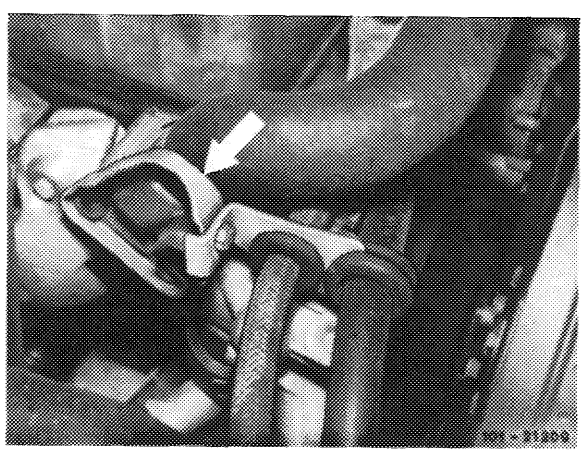


Model 116.120
1 Temperature switch 100 °C
2 Vacuum line
3 Vent line
4 Intake line

3 On engines with EGR (USA) cover return line from cyclonic oil separator to oil pan (arrow).

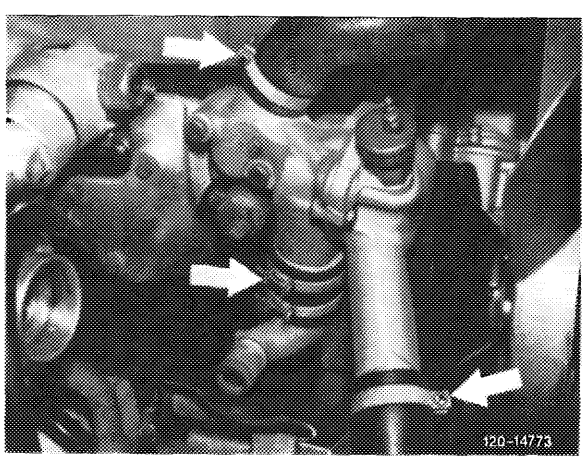


4 On model 123 with level control, unscrew line holder from thermostat housing (arrow).



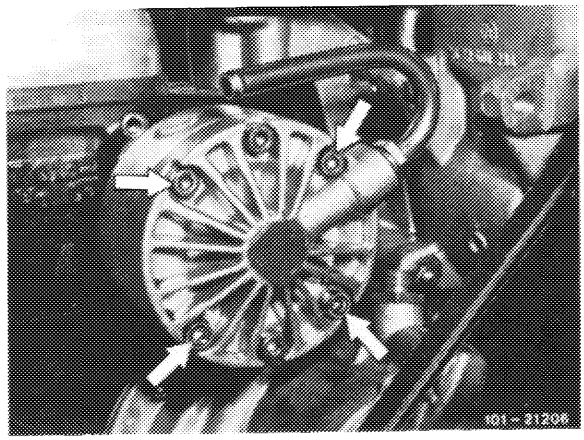
5 Disconnect the three coolant hoses (arrows) on thermostat housing and heater supply hose on cylinder head. Remove upper coolant hose to radiator.

6 Unscrew bleed line between cylinder head and water pump housing.

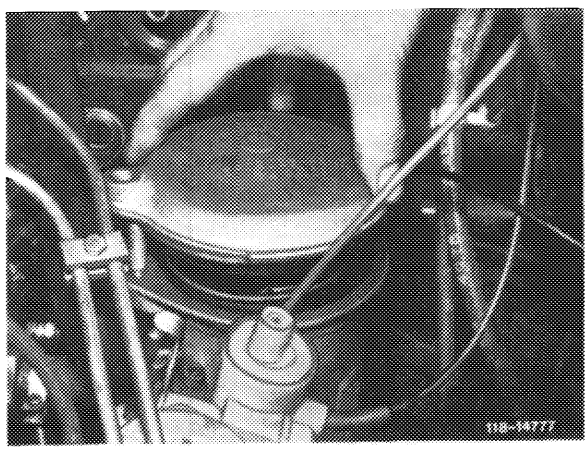


7 On model 123 with level control, remove hydraulic oil pump with connected lines and put aside.

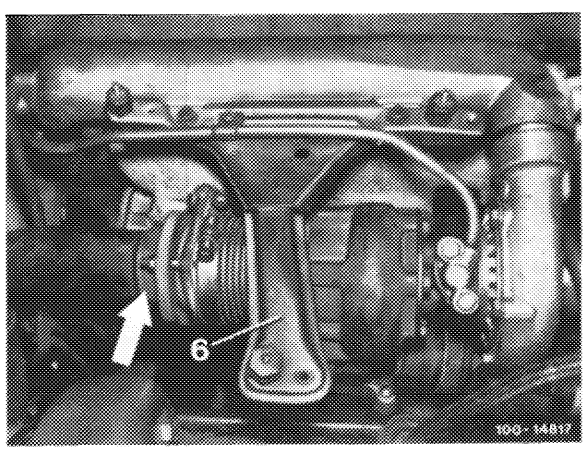
For this purpose, unscrew screws (arrows).

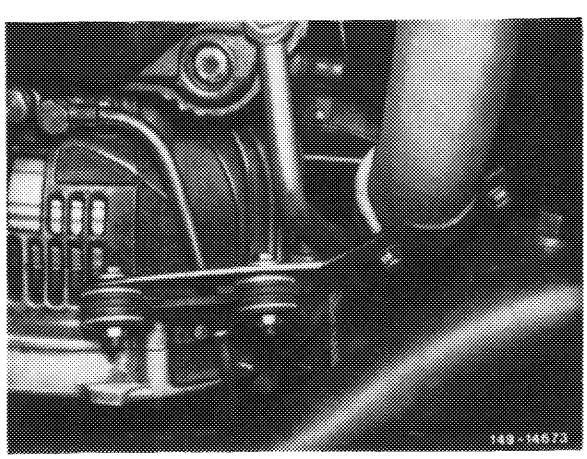


8 Loosen oil filter cover and pull up for a short distance.

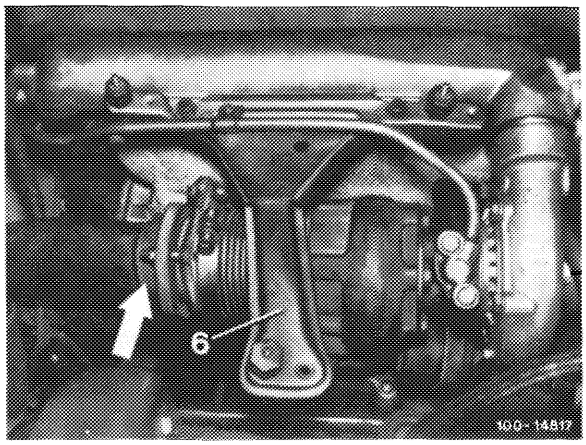


9 Unscrew exhaust on exhaust gas turbo-charger (arrow) and on transmission.





10 Unscrew oil dipstick guide tube of automatic transmission on boost air pipe.

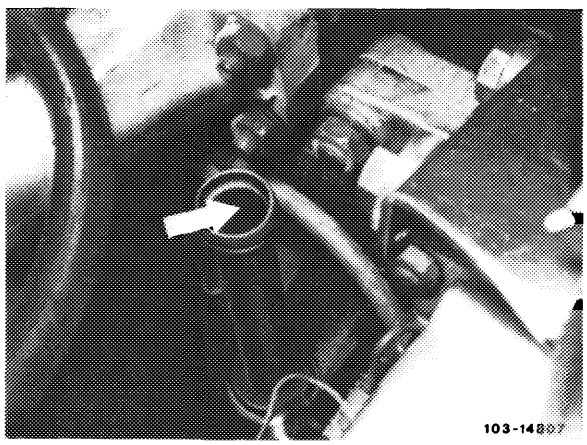


11 Completely unscrew oil feed line for exhaust gas turbo-charger.

12 Unscrew line (a) on boost air pipe.

13 Remove injection line and cover connections.

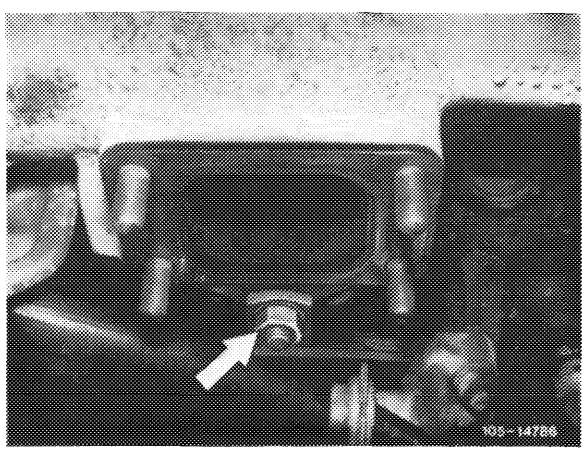
14 Unscrew or pull off cable harness on pencil element glow plugs, on pressure switch in boost air pipe and on (USA) up to 1980 on temperature switch.



15 Pull fuel return line from 1st injection nozzle.

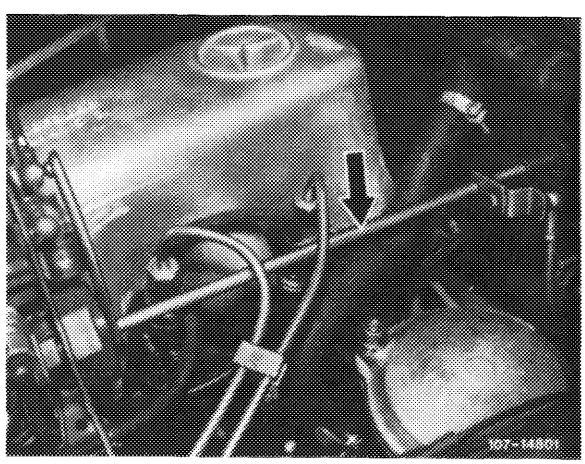
16 On models 123 and 126.120 with cruise control/ tempomat, unscrew actuator with holder on power steering pump carrier, disconnect linkage and put actuator aside.

17 Remove power steering pump with bracket and fuel filter and put aside.



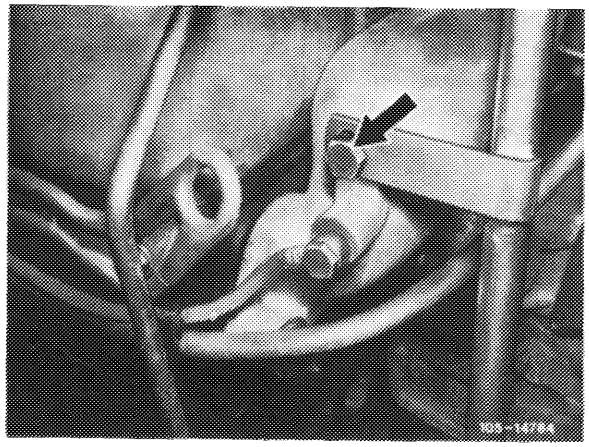
For this purpose, unscrew the five screws indicated by arrows.

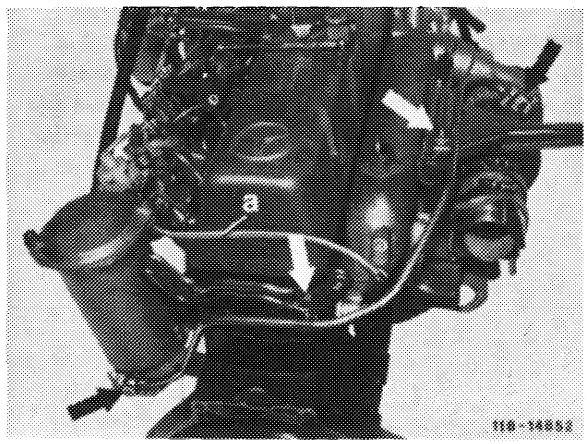
Do not disconnect hoses and lines.



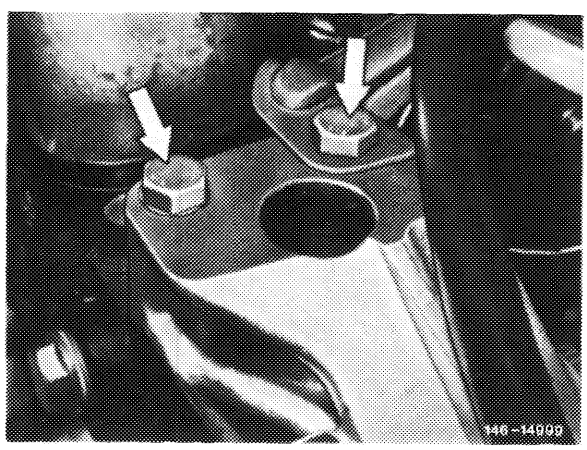
18 Remove exhaust turbo-charger.

For this purpose, unscrew holder (6) for air filter. Cover oil return pipe (arrow).



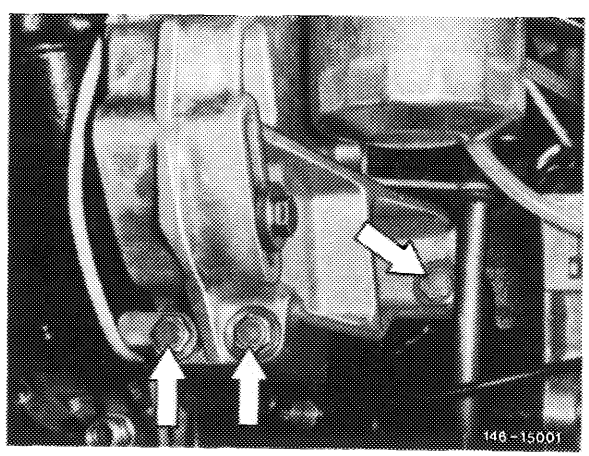


19 Unscrew exhaust manifold support on manifold (arrow).



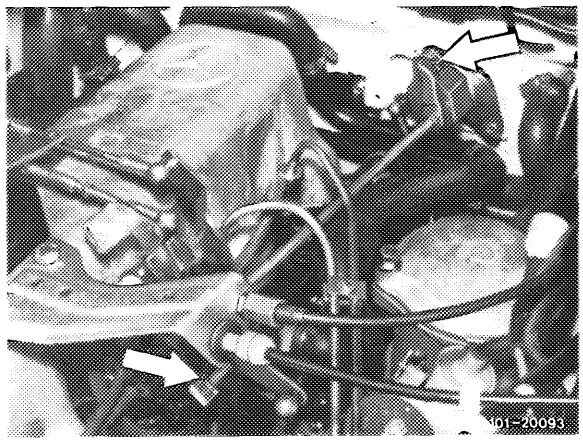
20 Remove cylinder head cover. For this purpose, disconnect regulating linkage. Pull out locking eye of longitudinal regulating shaft (arrow).

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



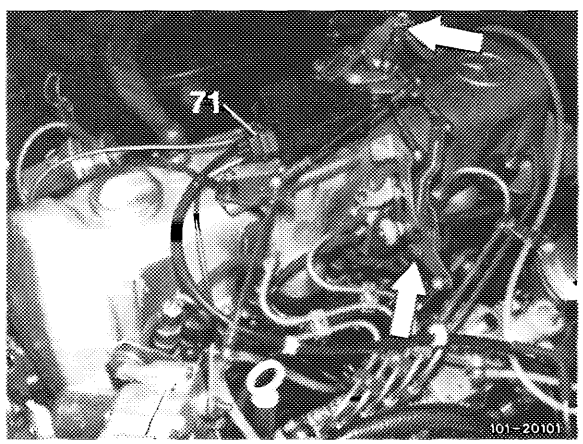
Model 116.120

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



Model 123

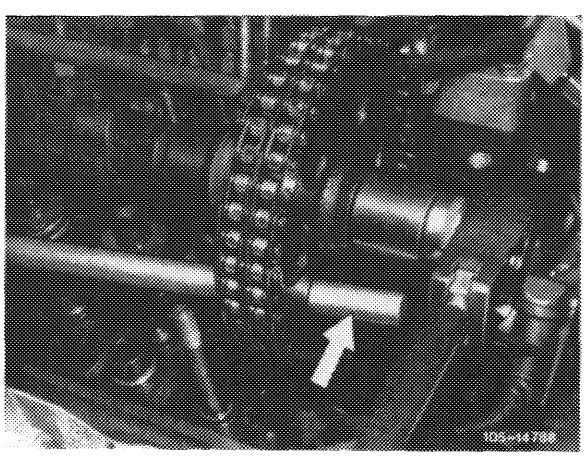
On models 123 with automatic transmission 722.303 (W4A 040) and 126.120, pull off central plug for vacuum lines (71) or vacuum lines. Disconnect bowden wire, compress black plastic clip (arrow) and pull bowden wire out of holder in rearward direction.



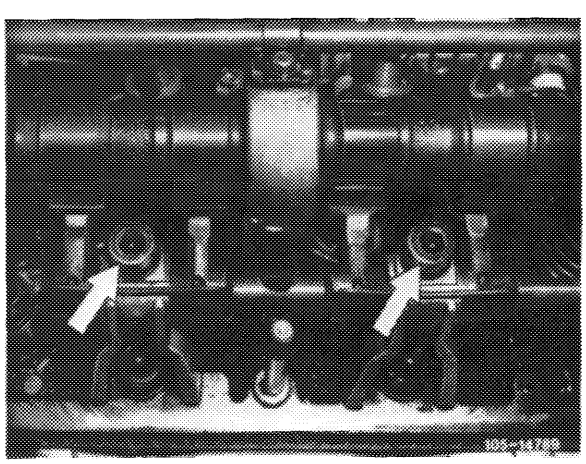
Model 126.120

21 Loosen necked-down screw for attaching camshaft sprocket, do not screw out.

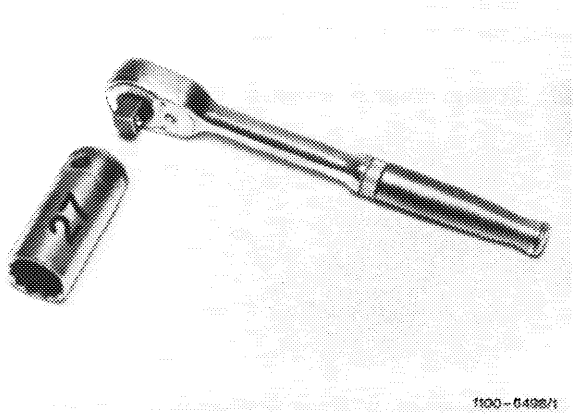
For loosening camshaft sprocket, apply counterhold with a screw driver or a steel bolt.



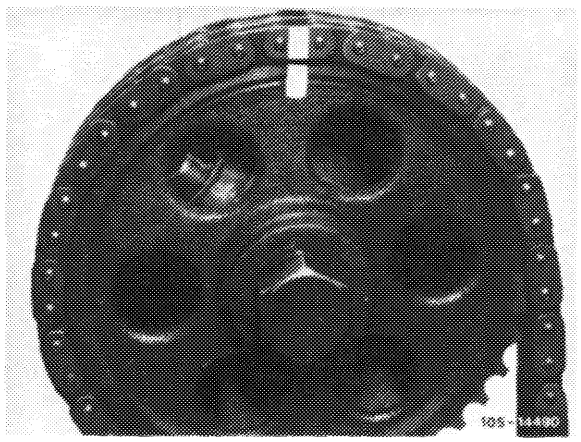
22 Remove both rocker arm groups. For this purpose, set camshaft in such a manner that the rocker arms are not under load.



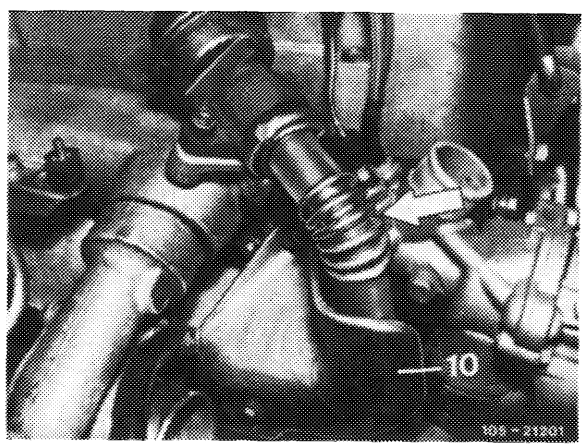
23 Set engine to ignition TDC of 1st cylinder. For this purpose, rotate engine at crankshaft by means of tool combination.



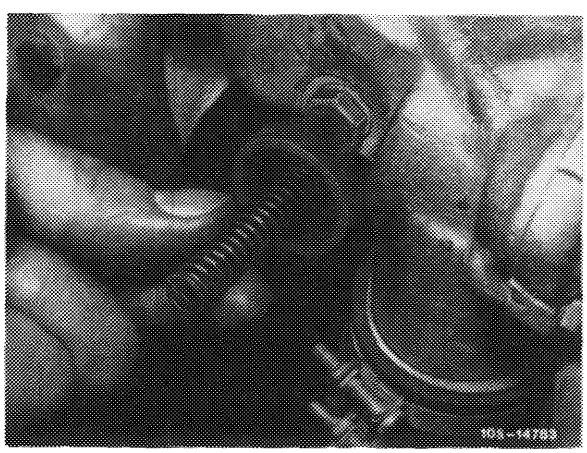
24 Mark camshaft sprocket and timing chain in relation to each other.



25 On engines with EGR (USA), remove pipe line between EGR valve and exhaust manifold (arrow). For this purpose, unscrew shielding plate (10).

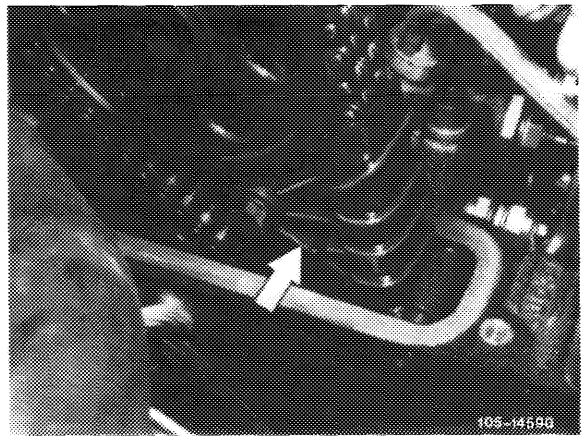


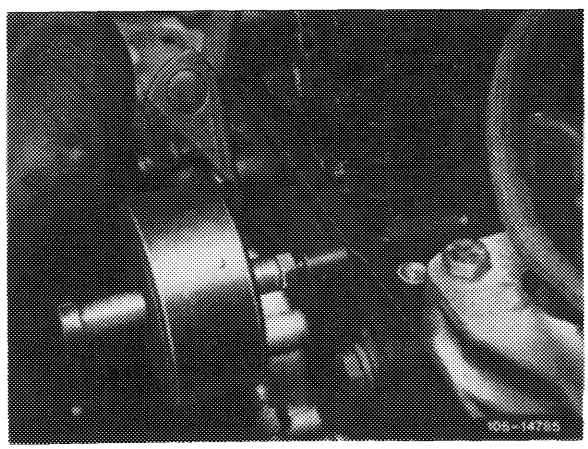
26 Unscrew closing screw of chain tensioner and remove compression spring.



27 Remove slide rail in cylinder head. Pull out bearing bolt by means of impact puller.

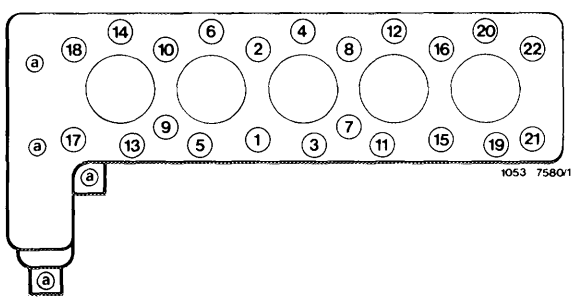
28 Remove camshaft sprocket.



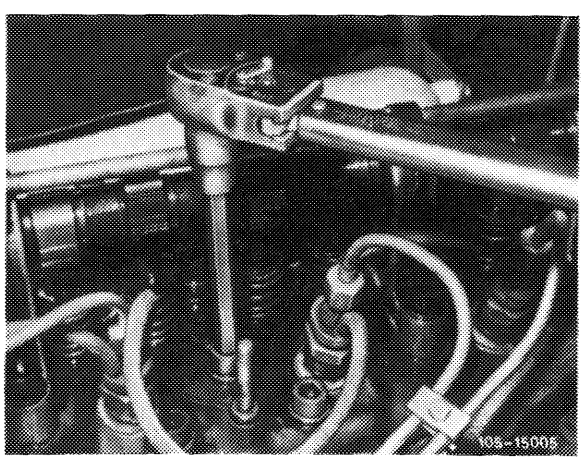


29 Loosen cylinder head bolts in reverse order of tightening diagram by means of Allen wrench insert and screw out.

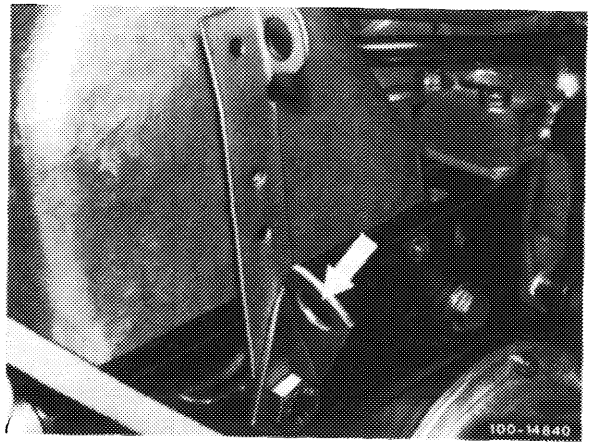
Unscrew the M 8-screws by means of Allen wrench 6 mm, 440 mm long.



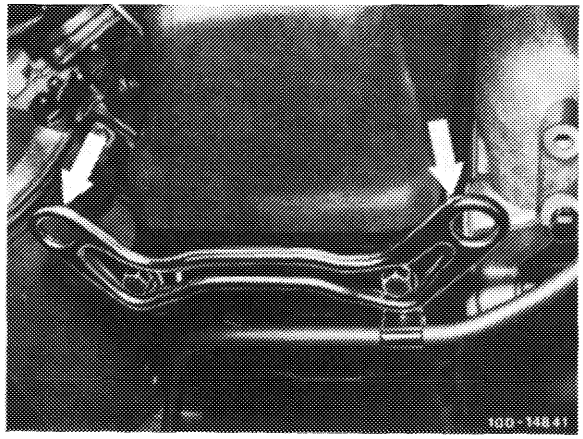
30 Remove injection nozzles to remove the 5 screws adjacent to injection nozzles.



31 Lift out cylinder head. This can also be done by means of a crane and an engine hoist (Motordirigent). Suspend the cables for this purpose at the three suspension eyes.



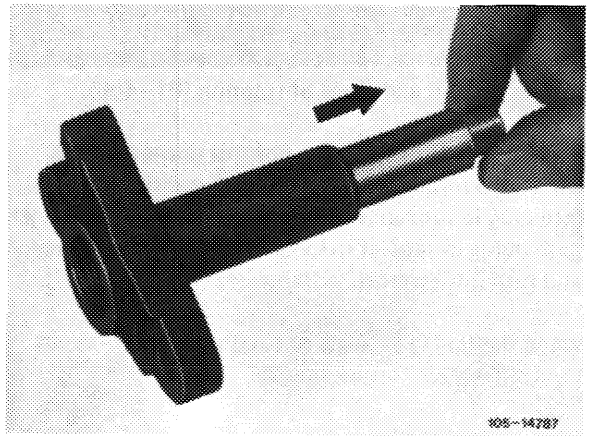
Suspension eye front



Suspension eyes rear

32 Pull out thrust bolts of installed chain tensioner in inward direction (arrow).

33 Thoroughly clean cylinder crankcase and cylinder parting surface.



Installation

34 Mount new cylinder head gasket.

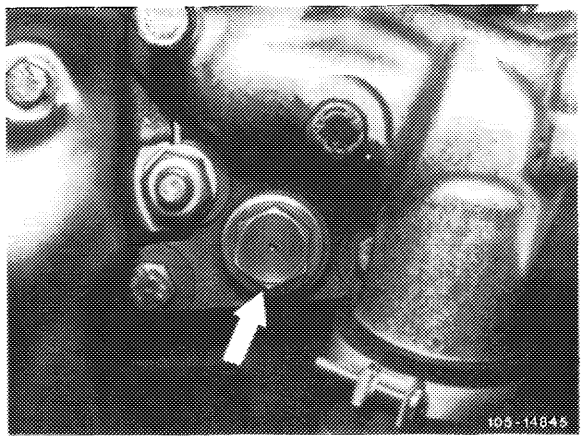
35 Mount cylinder head while paying attention to hollow dowel pins for locating cylinder head.

36 With double hex. cylinder head bolts, measure

43 Install slide rail.

44 Insert thrust bolts and compression spring of chain tensioner from outside.

Position closing plug with new sealing ring and tighten to 90 Nm.

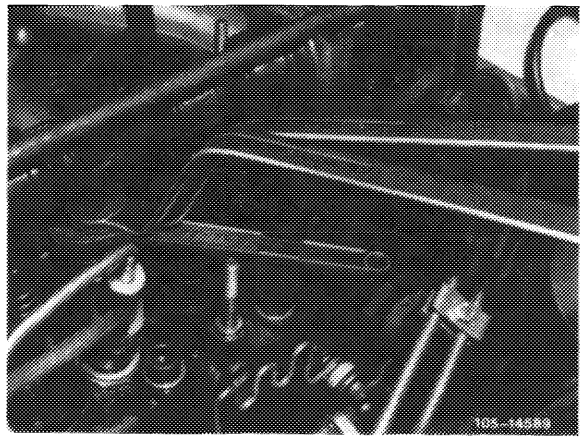


45 Adjust valve clearance (05—210).

46 Install injection nozzles. Insert new nozzle reeds first.

47 Screw-on exhaust manifold support.

48 Install exhaust gas turbo-charger with new gasket. When positioning turbo-charger, pay attention to oil return pipe. Remove cover.



49 Unscrew oil feed line for exhaust gas turbo-charger. Insert new gasket for exhaust gas turbo-charger.

50 For further installation proceed vice versa to removal.

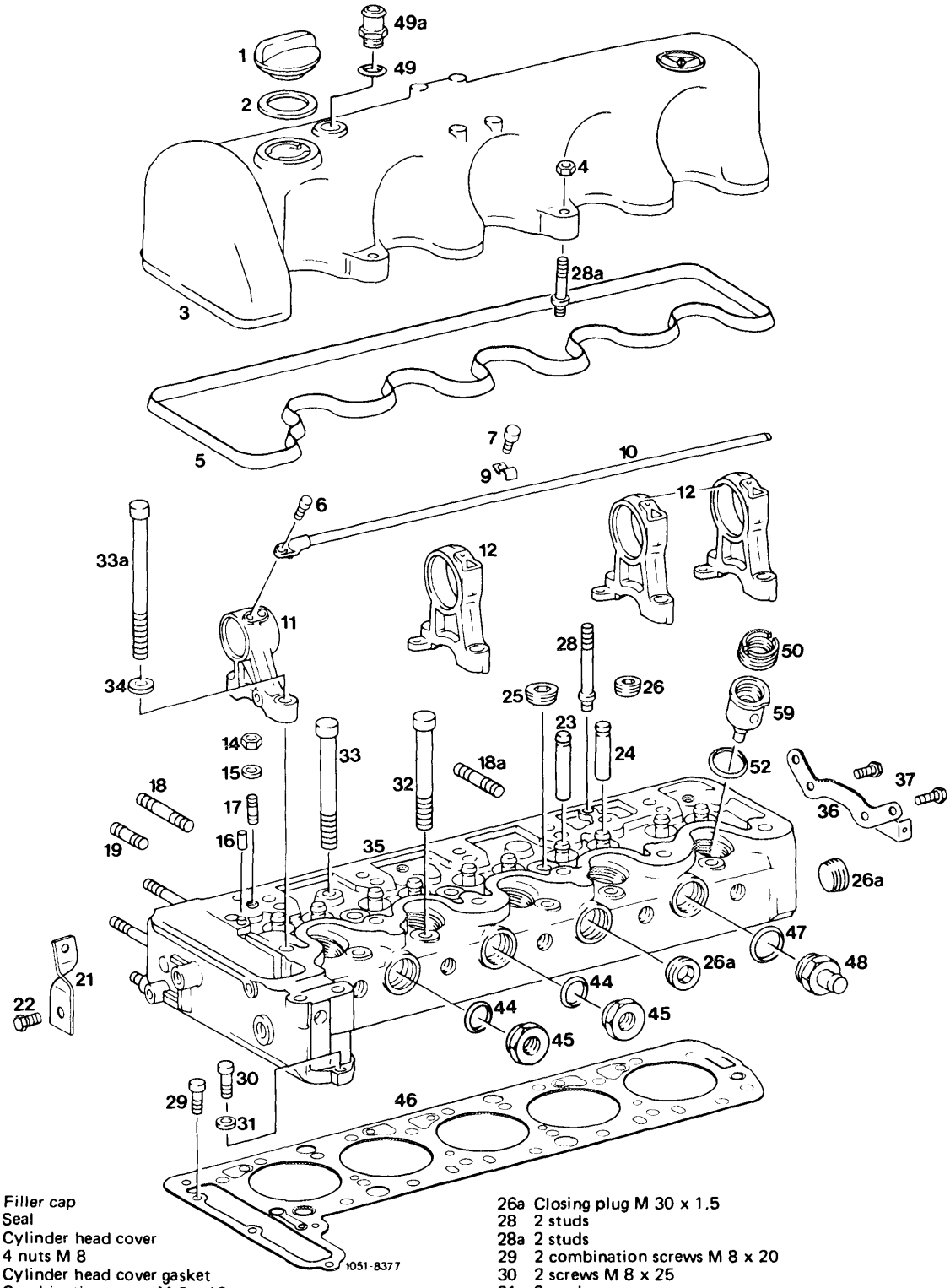
51 Add coolant (20—010) and pressure-test cooling system.

52 Bleed injection system by means of a hand pump.

53 Run engine and check for leaks.

Note: Retightening of cylinder head bolts and setup of valve clearance on warm engine not required.

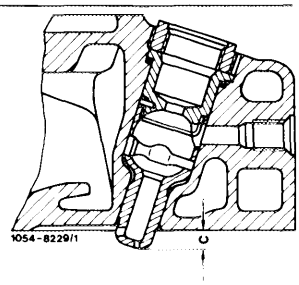
Cylinder head and cylinder head cover



1 Filler cap
2 Seal
3 Cylinder head cover
4 4 nuts M 8
5 Cylinder head cover gasket
6 Combination screw M 6 x 12
7 3 combination screws M 5 x 10
9 3 fastening clips
10 Oil pipe
11 Camshaft bearing crank end
12 Camshaft bearing
14 4 nuts M 8
15 4 washers 8.4
16 8 cyl. pins 8 x 8
17 4 studs M 8 x 18
18 5 studs M 10 x 52
18a Stud M 10 x 40
19 Stud M 10 x 30
21 Suspension eye
22 Screw
23 5 valve guides intake
24 5 valve guides exhaust
25 4 closing plugs M 26 x 1.5
26 Closing plug M 22 x 1.5
26a Closing plug M 30 x 1.5
28 2 studs
28a 2 studs
29 2 combination screws M 8 x 20
30 2 screws M 8 x 25
31 2 washers
32 5 cylinder head bolts M 12 x 105 or 104
33 9 cylinder head bolts M 12 x 120 or 119
33a 8 cylinder head bolts M 12 x 145 or 144
34 22 washers
35 Cylinder head
36 Suspension eye
37 Screw M 8 x 16
44 Sealing ring A 30 x 36
45 Screw connection
46 Cylinder head gasket
47 Sealing ring A 30 x 36
48 Thread connection for heater
49 Sealing ring A 18 x 24
49a Connection
50 5 threaded rings
52 5 sealing rings
59 5 pre-chambers

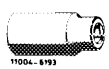
Data

Pre-chamber standout on cylinder head
dimension "c" 7.8–8.4 mm



Tightening torques	Nm
Coupling nuts of injection lines	25
Nuts for cylinder head cover	15
Pre-chamber in cylinder head (threaded ring)	150–180
Nozzle holder in pre-chamber	70–80

Special tools

Open box wrench insert, 17 mm, 1/2" square socket for injection lines	 11004-6359	000 589 68 03 00
Socket 27 mm, 1/2" square socket	 11004-6193	001 589 65 09 00
Socket wrench for threaded ring of pre-chamber	 11004-6360	615 589 00 07 00
Puller for pre-chamber	 11004-6365	615 589 00 33 00

Note

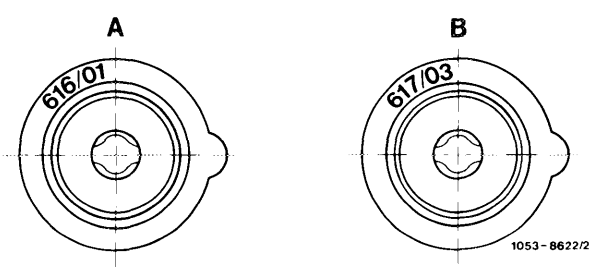
The prechambers of engines 616.912 and 617.912 may not be installed on these engines.

For identification, a code number (617/03) is shown at upper flange of pre-chamber.

In addition, the pre-chamber can be identified by means of the smaller bore (0–9 mm dia.) for glow plug.

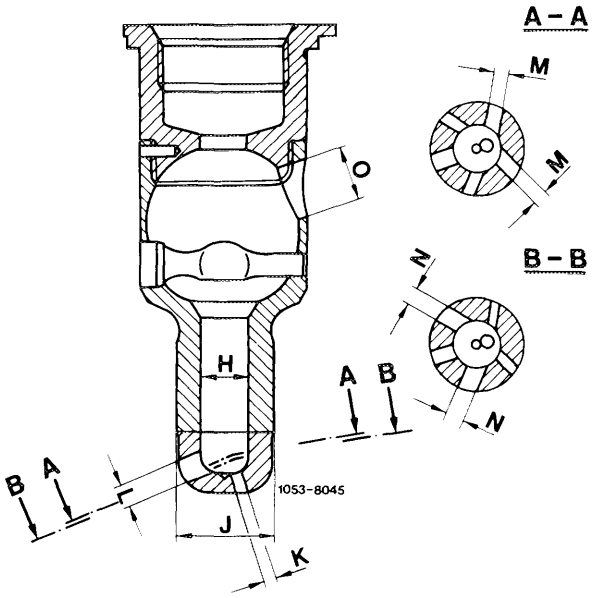
A Prechamber engines 616.912/617.912

B Prechamber engines 617.950/951/952



Six burner bores of different diameter are in place in pre-chamber lower half (burner neck) at different levels and angle positions.

The firing duct (H) has a diameter of 8 mm, the burner neck (J) of 16 mm.



H	Firing duct	8 mm dia.
J	Burner neck	16 mm dia.
K	Burner bore	2 mm dia.
L	Burner bore	3.5 mm dia.
M	Burner bore	2.5 mm dia.
N	Burner bore	3.2 mm dia.
O	Bore for glow plug	9 mm dia.

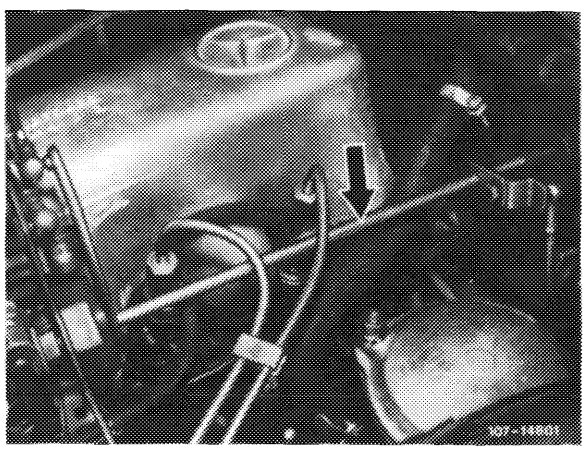
In addition, the pre-chamber bottom is of spherical shape.

The spherical shape provides uniform wall thickness in range of burner bores.

Removal

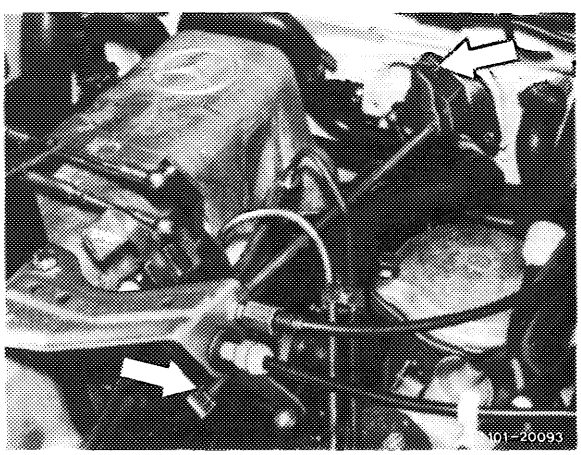
1 Disconnect regulating linkage to remove cylinder head cover. Pull out locking eye of longitudinal regulating shaft (arrow).

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



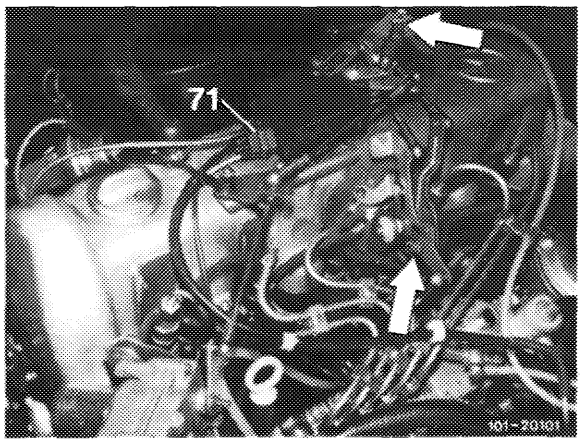
Model 116.120

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



Model 123

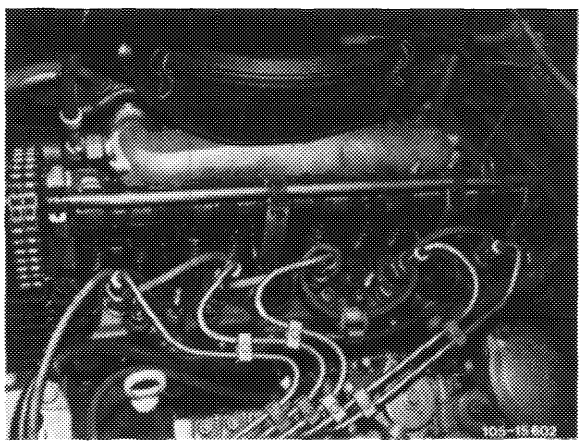
On models 123 with automatic transmission 722.303 (W4A 040) and 126.120, pull off central plug for vacuum lines (71) or vacuum lines. Disconnect bowden wire, compress black plastic clip (arrow) and pull bowden wire out of holder in rearward direction.



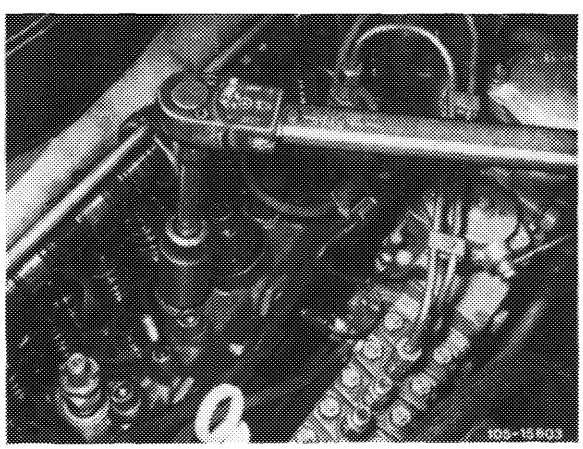
Model 126.120

2 Remove injection lines.

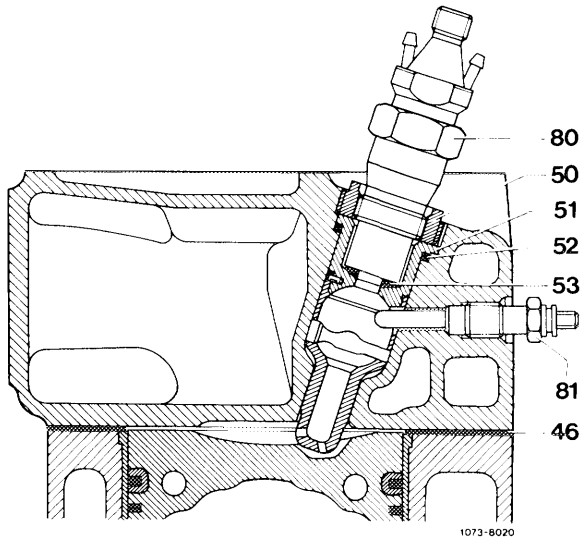
3 Pull fuel return hoses from injection nozzles.



4 Unscrew complete nozzle holder by means of socket (27 mm).



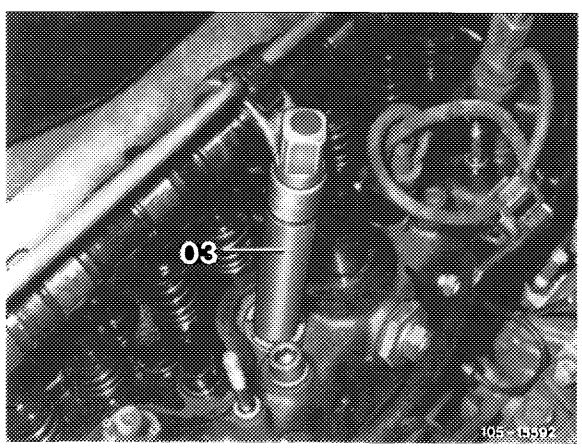
5 Unscrew rod-type glow plugs (81).



46 Cylinder head gasket
50 Threaded ring
51 Pre-chamber
52 Sealing ring
53 Nozzle reed
80 Nozzle holder
81 Rod-type glow plug

6 Unscrew threaded ring (50) by means of socket wrench.

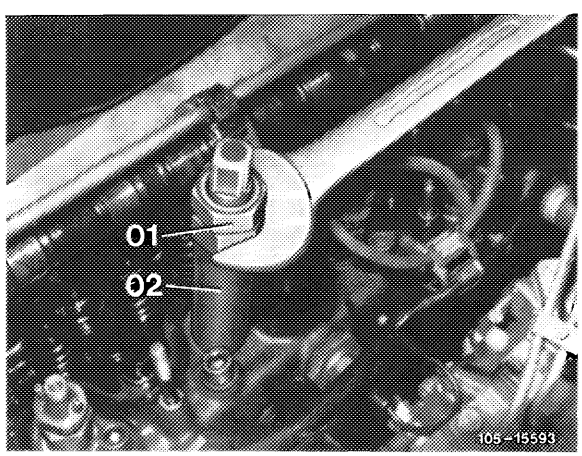
For this purpose, screw insert (03) into threaded ring, place sleeve (02) into grooves of threaded ring (arrows) and tighten with nut (01).



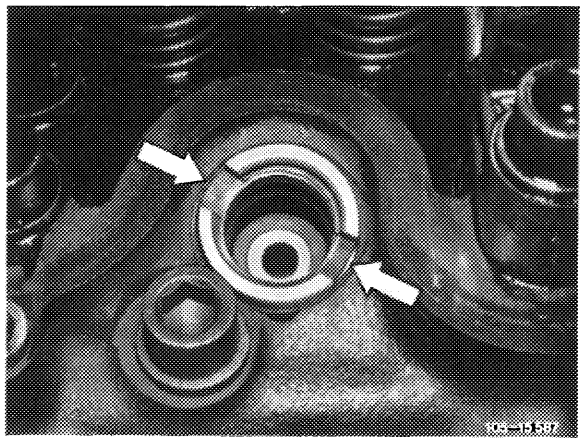
03 Screw insert

Sleeve (02) should be seated in grooves tight enough to prevent slipping out of grooves when the threaded ring is released.

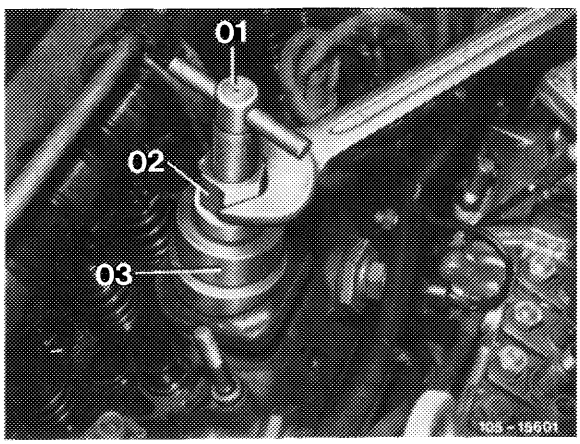
Position wrench against hex. head of sleeve (02) and unscrew threaded ring.



01 Nut
02 Sleeve



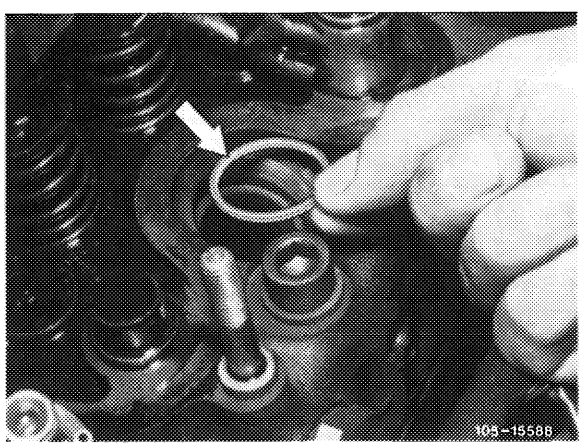
7 Pull-out pre-chamber by means of puller. Screw spindle (01) into pre-chamber. Place bell-shaped member (03) on cylinder head. The contact surface of the bell-shaped member is provided with 2 lugs. One lug each should be seated in hex. or double hex. socket of cylinder head bolt adjacent to pre-chamber. Pull-out pre-chamber by rotating nut (02) with an open-end wrench.



01 Spindle
02 Nut
03 Bell

8 Remove sealing ring (arrow) from cylinder head.

9 Cover bore in cylinder head.



Installation

Note: If the removed pre-chambers are installed again, check for perfect condition.

Ball pin should not be burnt or scaled.

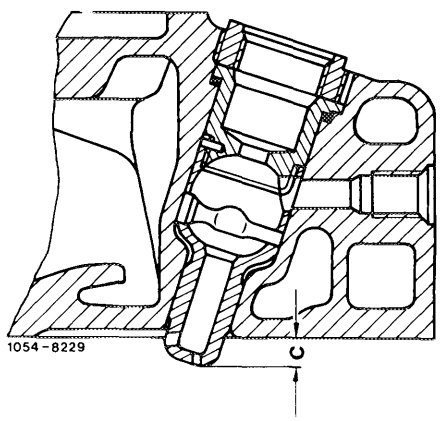
In addition, if burner tops are scorched or if pre-chamber lower half shows cracks, remove boost air pipe and check inside for traces of oil.

If oil-moist spots are found, check diaphragm of vacuum pump on engine 617.950 (USA) up to 1979 for cracks and other damage or renew vacuum control unit on injection pump of all engines.

The faulty component is identified by means of the vacuum lines (blackened by oil).

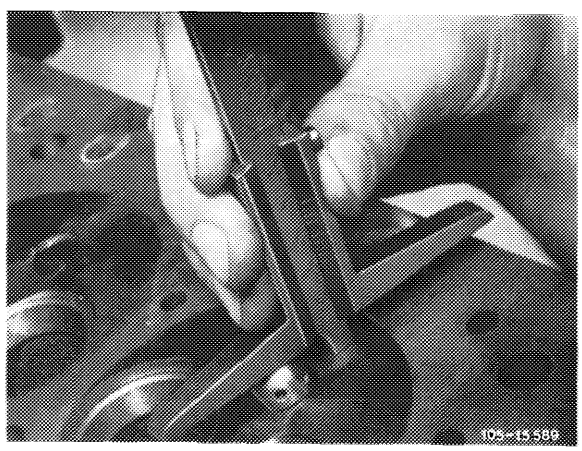
10 Place new sealing ring (52) into cylinder head. Use original sealing ring of specified thickness and shape only, so that the required distance (c) of 7.8–8.4 mm between pre-chamber and cylinder head is maintained.

Note: If a cylinder head has been faced at parting surface, add thicker sealing rings (52) between cylinder head and pre-chamber when installing pre-chambers.



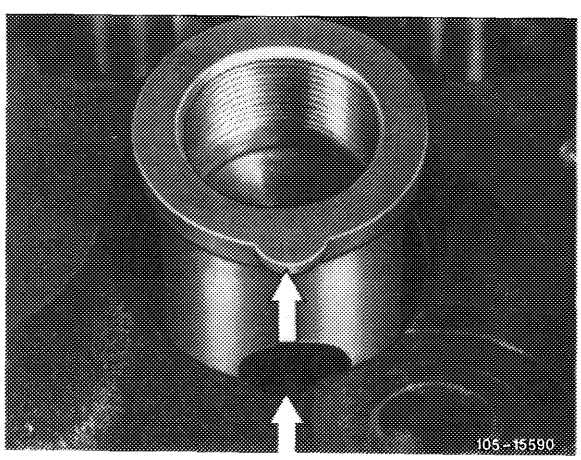
The following sealing rings are available:

Thickness	Part No.
1.9–2.1 (standard)	615 017 00 60
2.2–2.4	615 017 01 60
2.5–2.7	615 017 02 60
2.8–3.0	615 017 03 60



11 Screw spindle (01) of puller into pre-chamber (illustration item 7). Position pre-chamber in such a manner that the lug faces recess in cylinder head (arrows).

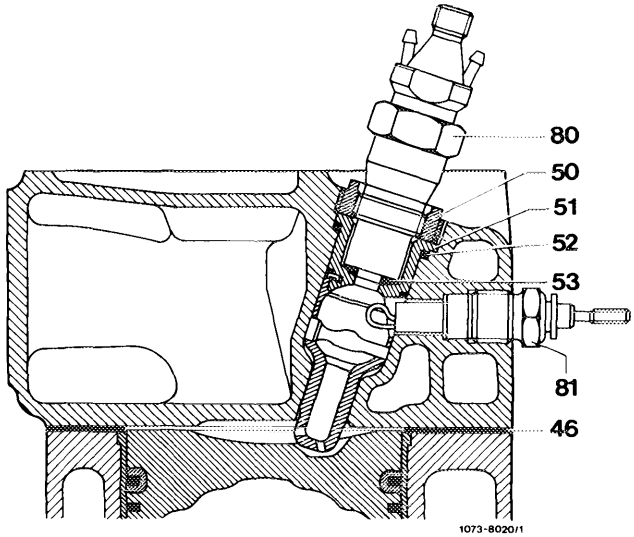
Insert pre-chamber by means of light blows with a plastic hammer against spindle. Pull bell-shaped member (03) with one hand in upward direction and hold in place (illustration item 7).



12 Lubricate threaded ring (50) and tighten to specified torque of 150—180 Nm by means of pertinent socket wrench.

13 Screw-in pencil element glow plugs and connect.

14 Insert new nozzle plate (53 Fig. item 5).
The resilient nozzle plate can be installed on all engines.



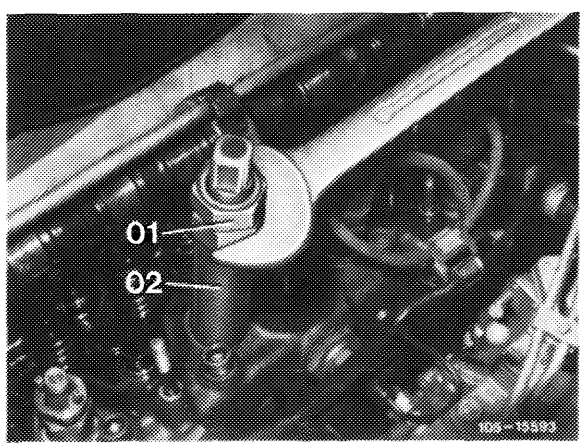
53 Nozzle plate
80 Nozzle holder
81 Pencil element glow plug

15 Completely screw-in nozzle holder and tighten to 70—80 Nm.

16 Install injection lines.

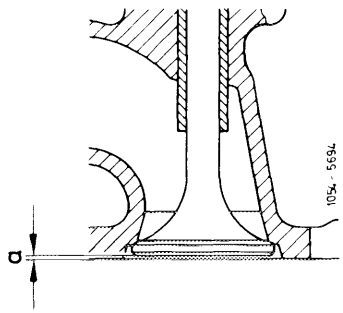
17 Plug fuel return hoses to injection nozzles.

18 Mount cylinder head cover.



Data

Total height of cylinder head		84.8–85.0
Minimum height upon machining		84.0
Permissible unevenness of parting surfaces	in longitudinal direction	0.08
	in transverse direction	0.0
Permissible deviation in parallel of upper parting surface in relation to lower parting surface in longitudinal direction		0.1
Roughness		0.016
Test pressure with air under water in bar gauge pressure (atü)		2
Minimum distance "a" with new valves and new valve seats		
Intake	+ 0.17 to –0.23	
Exhaust	+ 0.12 to –0.28	
Max. distance "a" with new valves and machined valve seats		
Intake	1.0	
Exhaust		

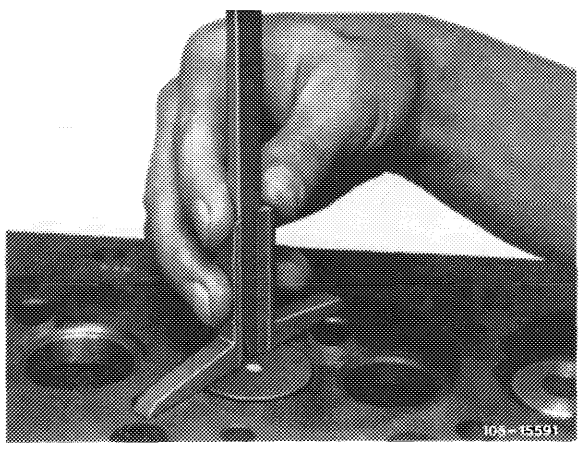


Facing

1 Face parting surface of cylinder head.

2 Refinish valve seats until minimum distance "a" is attained.

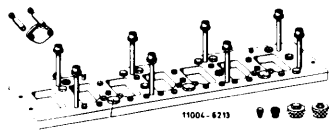
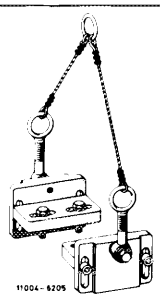
3 Check timing (05–215).



Data

Test pressure with air under water in bar gauge pressure (atü)	2

Special tools

Pressure plate		617 589 01 25 00
Suspension device		115 589 34 63 00

Conventional tool

Electrically heated water basin	e.g. made by Otto Dürr, D-7123 Sachsenheim-Ochsenbach

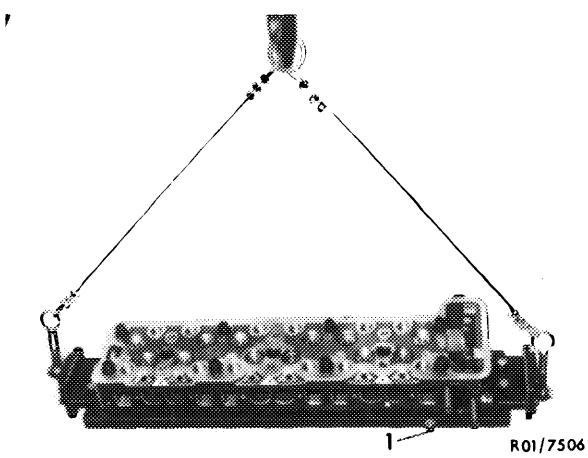
Pressure test

If cylinder seems to have cracks (coolant loss), a pressure test is required.

1 Screw pressure plate on clean cylinder head.

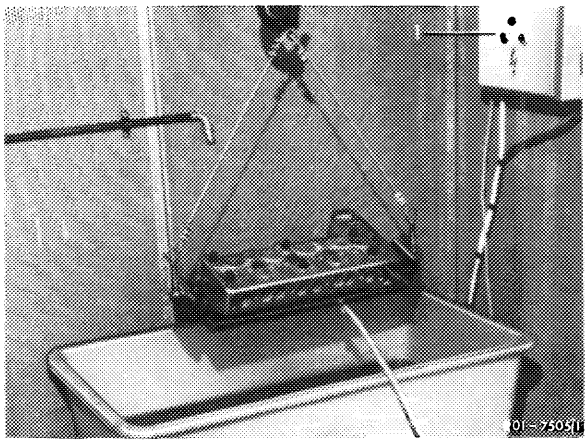
2 Close bores and connections.

3 Connect compressed air hose (1) and set compressed air to 2 bar gauge pressure.



4 Attach cylinder head to suspension device and lower into water heated to 80 °C.

5 If air bubbles are rising, find leaks.



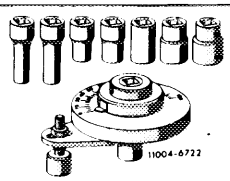
Dimensions of connecting rod bolt

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

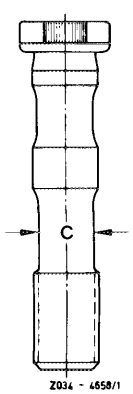
Angle of rotation tool		116 589 01 13 00

Self-made tool

Steel plate	refer to Fig. item 3

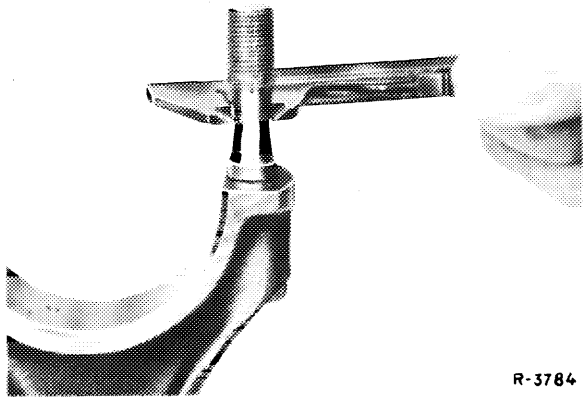
Checking

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



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.

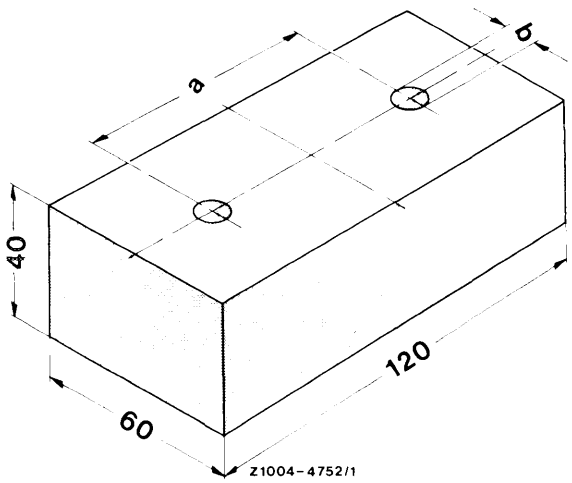


Replacement

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.



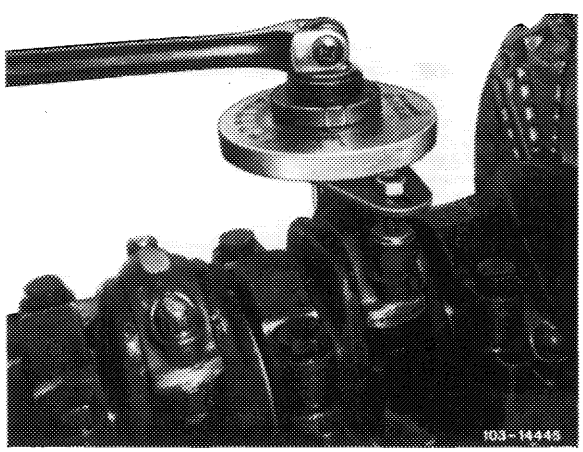
Hole spacing a = 67 mm
Bore b = 11 mm

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.

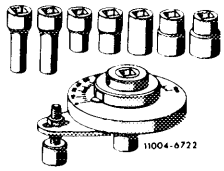
Data

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

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

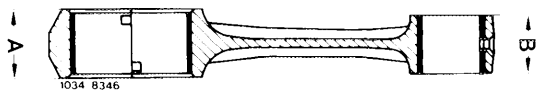
Connecting rod straightening tool	e.g. made by Hahn & Kolb, D-7000 Stuttgart model BC 503

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.

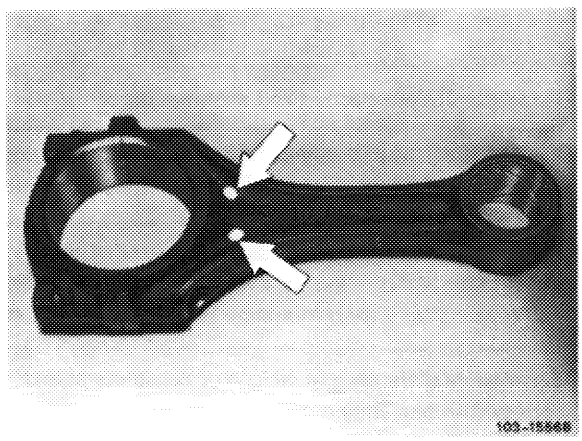


A Width of connecting rod bearing bore
B Width of connecting rod bushing bore

The connecting rods are subdivided into weight classes.

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

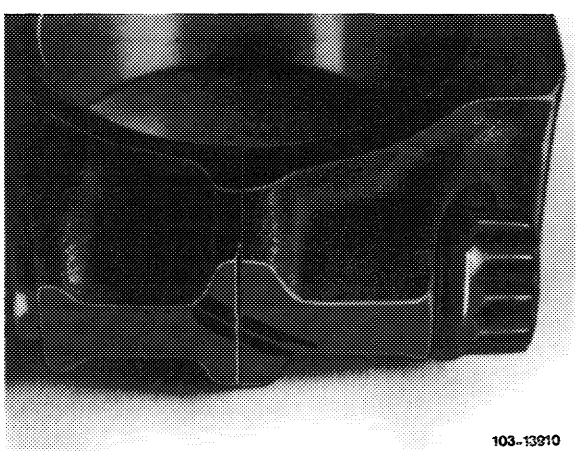
Install only connecting rods with the same color dots in engine.



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.



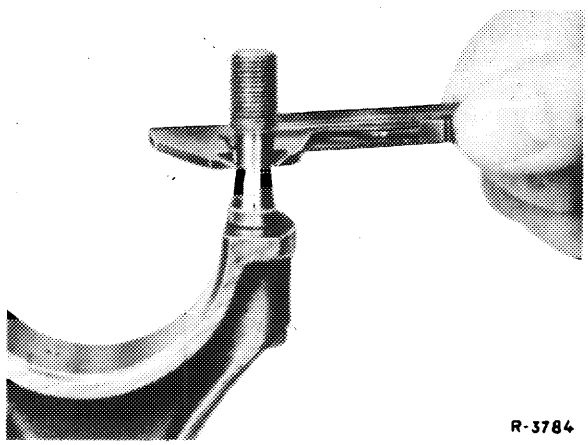
In the period from May to October 1980, connecting rod bearing shells of a second manufacturer (Karl Schmidt) were installed. Standard shells from Glyco.

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

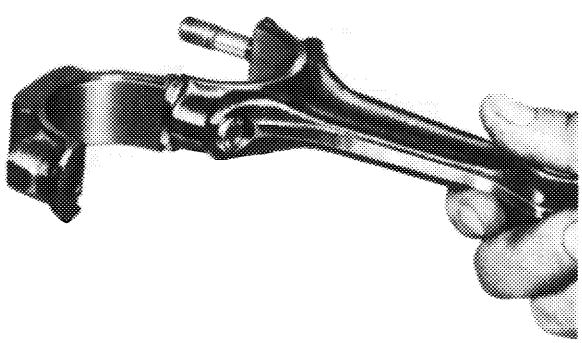
Reconditioning

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


R-3784

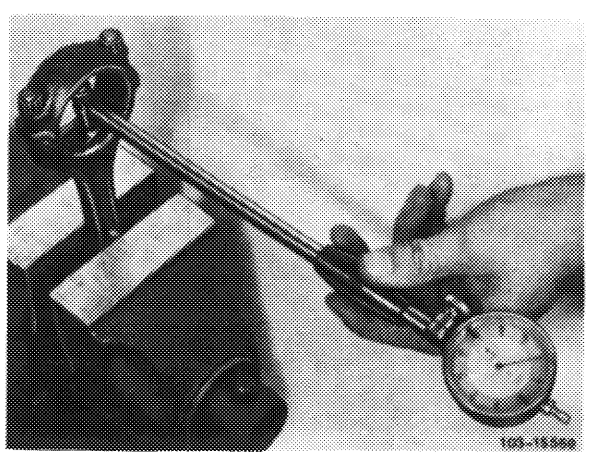
2 Check bores for connecting rod bolts.

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.

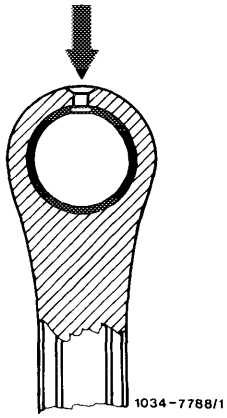


5 Press-in new connecting rod bushing in such a manner that the oil bores are in alignment.

Pressing-in pressure 2500 N.

6 Machine or ream connecting rod bushing.

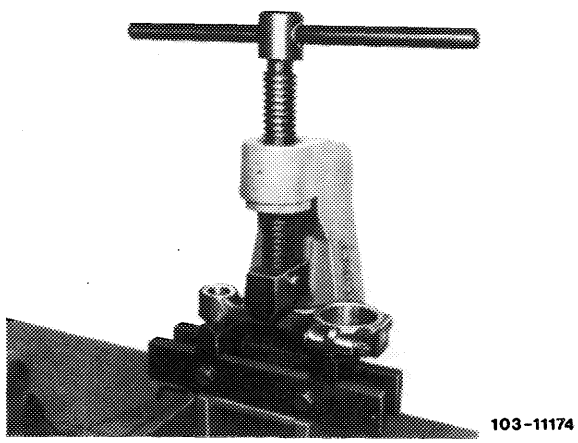
7 Refinish lateral contact surfaces of connecting rod on a face plate.



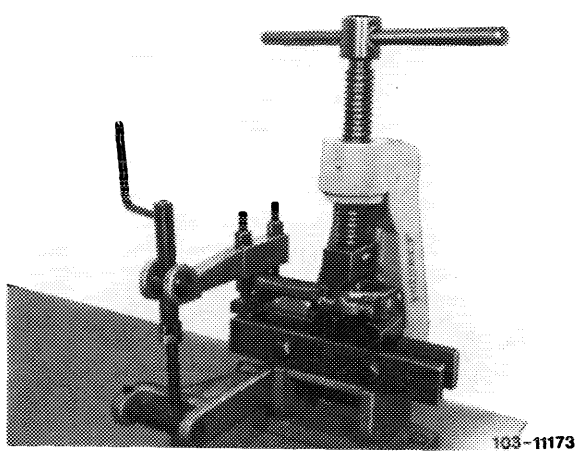
Squaring

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.



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

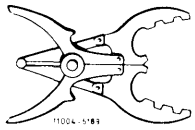
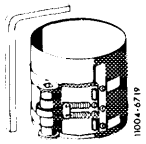
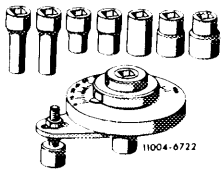
Distance between piston crown and cylinder crankcase parting surface	standout max. 0.9 standout min. 0.5

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

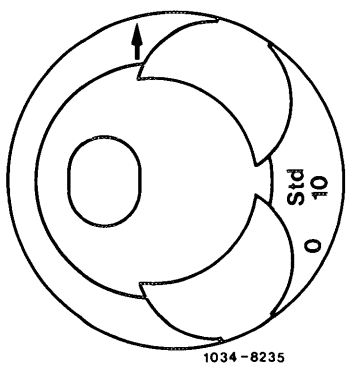
Expanding pliers for piston rings		000 589 51 37 00
Clamping strap for piston rings		000 589 04 14 00
Angle of rotation tool		116 589 01 13 00

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 crankcase parting surface.

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



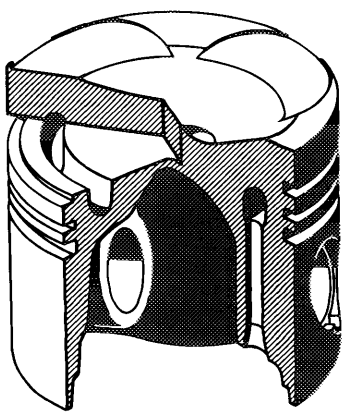
1034-8235

The specified piston clearance will then be maintained.

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

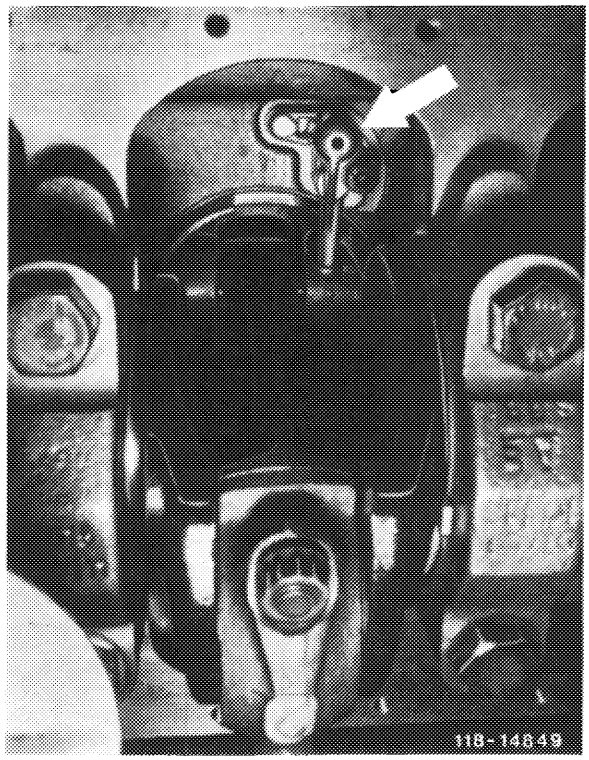
The piston shank is graphite-treated.

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).


1034-8120

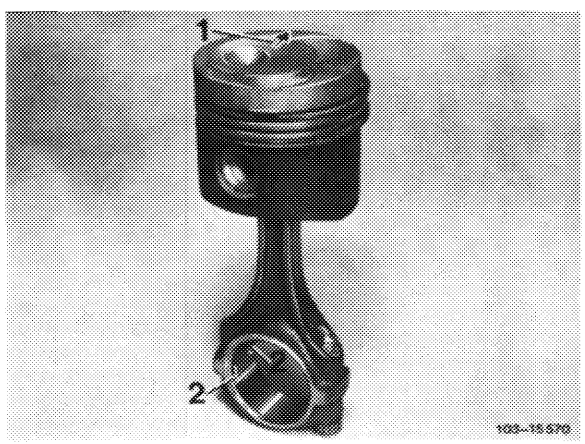
Removal

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).

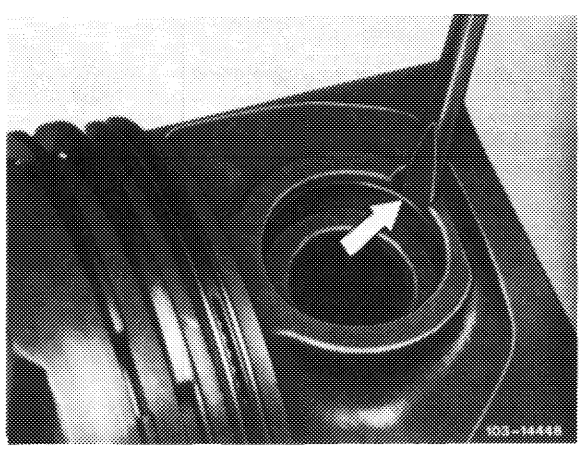


Removal

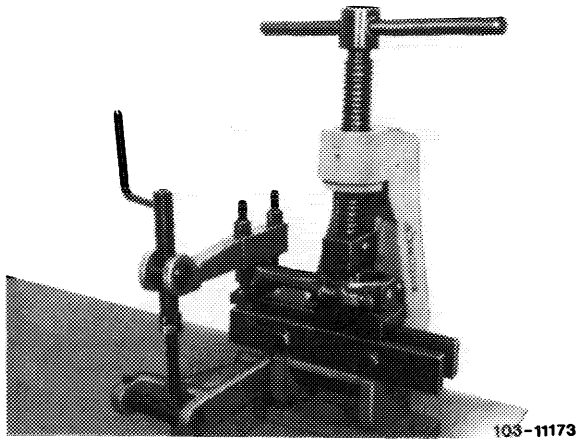
1 Remove connecting rod with piston in upward direction.



2 Remove piston pin lock and force out piston pin.



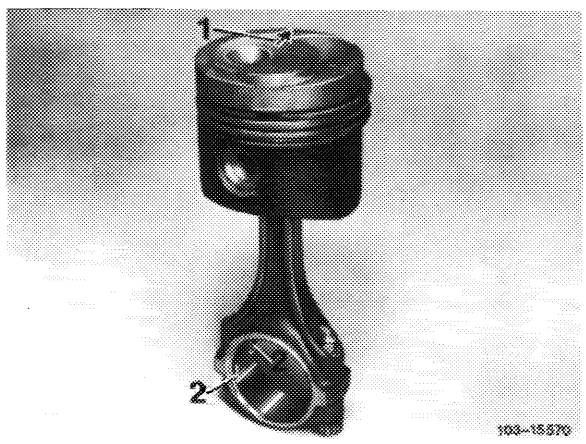
3 Recondition and square connecting rod (03–313).



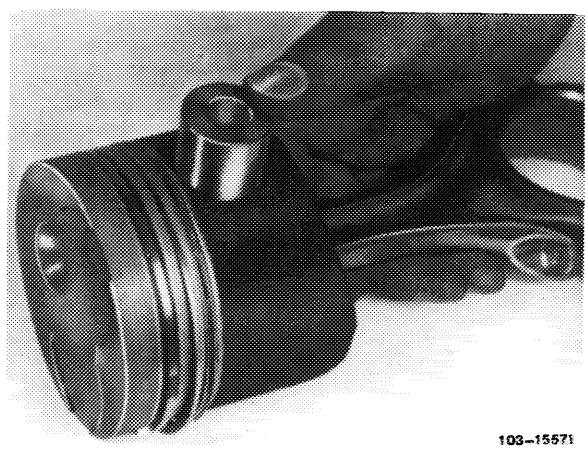
Installation

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**.

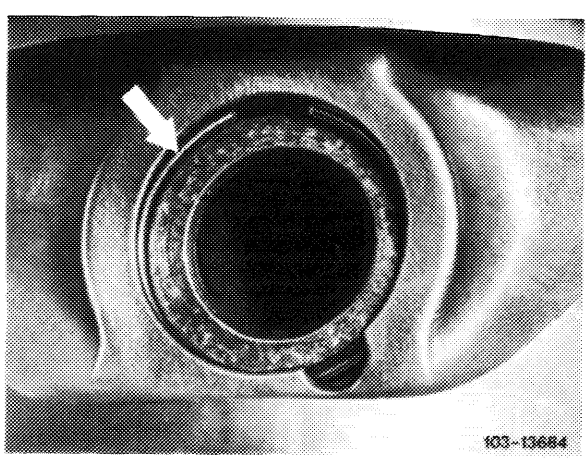


6 Place piston pin lock into groove.

Check piston rings for easy operation.

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

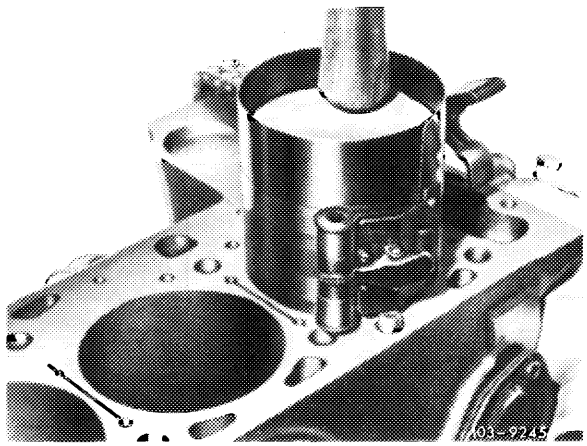
7 Lubricate clean cylinder bores, connecting rod bearing journals, connecting rod bearing shells and pistons.



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

9 Position piston ring clamping strap and insert piston.

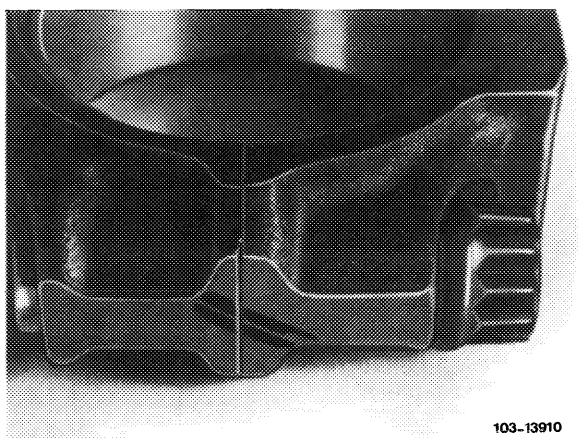
The arrow in piston crown should point in driving direction.



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.

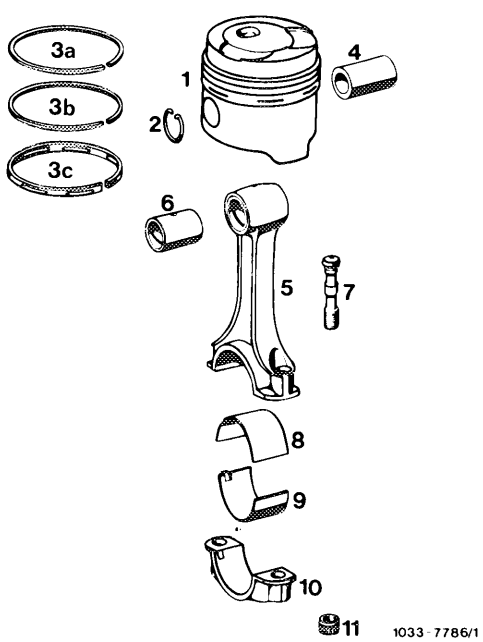
11 Rotate crankshaft and check clearance between piston pin eye and connecting rod.

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

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	69.96 / 69.95	2.15	34.00 / 34.03	51.96 / 51.95	32.00 / 32.10
		2.20	34.10 / 34.13		
1st repair stage	69.71 / 69.70	2.25 or 2.35 or 2.40	34.20 / 34.23 or 34.40 / 34.43 or 34.50 / 34.53	51.71 / 51.70	to 32.30
2nd repair stage	69.46 / 69.45			51.46 / 51,45	
3rd repair stage	69.21 / 69.20			51,21 / 51.20	
4th repair stage	68.96 / 68.95			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
Fillets	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

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.

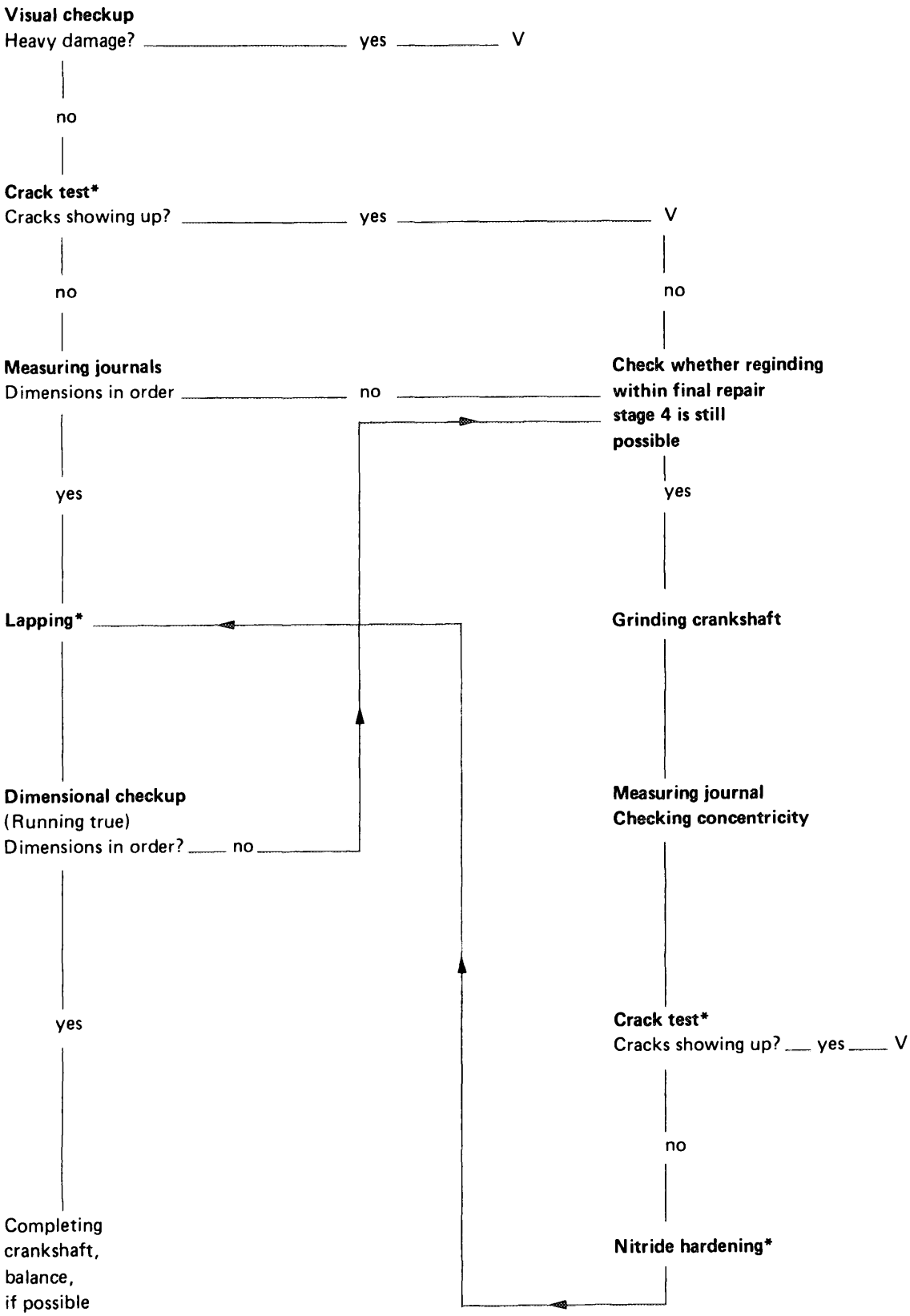
Conventional hardness tester (hardness drop tester) provides no information concerning proper hardness (depth of connecting layer) for crankshafts hardened in a nitride bath. No hardness test according to the above method is therefore required.

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

Diagram

* Refer to section "Explanations Concerning Diagram"

V = scrap.


Visual checkup
Heavy damage?
yes
V
no
Crack test*
Cracks showing up?
yes
V
no
no
Measuring journals
Dimensions in order
no
Check whether reginding within final repair stage 4 is still possible
yes
yes
Lapping*
Grinding crankshaft
Dimensional checkup
(Running true)
Dimensions in order?
no
Measuring journal
Checking concentricity
yes
Crack test*
Cracks showing up?
yes
V
no
Completing crankshaft, balance, if possible
Nitride hardening*

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).

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	69.96 / 69.95	2.15	34.00 / 34.03	51.96 / 51.95	32.00 / 32.10
		2.20	34.10 / 34.13		
1st repair stage	69.71 / 69.70	2.25	34.20 / 34.23	51.71 / 51.70	to 32.30
2nd repair stage	69.46 / 69.45	or 2.35	or 34.40 / 34.43	51.46 / 51.45	
3rd repair stage	69.21 / 69.20		or	51.21 / 51.20	
4th repair stage	68.96 / 68.95	or 2.40	34.50 / 34.53	50.96 / 50.95	

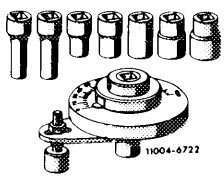
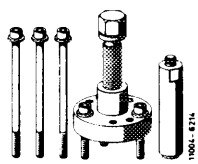
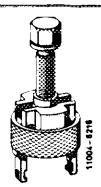
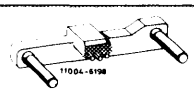
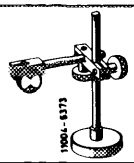
Basic bore and bearing play		Crankshaft bearing	Connecting rod bearing
Basic bore dia.		74.50 / 74.52	55.60 / 55.62
Basic bore width on fitted bearing		29.48 / 29.50	———
Connecting rod width		———	31.84 / 31.88
Permissible out-of-true of basic bore		0.01	
Permissible conicity of basic bore		0.01	
Bearing 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.

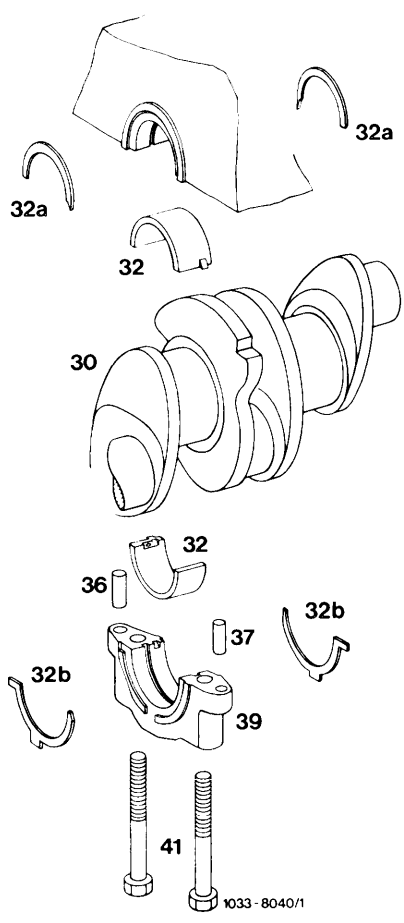
Check crankshaft for cracks, dimensional stability and concentricity (03–318).

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 distorsion 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
32a Thrust washers in cylinder crankcase
32b Thrust washers in bearing cap
36 Cylindrical pin 10m 6 x 16
37 Cylindrical pin 8m 6 x 16
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.

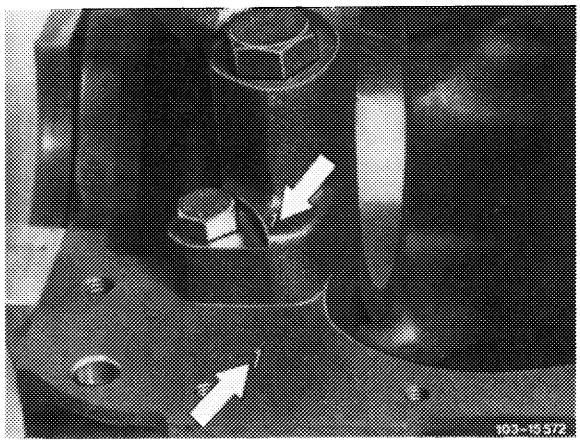
On these engines, do not install connecting rod bearing shells of engine 617.912.

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

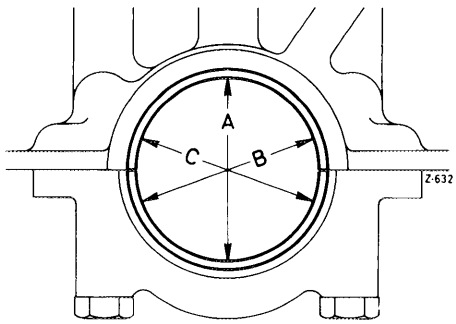
Coordinating crankshaft bearings, installing crankshaft



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

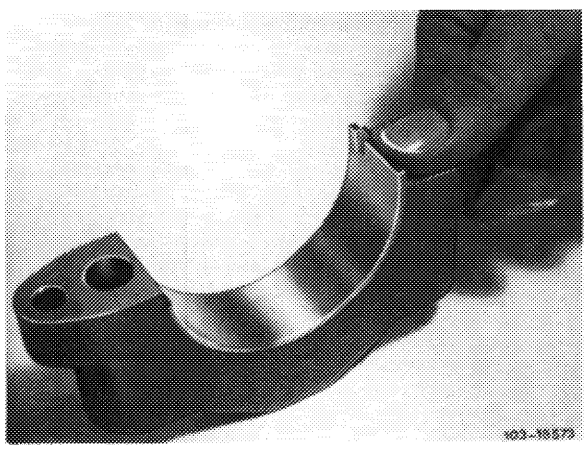
Do not interchange crankshaft bearing caps.

2 Tighten bolts to 90 Nm.

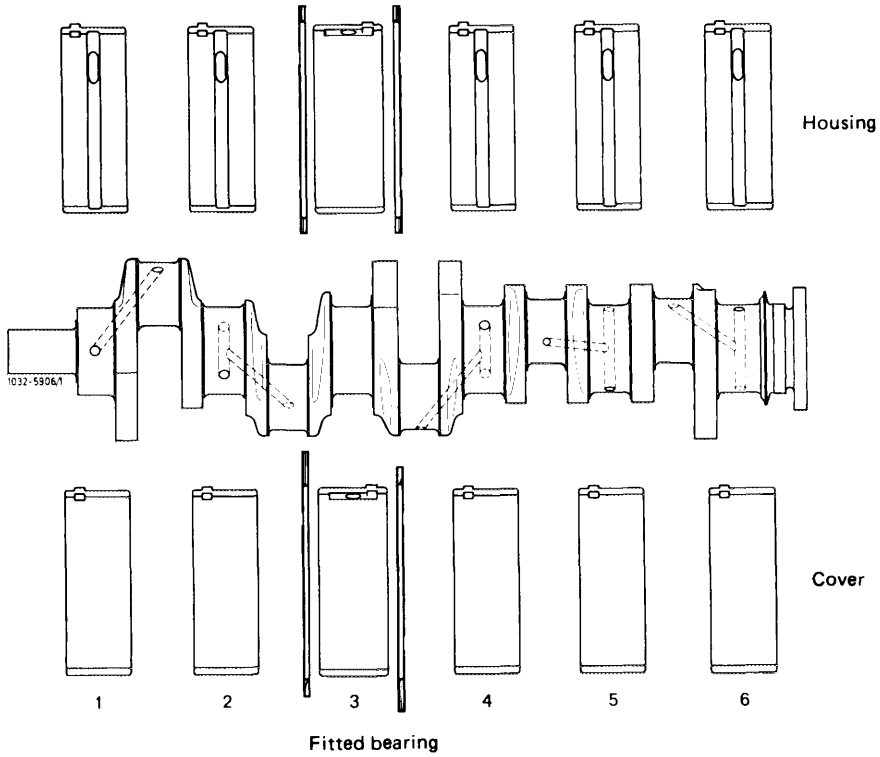


3 Measure basic bore in direction A, B and C on two levels (conicity).

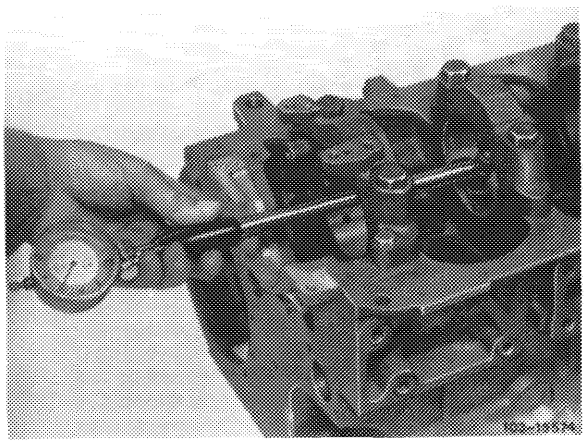
If a basic bore exceeds the specified value or is conical, touch up bearing cap at its contact surface on a surface plate by max. 0.02 mm.



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



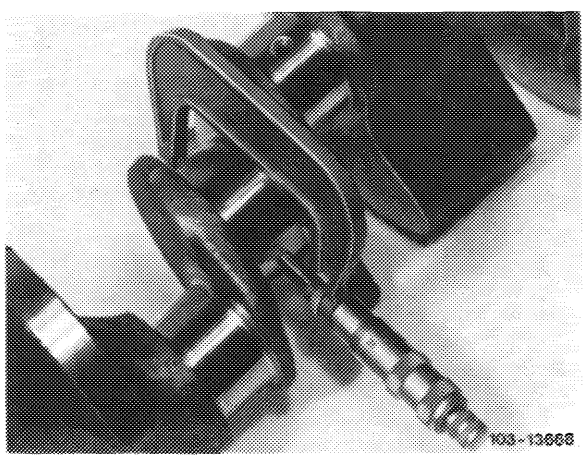
5 Measure bearing dia. and write down.



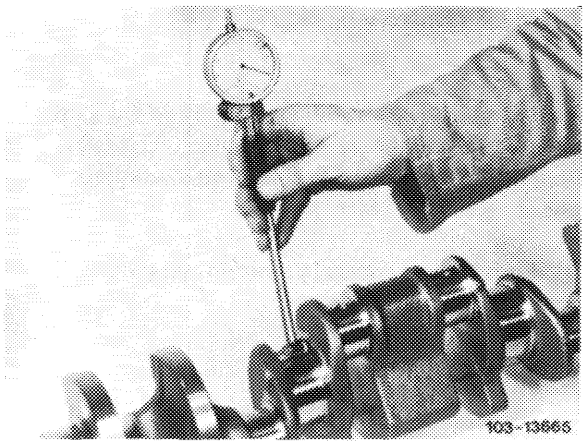
6 Measure crankshaft bearing journal, find crankshaft bearing radial play.

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.

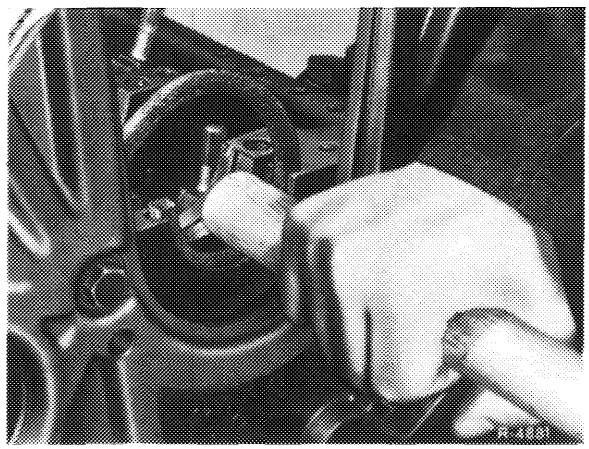


7 Measure width of fitted bearing journal and use pertinent thrust washers (refer to table, section "Data").



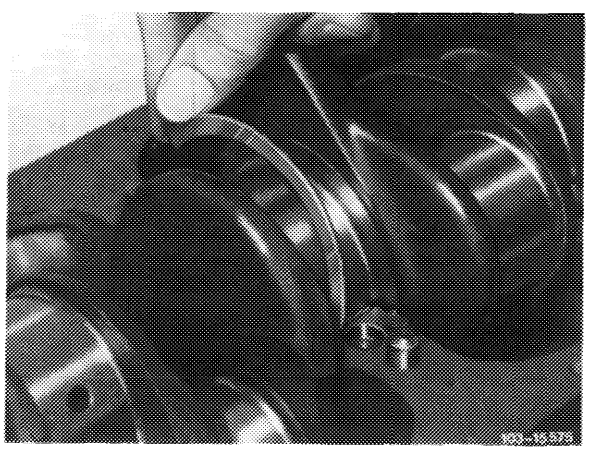
8 Renew rear crankshaft radial sealing ring (03–327).

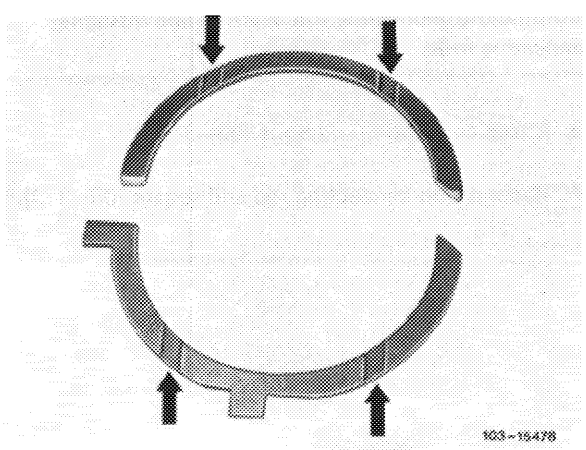
9 Provide bearing shells, crankshaft and radial sealing ring with engine oil and insert crankshaft.



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.

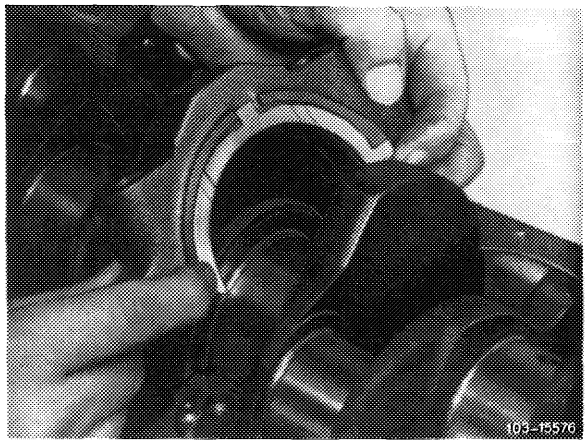




11 Mount fitted bearing cap.

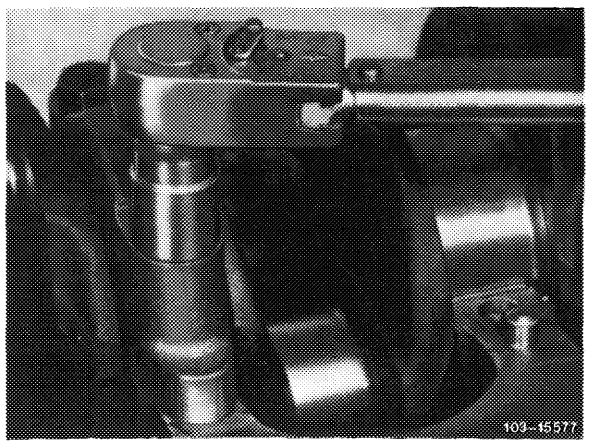
Attention!
Provide thrust washers with engine oil and place into grooves on fitted bearing cap. The two oil grooves (arrows) in thrust washers should face crankshaft webs.

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



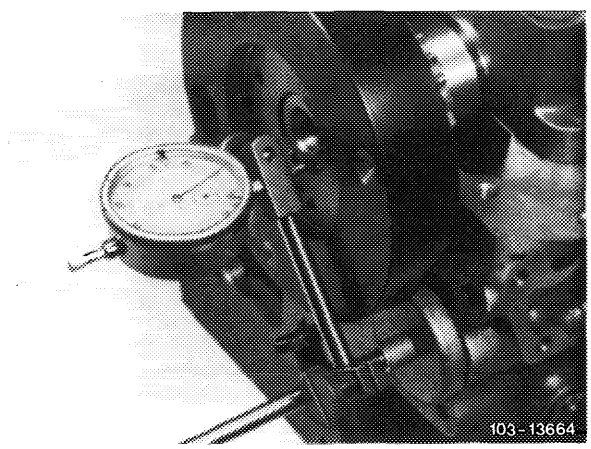
12 Mount crankshaft bearing cap.

13 Tighten all bearing caps to 90 Nm.



14 Measure crankshaft bearing end play.

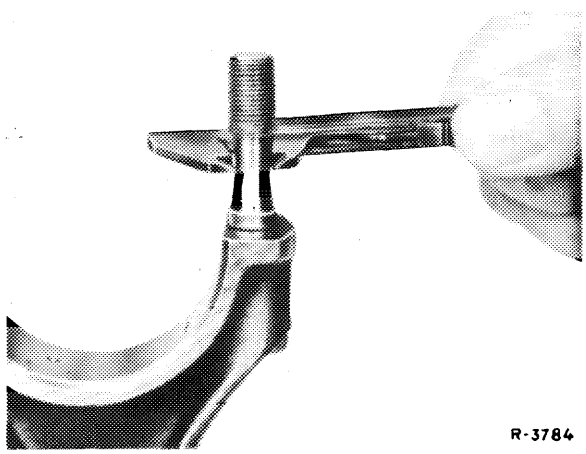
15 Turn crankshaft manually and check for unobstructed running.



Coordinating connecting rod bearings and installing connecting rods

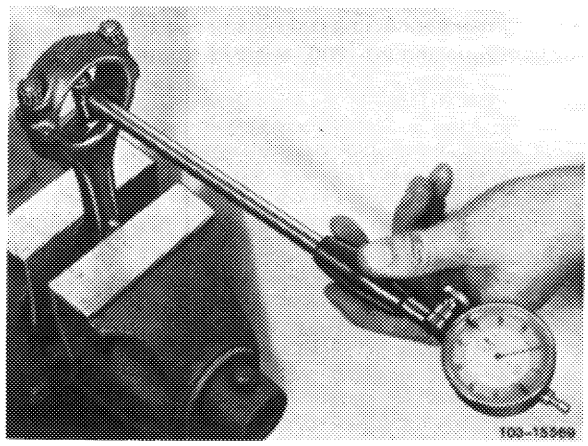
16 Check connecting rod bolts (03–310).

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

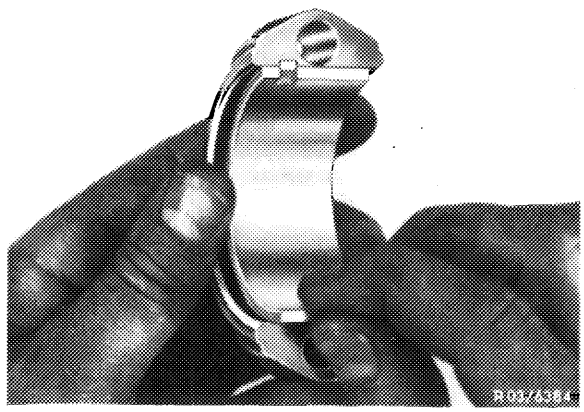


18 Mount connecting rod bearing cap, while paying attention to identification. Lubricate connecting rod nuts and tighten to 40–50 Nm.

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.



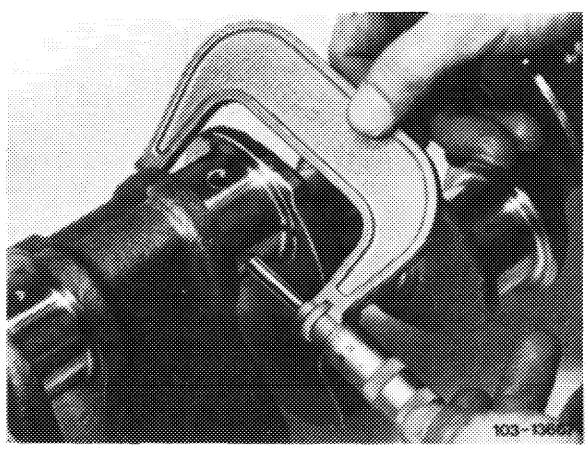
20 Insert connecting rod bearing shells, mount connecting rod bearing cap with bearing shells and tighten connecting rod nuts to 40–50 Nm.



21 Measure bearing dia. and write down.

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

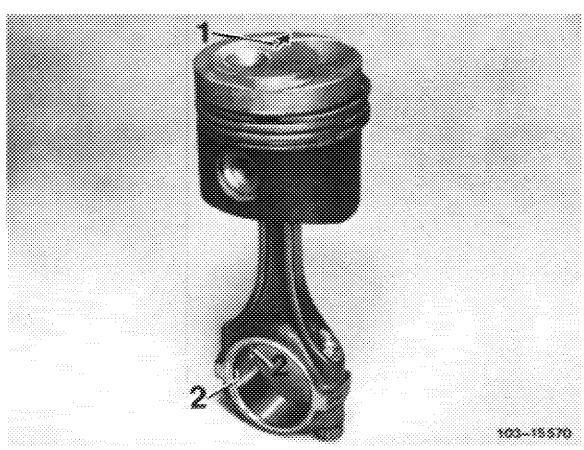
Note: The bearing play can be corrected by exchanging bearing shells, while trying for mean value of specified bearing play. Connecting rod bearing shells without color coding are thicker than those with blue color coding, while taking into account that the wall thicknesses without color coding and those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



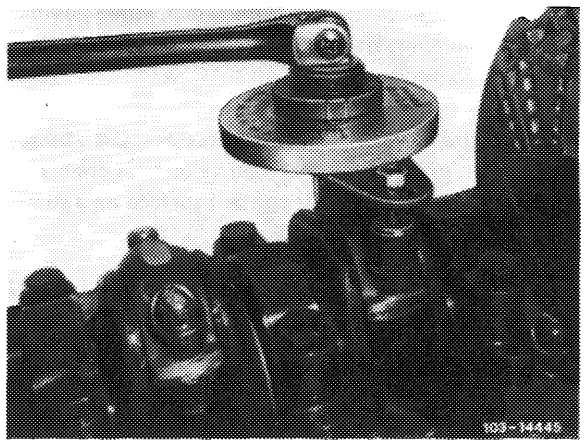
23 Mount piston on connecting rod (03–316).

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

Pay attention to identification.



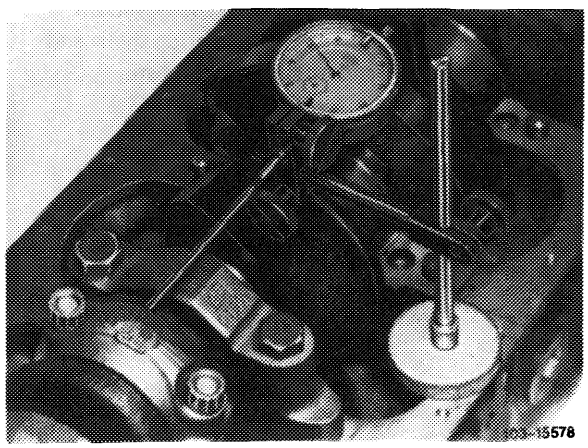
25 Tighten connecting rod nuts to 40–50 Nm **initial torque** and 90–100° **angle of rotation torque.**



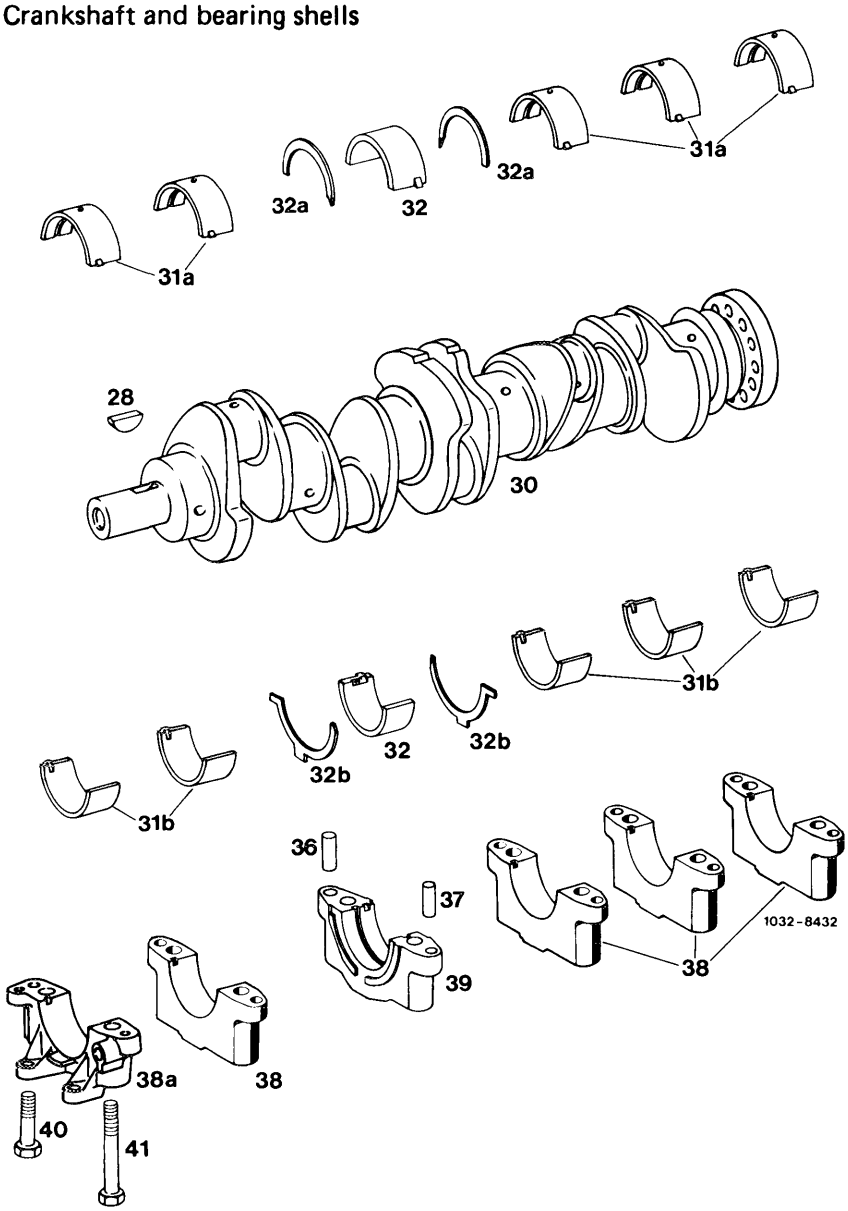
26 Measure connecting rod bearing end play. Check connecting rod for easy operation in piston.

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.



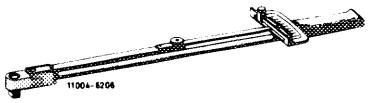
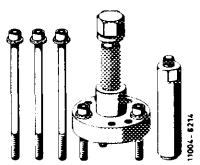
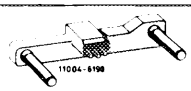
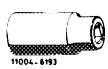
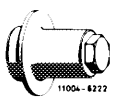
Crankshaft and bearing shells



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

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

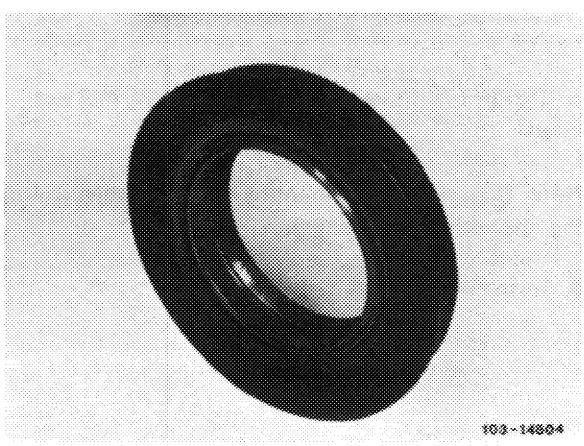
Note

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.

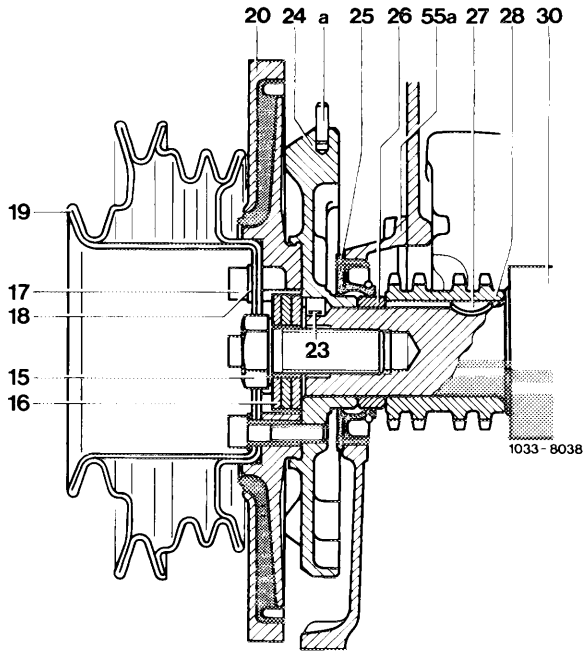


Removal

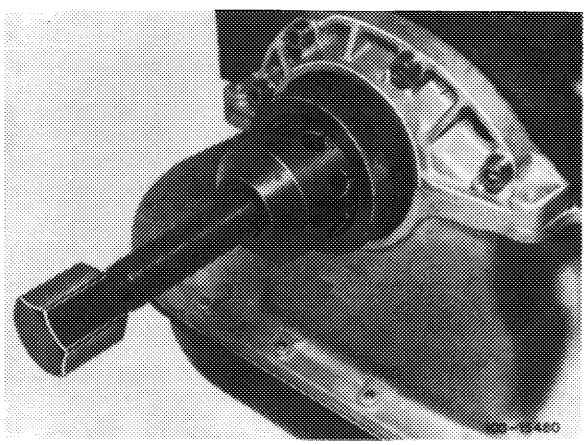
1 Remove cooler and fan.

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.



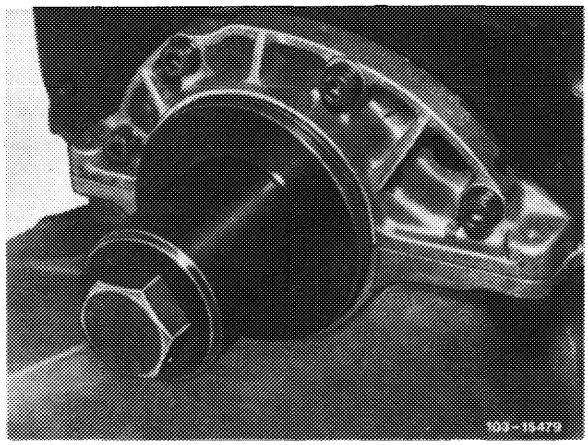
Installation

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.



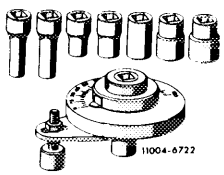
Attention!
The radial sealing ring should be accurately square in relation to crankshaft journal, since otherwise no perfect sealing will be obtained.

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

9 Install fan and cooler.

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

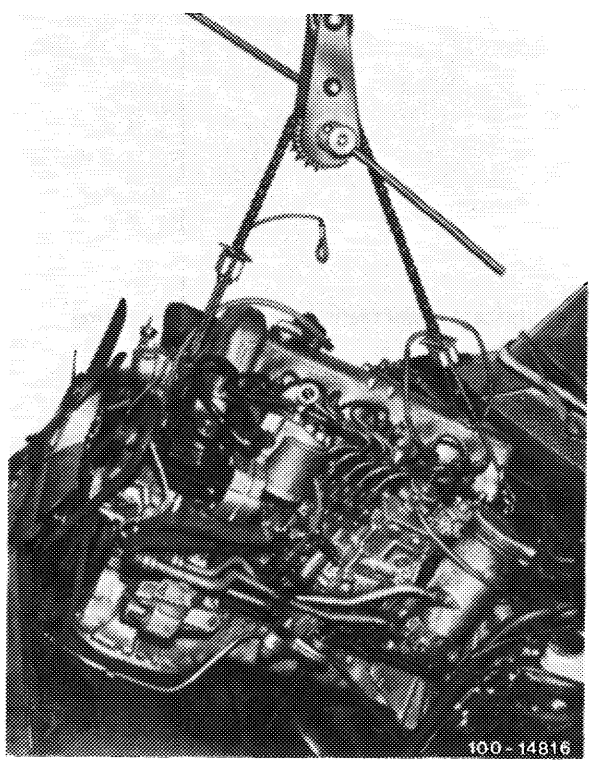
Angle of rotation tool		116 589 01 13 00

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.

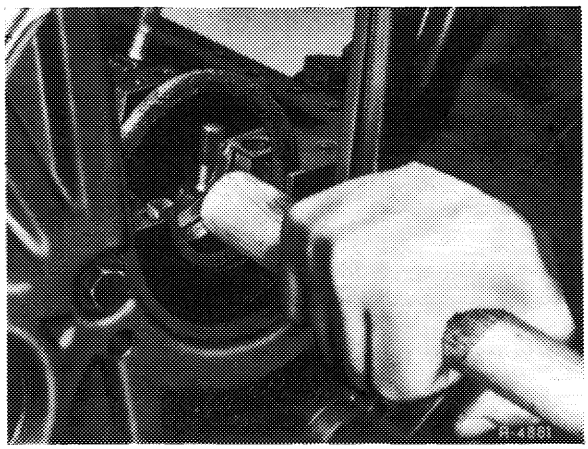


Renewing

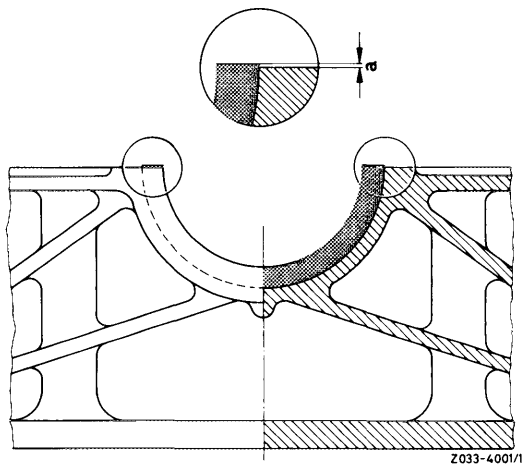
1 Remove engine (01–030).

2 Remove crankshaft.

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

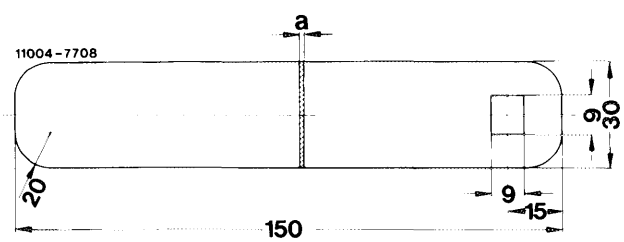


4 To obtain the required overlap, cut off radial sealing ring in cylinder crankcase and oil pan approx. 1.0 mm above parting surface.



Dimension a = 1.0 mm

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



Dimension a = 1.0 mm

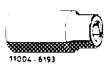
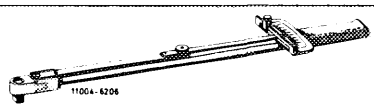
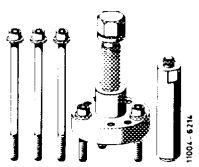
5 Lubricate radial sealing ring prior to installing crankshaft.

6 Install crankshaft.

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

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).

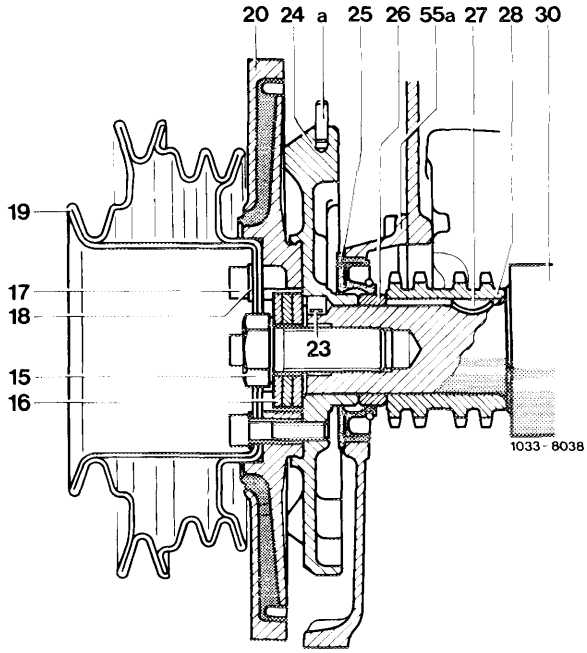
Since January 1979, the fastening screws (17) for pulley and vibration damper on engine 617.950 are inserted without washers (18). On engines 617.951/952 from start of series.

Removal

1 Remove radiator and fan.

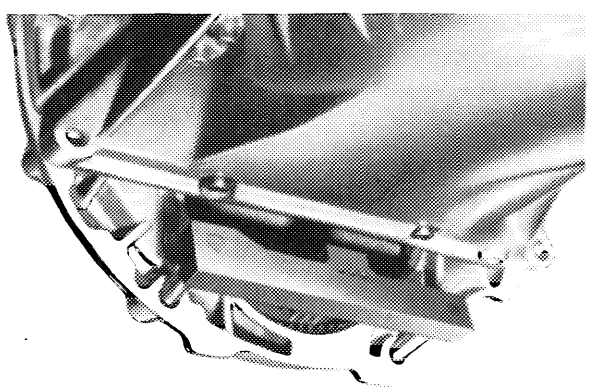
2 Remove all V-belts (13–340).

3 Remove pulley and vibration damper.



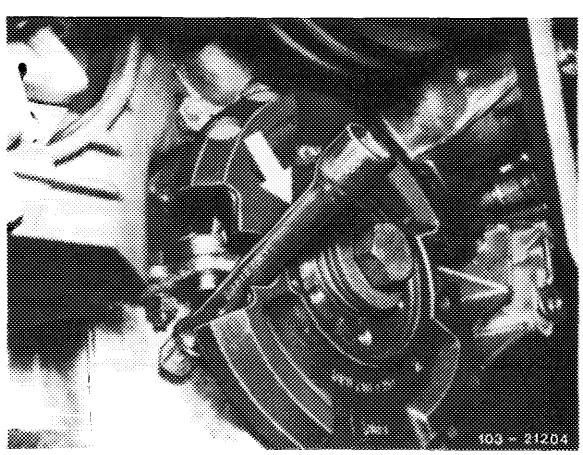
15 Bolt M 18 x 1.5 x 45
16 Cup spring
17 Bolt M 8 x 30
18 Washer
19 Pulley
20 Vibration damper
23 Fitted pin 8 x 8
24 Balancing disc
25 Radial sealing ring
26 Spacing ring
27 Woodruff key
28 Crankshaft gear
30 Crankshaft
55a Cover
a Pin

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

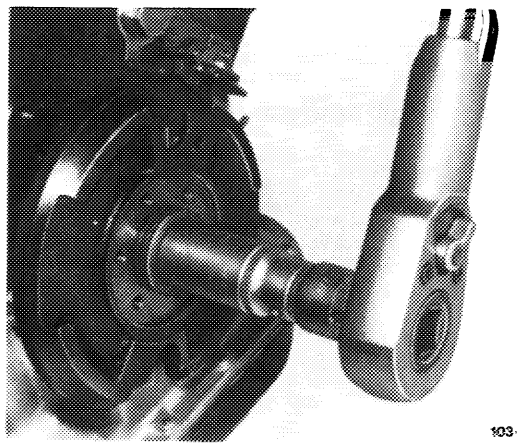


103-9243

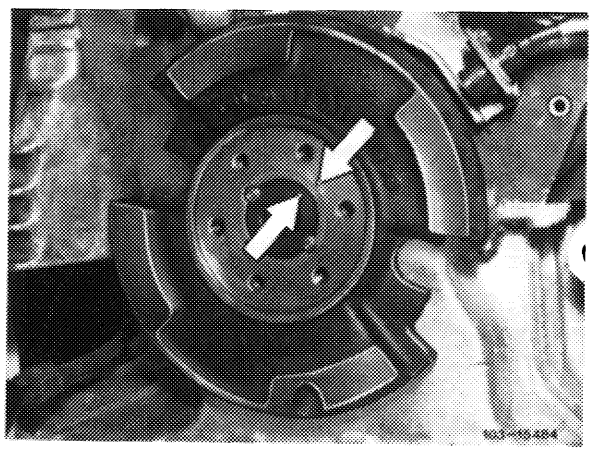
On models 126.120 and 123 with automatic transmission 722.303 (W4A 040) use a steel bolt as a counterhold in one of the recesses on balancing disc and on cylinder crankcase (arrow).



5 Remove screw on crankshaft.

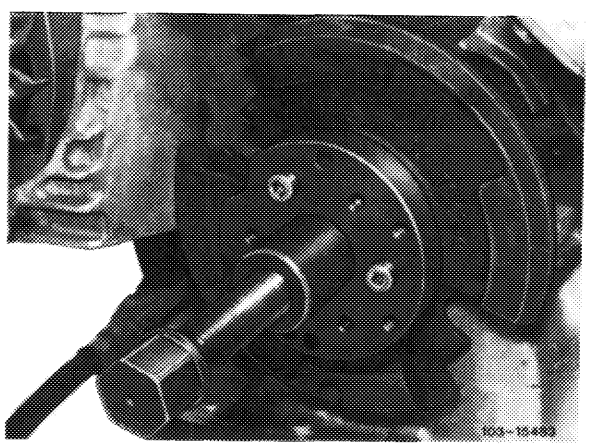


6 Identify balancing disc and crankshaft by punch marks.



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.



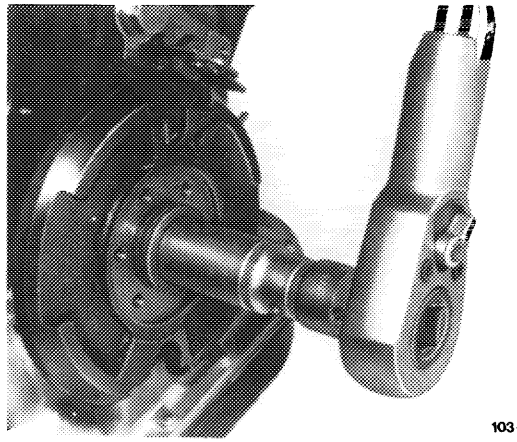
Installation

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.

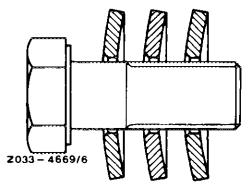
9 Mount balancing disc on crankshaft with screw M 18 x 1.5 x 45 and cup springs.

10 Knock-in both fitted pins.



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.

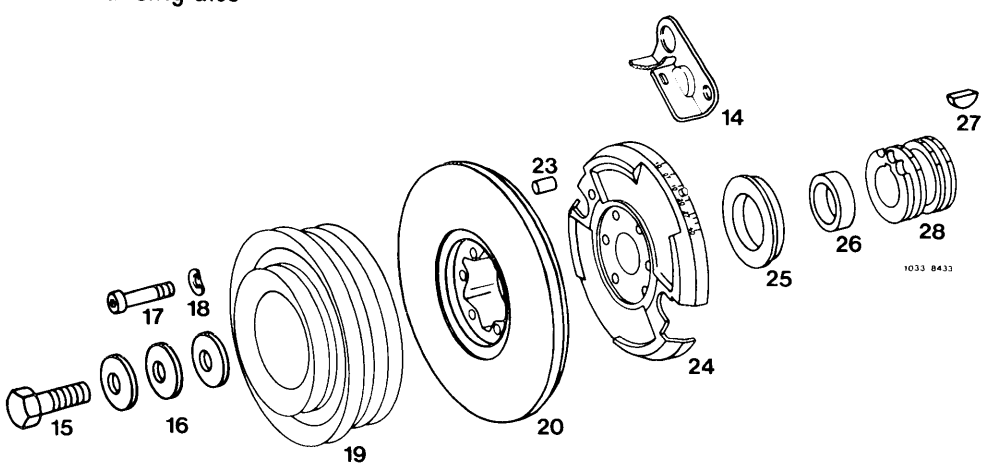


13 Install vibration damper, pulley, fan and radiator.

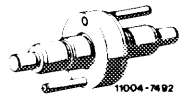
14 Tension V-belt.

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

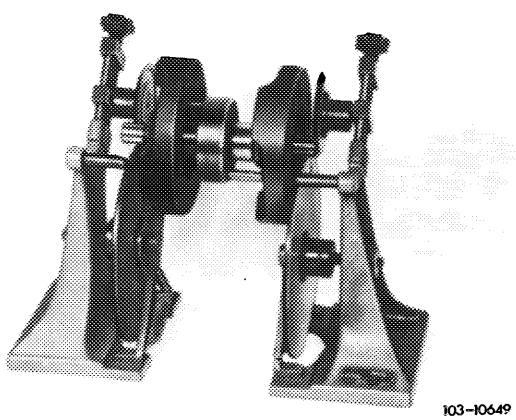
The state of balance of the old balancing disc must be transferred to the new balancing disc.

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.

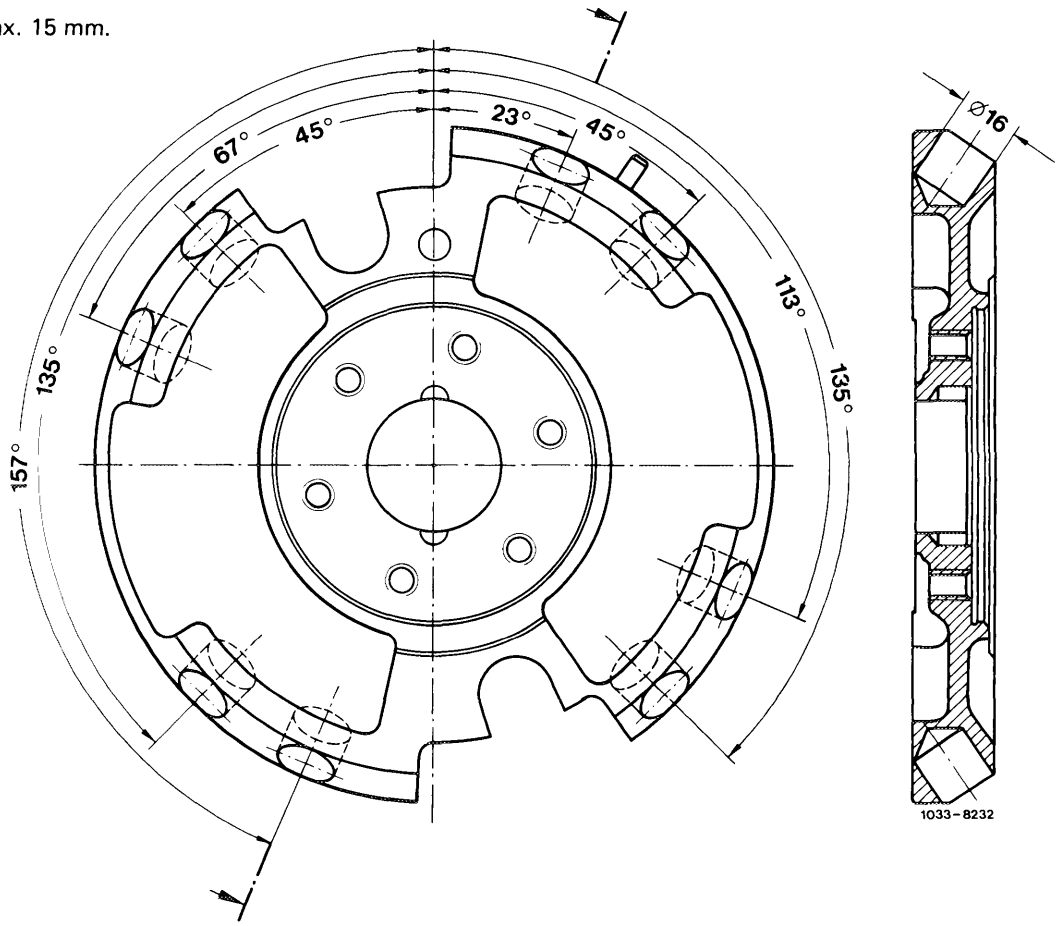


103-10649

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.

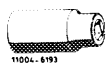
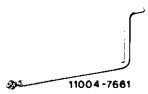
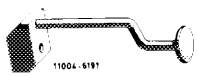
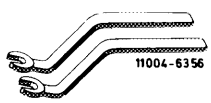
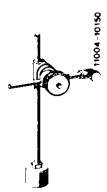
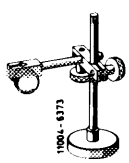


Valve clearance	With engine cold (approx. 20 °C)	With engine warm (60 °C ± 15 °C)
Intake	0.10[1])	0.15[1])
Exhaust	0.35	0.40

[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	 11004-6193	001 589 65 09 00
Measuring extension	 11004-7661	123 589 09 63 00
Locating device for adjusting slide	 11004-10349	116 589 19 21 00
Assembly mandrel for valve stem seals	 11004-6191	617 589 00 43 00
Valve adjusting wrench 14 mm (2 each)	 11004-6356	615 589 00 01 00
Holding wrench for valve spring retainer	 11004-7118	615 589 00 03 00
Dial gauge holder	 11004-10150	121 589 00 21 00
Magnetic dial gauge holder	 11004-6373	116 589 12 21 00

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.

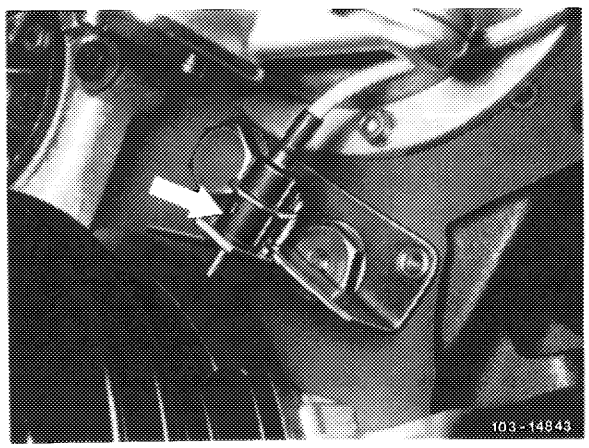
a) When renewing TDC transmitter adjusting slide.

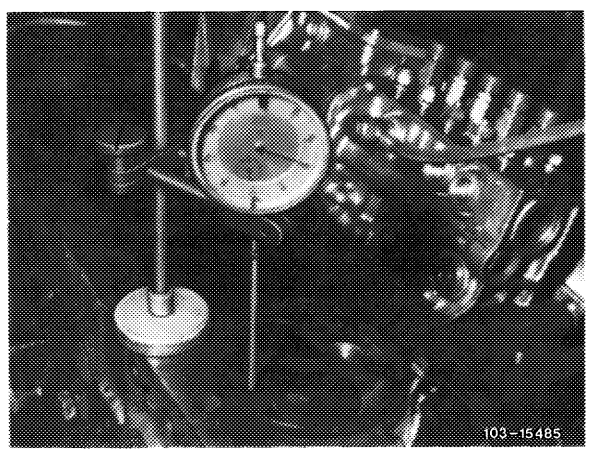
b) When renewing crankshaft with balancing disc and vibration damper.

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.

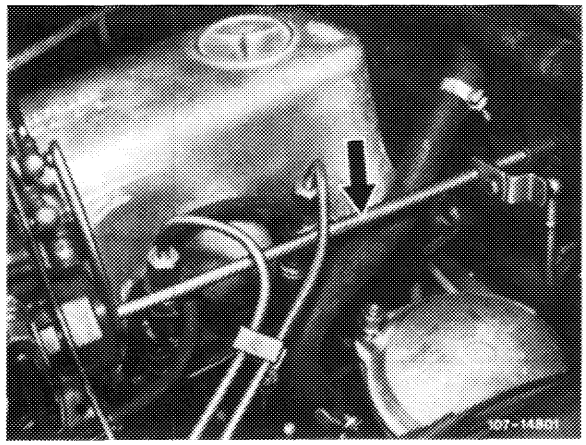
3 Remove V-belt of power-steering pump and refrigerant compressor (13–340).

4 Remove double diaphragm or piston-vacuum pump.

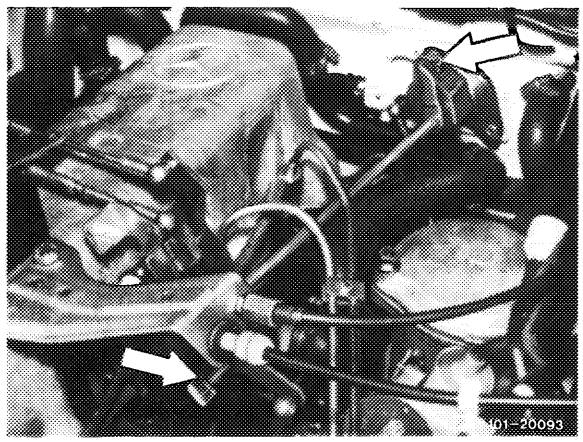
5 Disconnect regulating linkage to remove cylinder head cover. Pull out locking eye of longitudinal regulating shaft (arrow).

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.

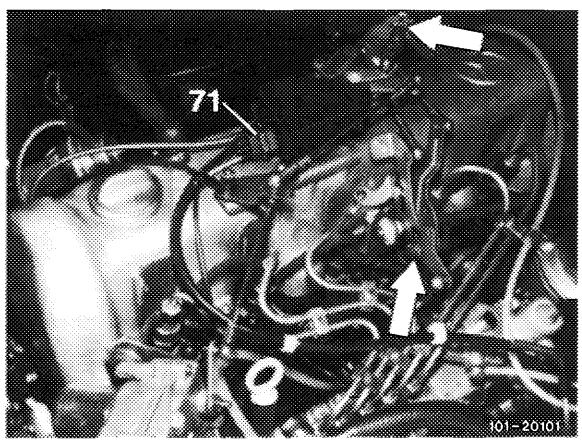


Model 116.120



Model 123

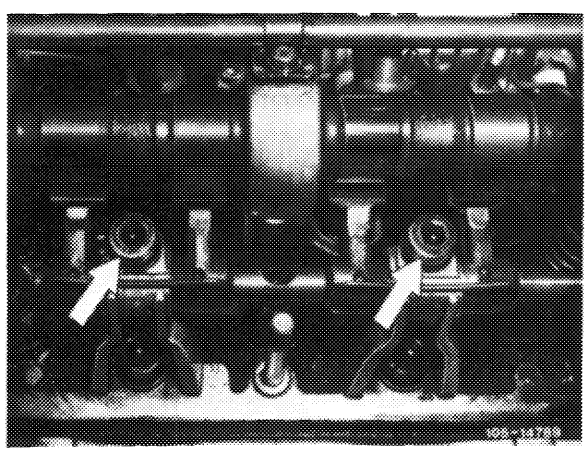
On models 123 with automatic transmission 722.303 (W4A 040) and 126.120, pull off central plug for vacuum lines (71) or vacuum lines. Disconnect bowden wire, compress black plastic clip (arrow) and pull bowden wire out of holder in rearward direction.



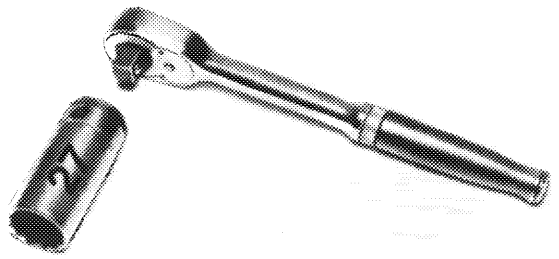
Model 126.120

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.

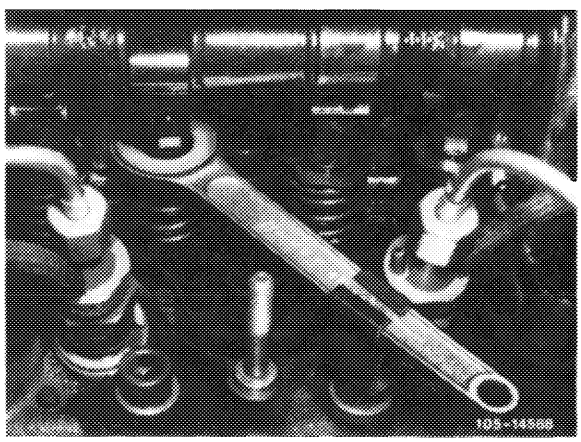


7 Set piston of 1st cylinder to TDC. Rotate crankshaft with tool combination.



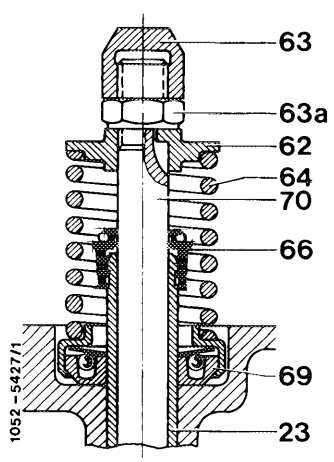
1100-6498/1

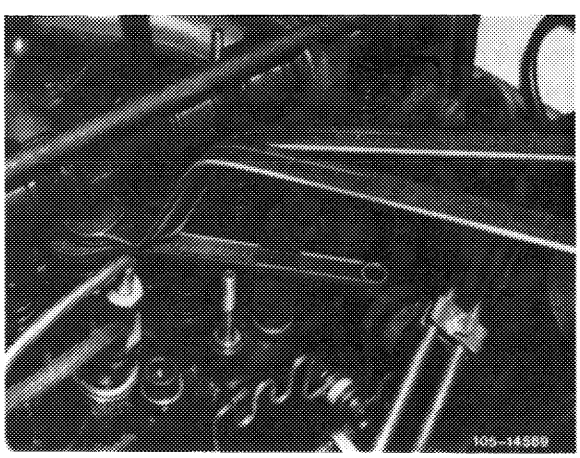
8 At intake valve of 1st cylinder, place holding wrench on hexagon of valve spring retainer.



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).



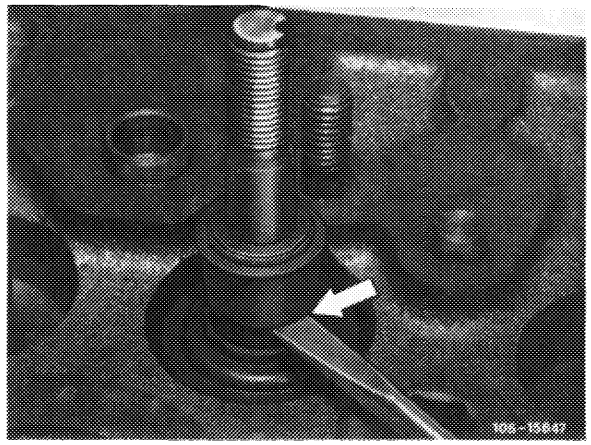


11 Remove valve spring retainer and valve spring.

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.

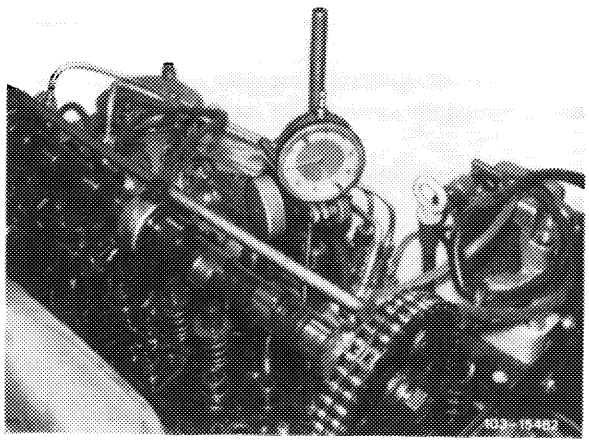
13 Push valve on piston crown.



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

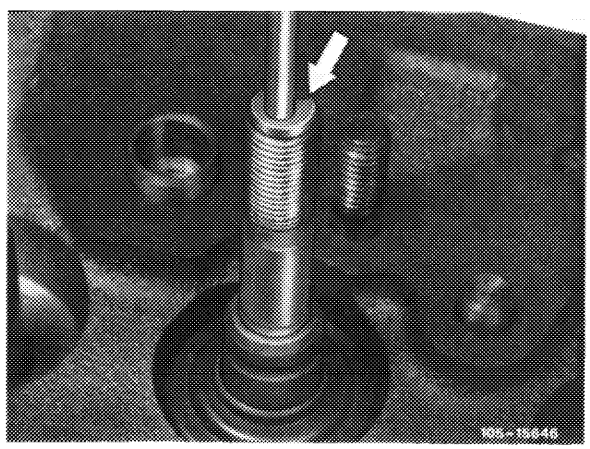
15 Screw dial gauge holder with threaded sleeve to stud in cylinder head.

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



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

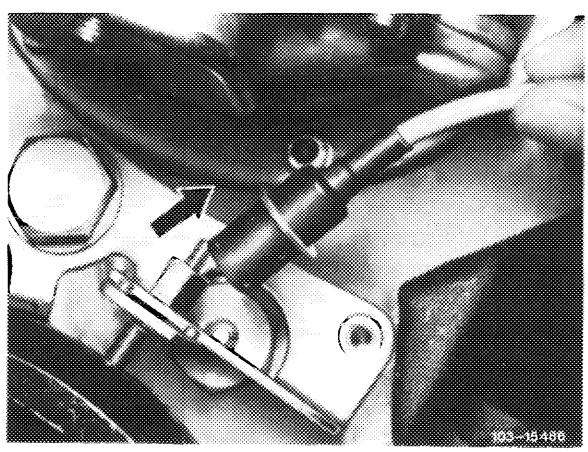
18 Slowly rotate crankshaft with tool combination in direction of rotation of engine until the large needle of the dial gauge stops (TDC position).



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.

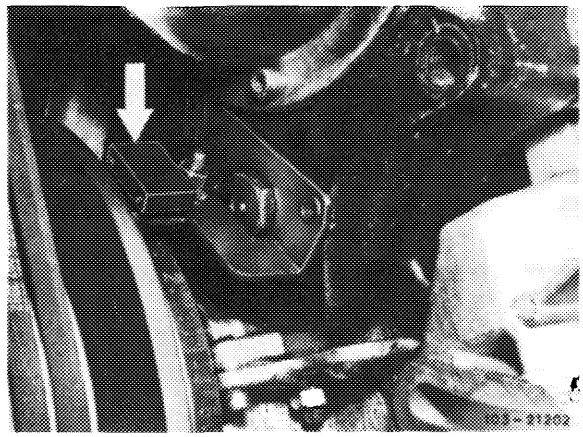
21 Slowly rotate crankshaft with tool combination in direction of ratation of engine until dial gauge has moved back by 3.63 mm.



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

Pin in balancing disc should enter groove of locating device.

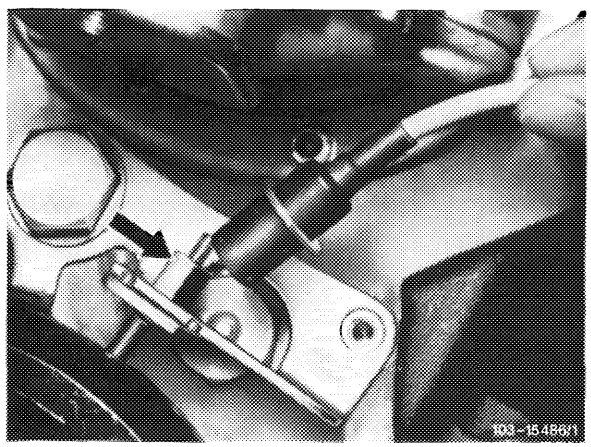
If pin is not engaging, correct position of adjusting slide.



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.

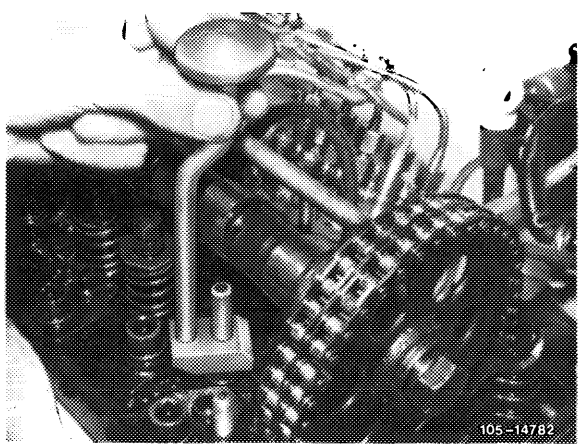


25 Insert TDC transmitter and tighten.

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.

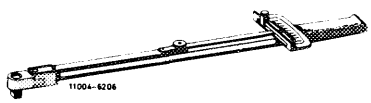
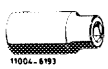
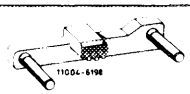
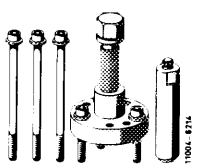
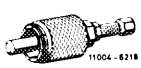
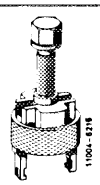
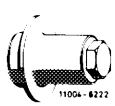
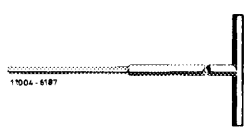
31 Install double diaphragm or piston-vacuum pump with new gasket.

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

33 Attach fan and fan cover.

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

Sleeve for centering front cylinder crankcase cover and oil pan	 11004-8102	617 589 00 14 00

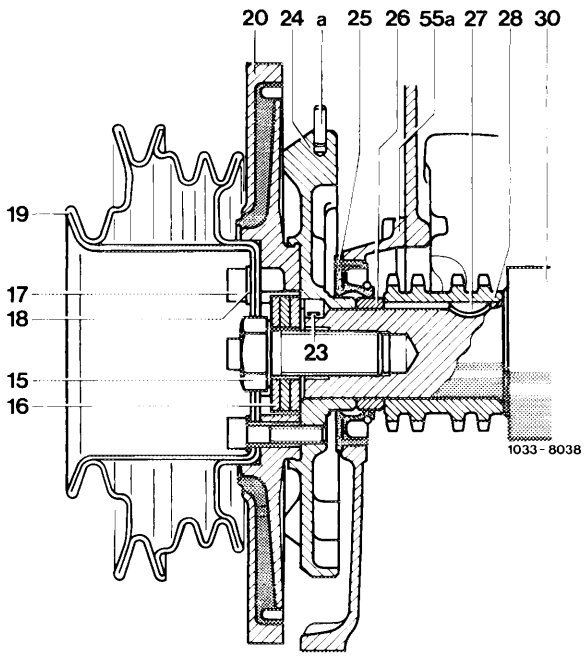
Conventional tools

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.

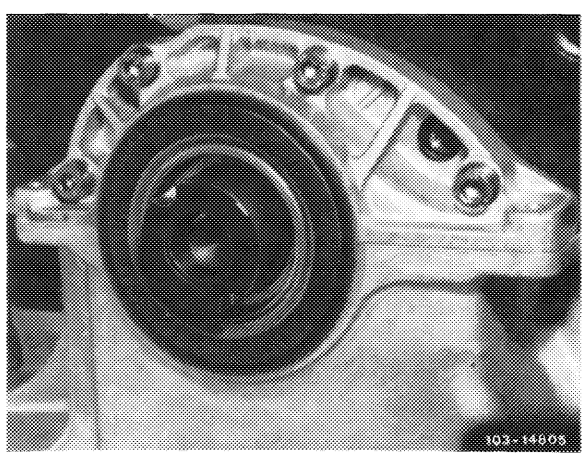
2 Remove pulley, vibration damper and balancing disc (03–340).



3 Completely remove oil pan (01–310).
On model 126.120, remove engine.

4 Remove front crankshaft radial sealing ring (03–324).

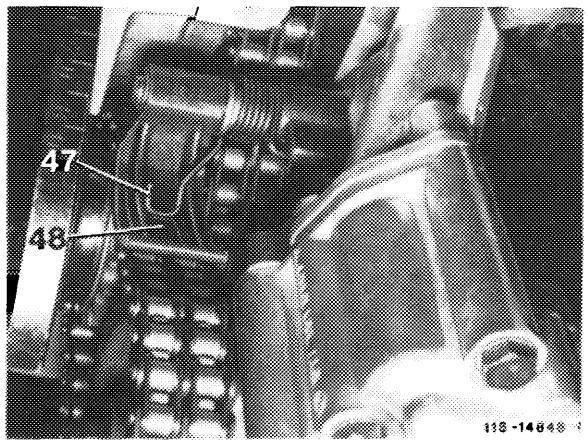
5 Remove front cylinder crankcase housing cover (01–215).



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.

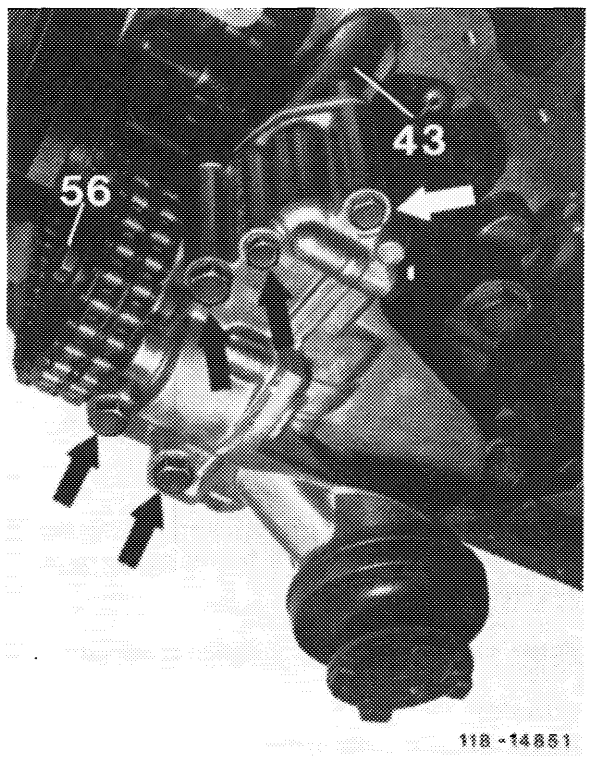


47 Torsion spring
48 Clamp

9 Remove sprocket by means of two screw-drivers.

10 Remove sprocket.

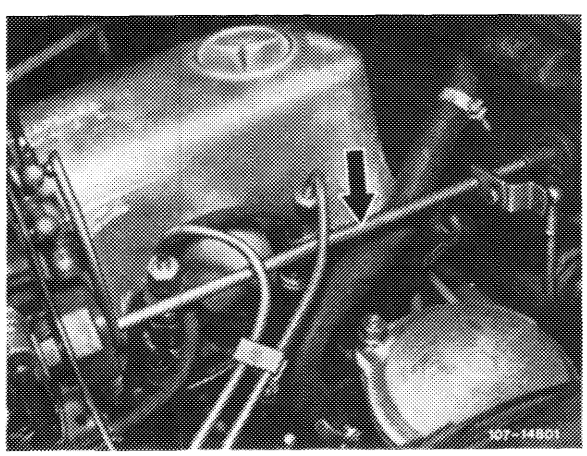
11 Remove double roller chain of oil pump.



43 Flange member
56 Fastening bolt

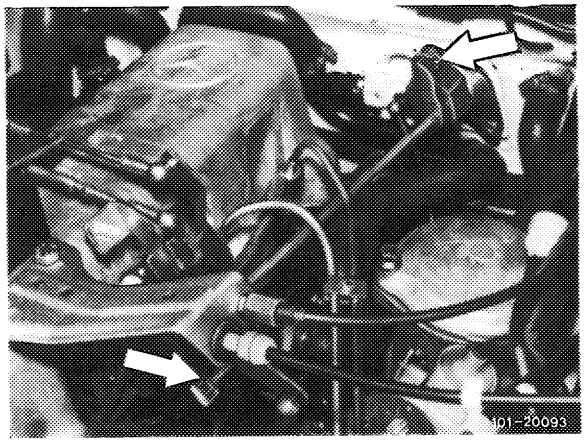
12 Disconnect regulating linkage to remove cylinder head cover. Pull out locking eye of longitudinal regulating shaft (arrow).

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



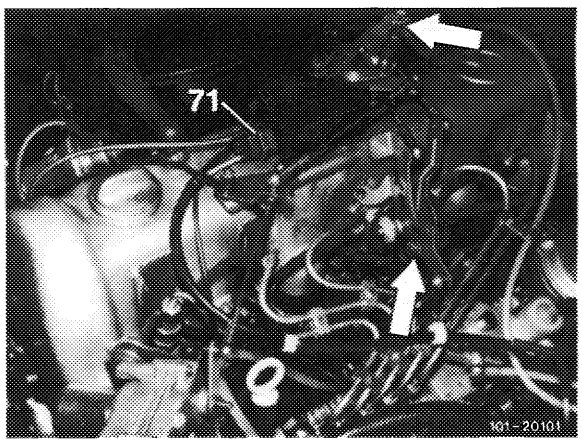
Model 116.120

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.

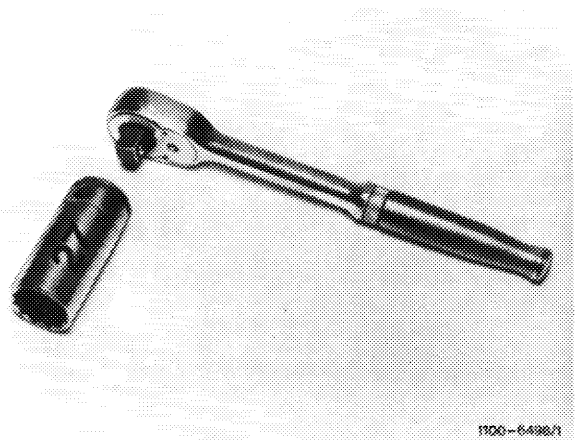


Model 126.120

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.

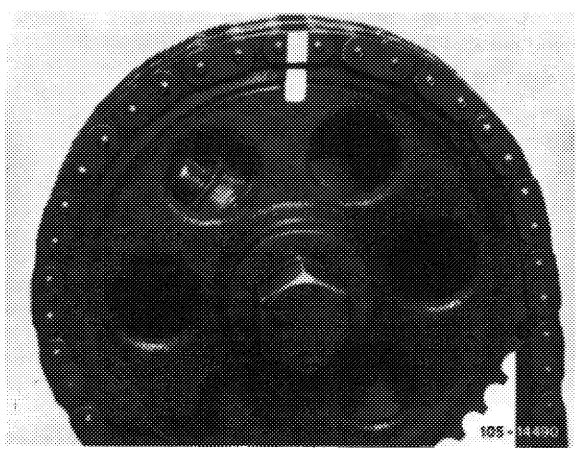
Rotate engine with tool combination at crankshaft.

Attention!
Rotate crankshaft only in direction of rotation of engine.

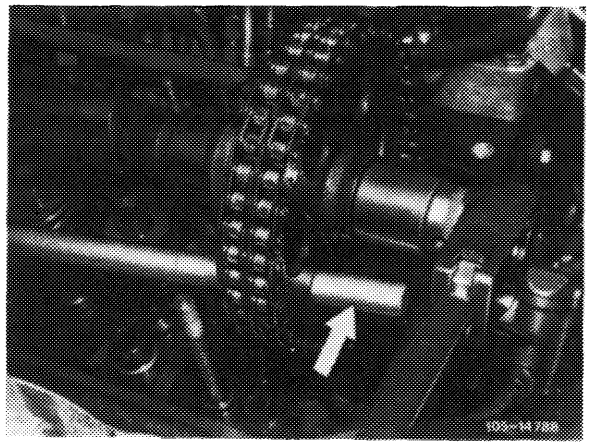


14 Mark camshaft and crankshaft sprocket with paint in relation to timing chain.

15 Remove chain tensioner (05–310).



16 Remove camshaft sprocket.

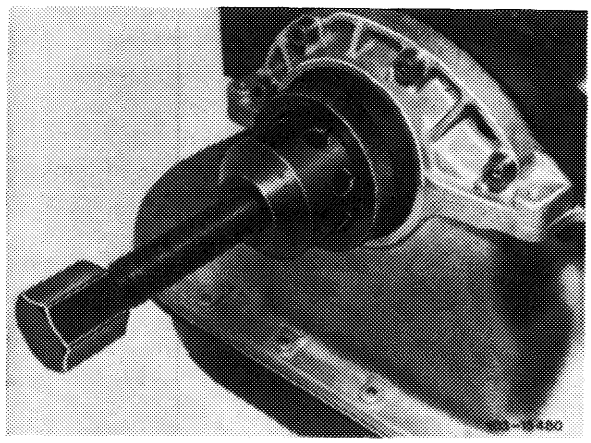


To loosen necked-down screw, apply counterhold to camshaft sprocket by means of a screwdriver or steel bolt, loosen holder for fuel lines and swivel sideways.

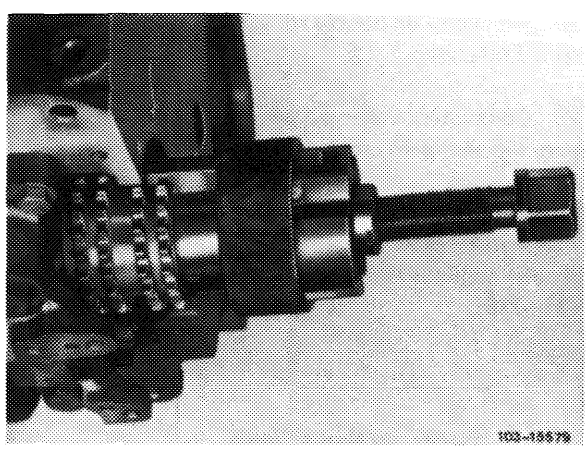
17 Remove timing chain from teeth of crankshaft sprocket.

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

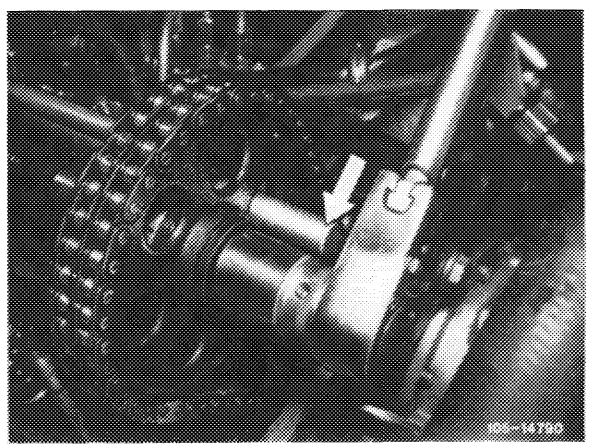
21 Transfer color mark from old crankshaft sprocket to new sprocket.

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.

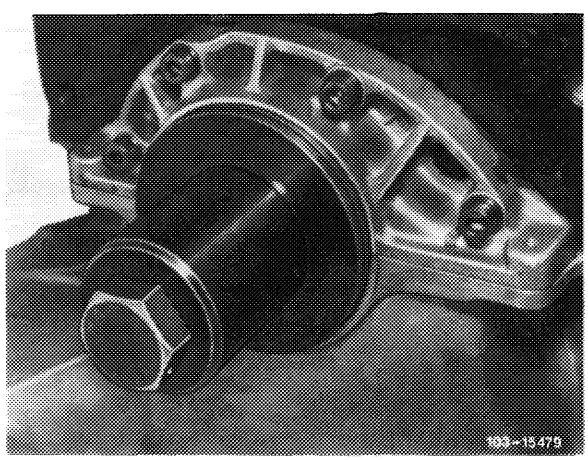
27 Place oil pump sprocket into double roller chain and then slip on drive shaft. Screw-in fastening screw.

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).

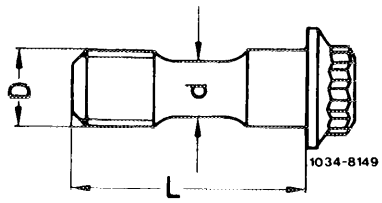
33 Rotate engine with tool combination and check adjusting marks.

34 Install chain tensioner (05–310).

35 For further installation proceed vice versa to removal.

Necked-down screws

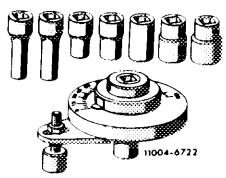
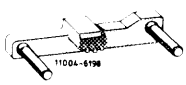
Part no.		110 990 04 19
Thread dia. D		M 10 x 1
Necked-down stem dia. d	when new	7.7–0.2
	minimum dia.	7.3
Length L		31



Tightening torques

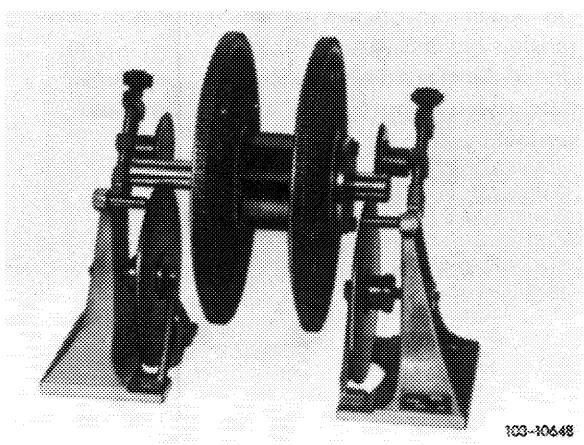
Initial torque	30–40 Nm
Angle of rotation torque	90–100°

Special tools

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

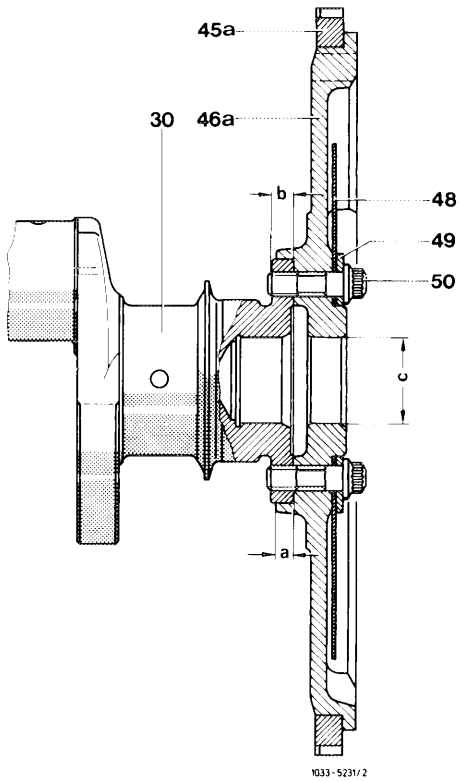
Note

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



Do not interchange this flywheel with flywheel of engine 110.

Engine 110: dimension a = 4.5 mm



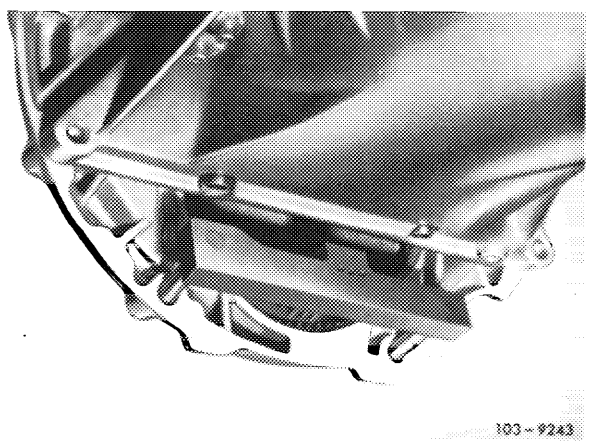
Layout flywheel and driven plate

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		

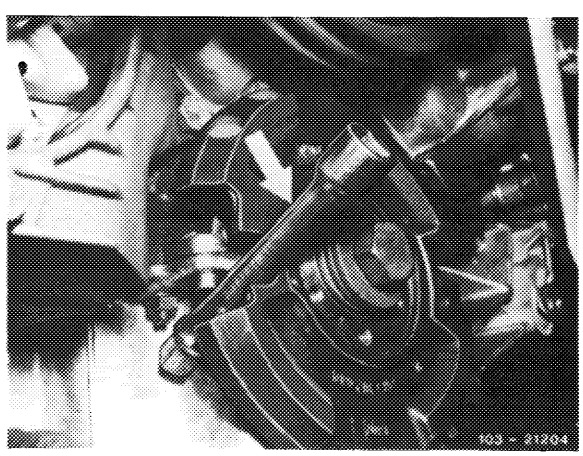
Removal

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.

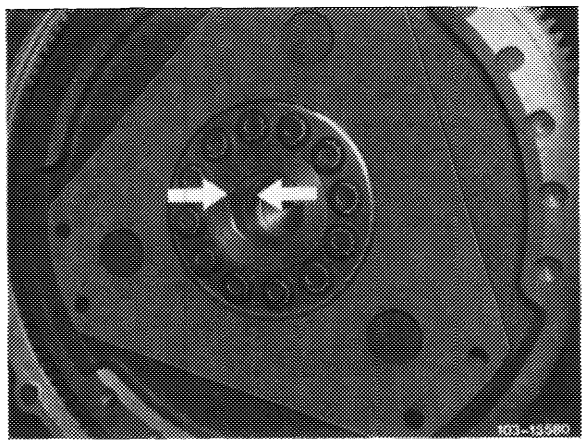


On models 126.120 and 123 with automatic transmission 722.303 (W4A 040), hold a steel bolt in one of the recesses on balancing disc for counterholding and support against cylinder crankcase (arrow).



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

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



Installation

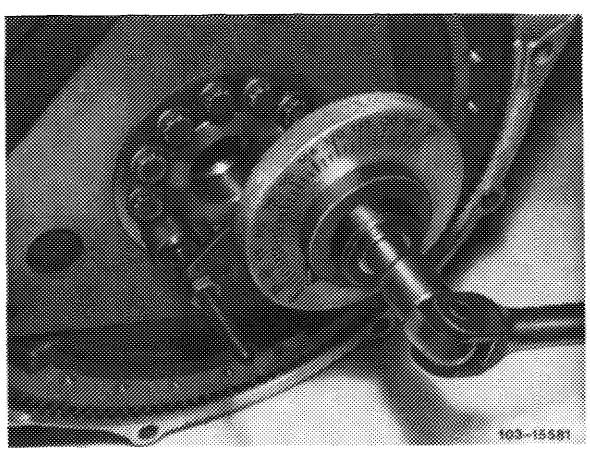
4 Measure necked-down stem dia. "d" of necked-down screws.

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

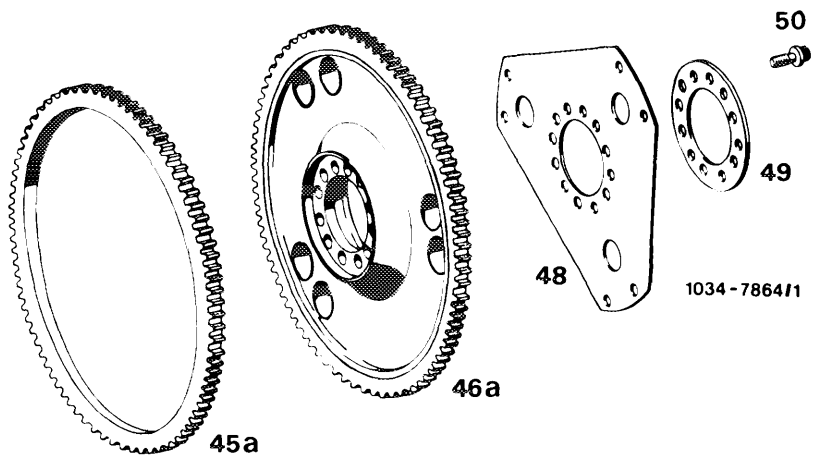
5 Position flywheel, driven plate and spacing washer on crankshaft journal in such a manner that the marks are in alignment.

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

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.

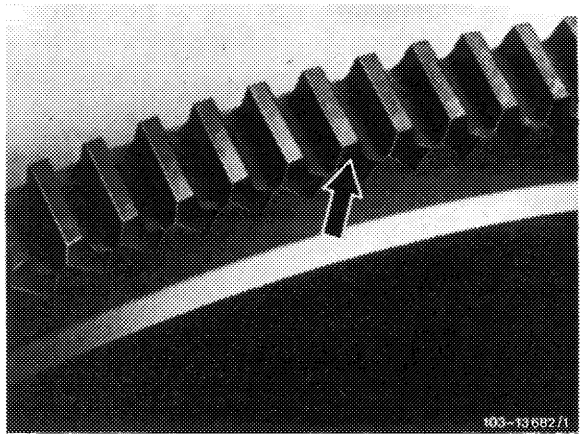
3 Uniformly heat new ring gear on a hot plate or in a heating oven.

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.

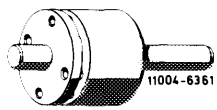
As a spare part, ring gears are available with chamfered teeth only.



Data

Flywheel for	Balancing bores Max. depth of bore	Bore dia.	Hole pattern 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

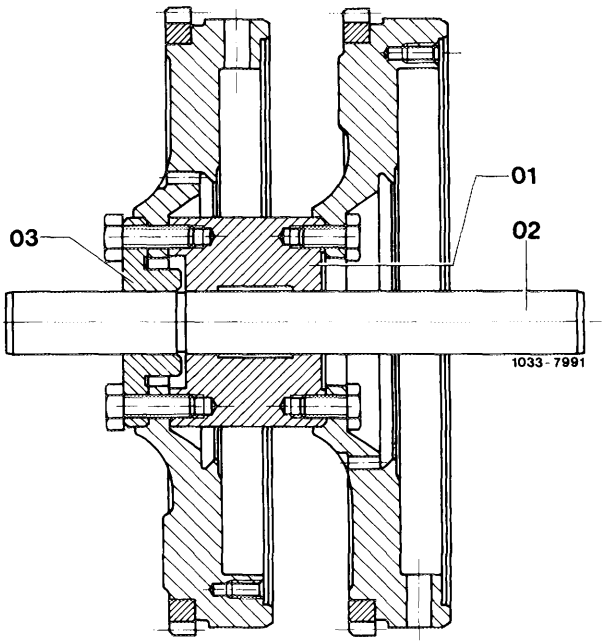
The engine is fully balanced, that is, the complete engine has been balanced on a balancing machine.

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

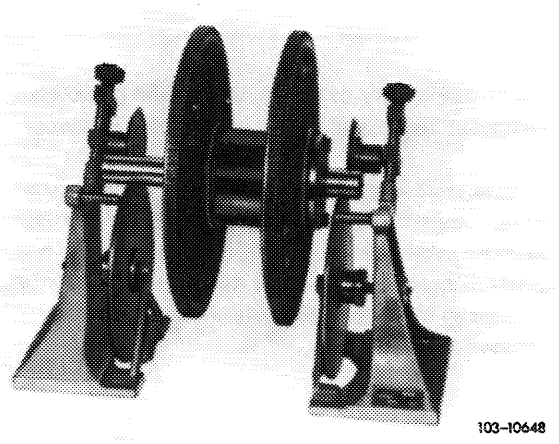
1 Place old and new flywheel one above the other in such a manner that all the bores are in alignment and both coupling surfaces are facing in one direction.

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 if 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.

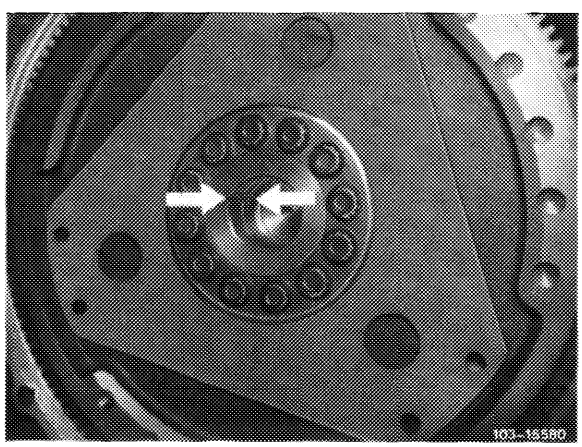
The engine 617.950 is fully balanced, that is, the complete engine has been balanced on a balancing machine.

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).

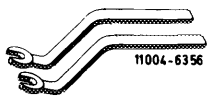
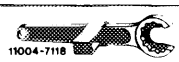
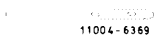
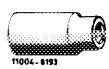
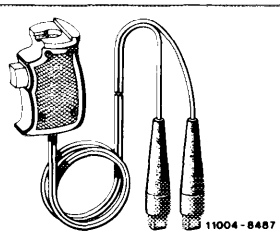
5 Shortblocs are fully balanced.

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

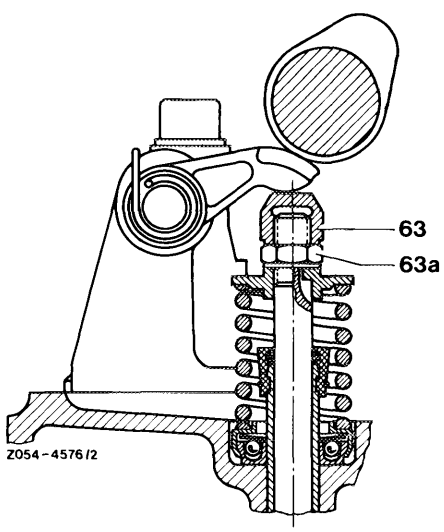
Special tools

Valve adjusting wrench 14 mm (2 each)	 11004-6356	615 589 00 01 00
Holding wrench for valve spring retainer	 11004-7118	615 589 00 03 00
Slip gage holder, red	 11004-6364	617 589 00 40 00
Slip gage blades 0.10 mm thick	 11004-6369	617 589 00 23 00
Slip gage blades 0.15 mm thick		617 589 01 23 00
Slip gage blades 0.20 mm thick		117 589 00 23 00
Slip gage blades 0.35 mm thick		617 589 03 23 00
Slip gage blades 0.40 mm thick		617 589 04 23 00
Socket 27 mm, 1/2" square for rotating engine	 11004-8193	001 589 65 09 00
Contact handle for rotating engine (component of compression pressure recorder 001 589 46 21 00)	 11004-8487	001 589 46 21 08

Note

Check valve clearance with engine cold or warm and adjust, if required.

During adjustment, check cap nut and counternut for tight seat and wear.

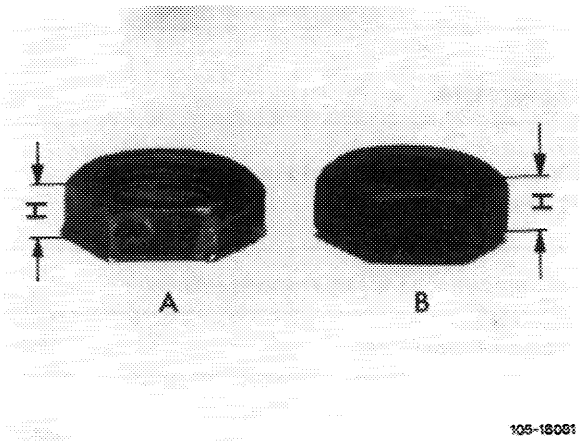


63 Cap nut
63a Counternut

Also check valves which are not in need of adjustment.

Renew cap nuts and counternuts in the following cases:

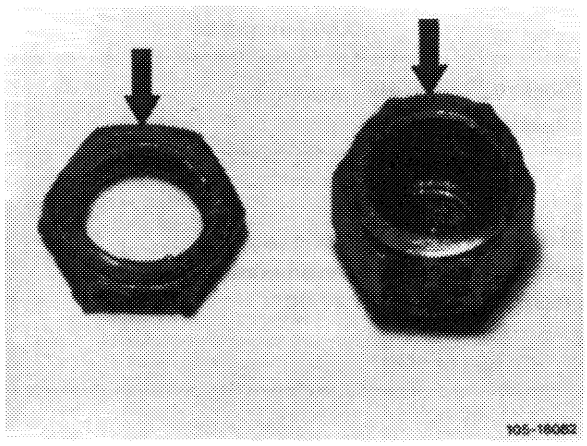
Height of counternut (A) below 5 mm (H). New counternuts (B) have a height of 6 mm.



105-18081

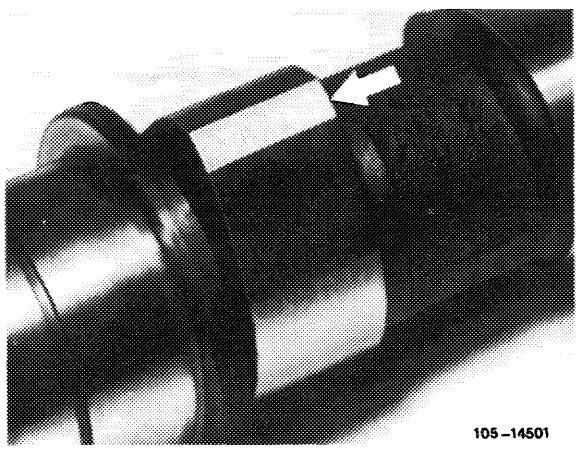
Counterlocking surfaces of nuts badly worn (arrows).

In such cases, check threads on valve stem and also replace valves, if required.



105-18082

Check camshafts made of malleable iron (code number 00) for wear. Formation of excessive flats on cam (arrow) may result in loosening of counterlocked nuts. If flats show up, renew camshaft, rocker arm, valve springs, as well as cap nuts and counternuts. Also check valves and replace, if required.

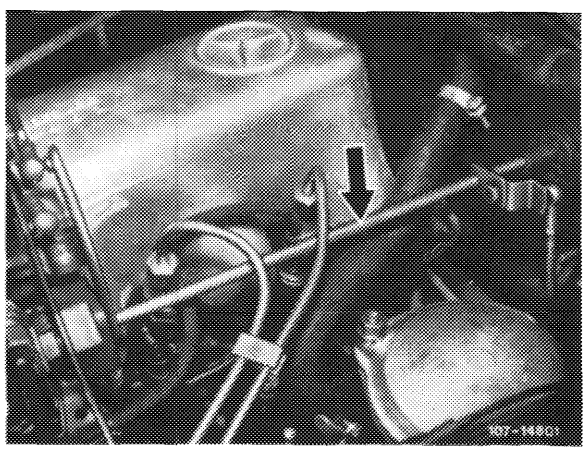


105-14501

On camshafts made of chilled cast iron (code number 05 and 08) a slight formation of flats is possible, but flats will not increase and are therefore technically insignificant.

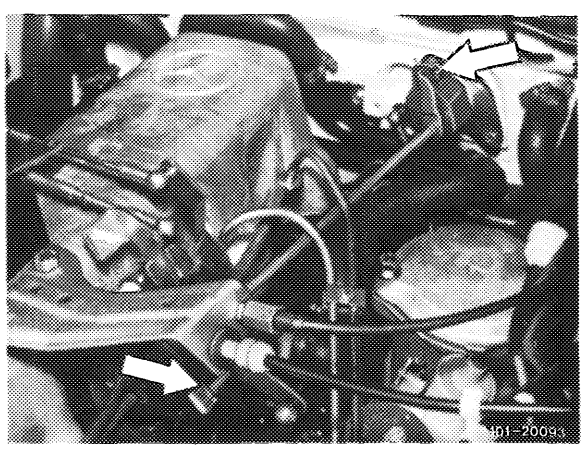
Adjustment

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



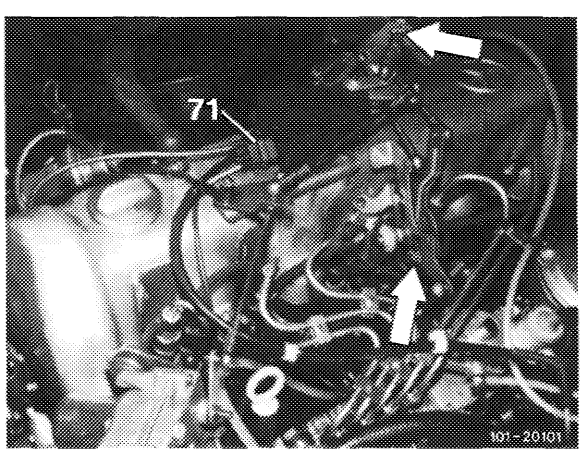
Model 126.120

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



Model 123

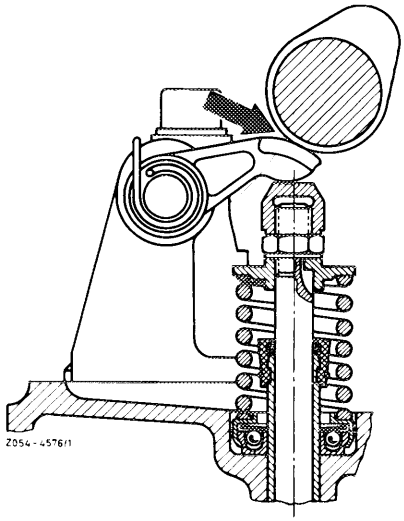
On models 123 with automatic transmission 722.303 (W 4 A 040) and 126.120, pull off central plug for vacuum lines (71) or vacuum lines. Disconnect Bowden wire, compress black plastic clip (arrow) and pull Bowden wire out of holder in rearward direction.



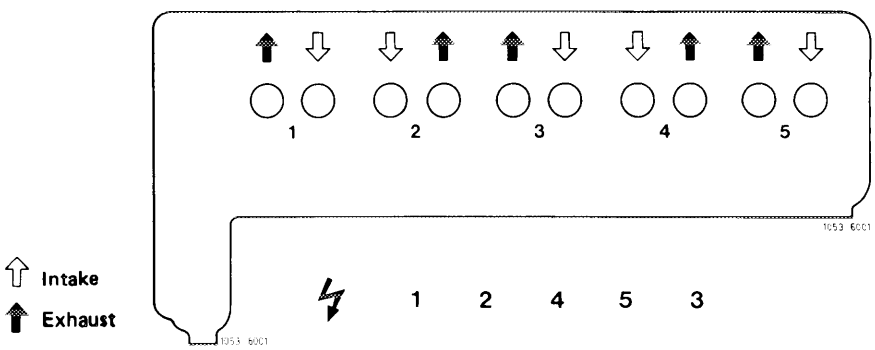
Model 126.120

2 Check valve clearance between slide surface of rocker arm and cam base circle of camshaft (arrow). Tip of cam should be vertical in relation to rocker arm.

Valve clearance is correctly set when pulling of slip gage blade requires some effort.



Observe layout of intake and exhaust valves.

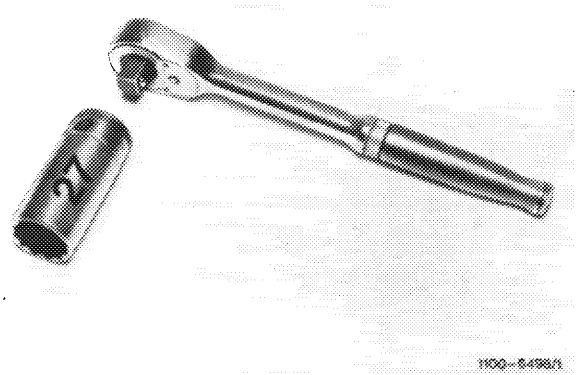


The engine can be rotated as follows:

a) With tool combination at crankshaft front

Attention!
Do **not** rotate engine at fastening bolt of **camshaft sprocket.**

Do **not rotate** crankshaft **in reverse.**

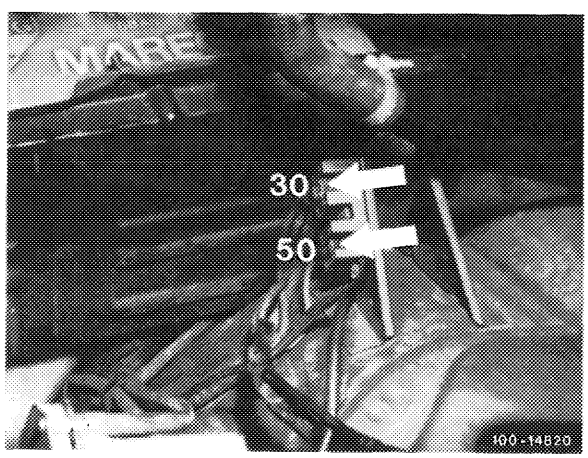


b) With starter motor and contact handle

Connect contact handle to cable connector, terminal 30 and 50.

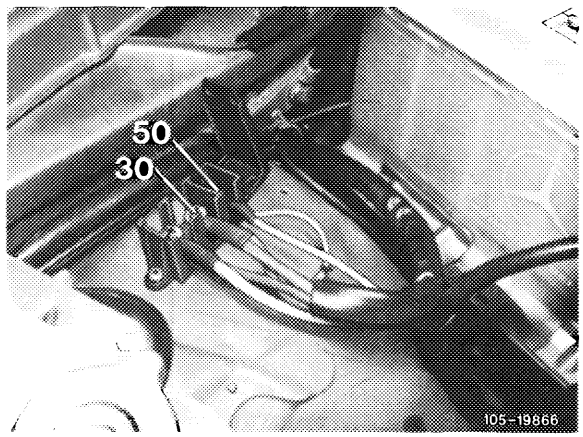
The cable connector is located at the following points:

Model 116.120: Under battery.



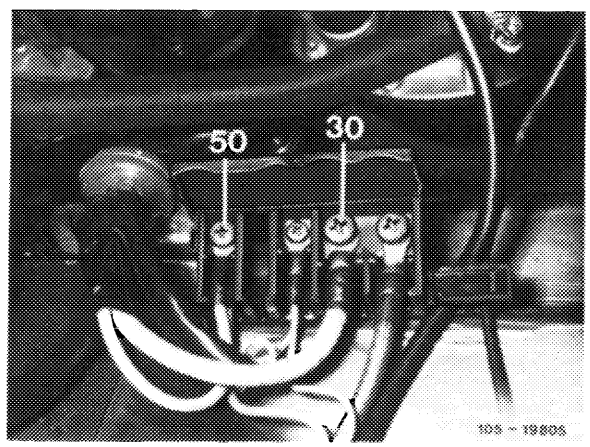
Model 116.120

Model 123: At right on wheel house.



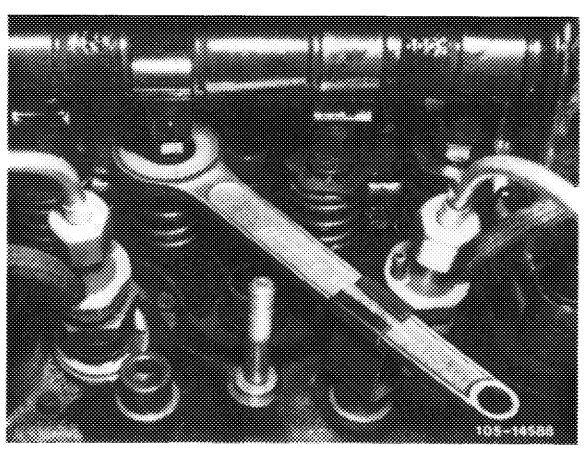
Model 123

Model 126.120: On frame side member.



Model 126.120

3 Place holding wrench on valve spring retainer.

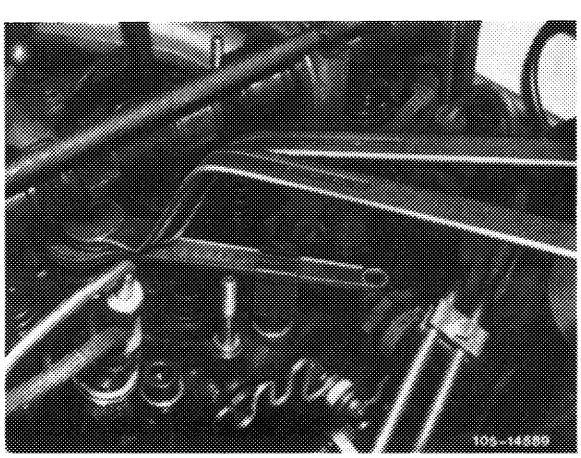


4 Loosen cap nut while applying counterhold to counternut on valve by means of valve adjusting wrench.

5 Adjust valve clearance by turning cap nut.

6 Following adjustment, secure cap nut with counternut (torque reference value 20–30 Nm).

7 Check valve clearance once again.



Timing at 2 mm valve lift

Engine	Camshaft code number[1])	Intake valve opens after TDC	closes after BDC	Exhaust valve opens before BDC	closes before TDC
617.950[2])	00 08[4])	with new timing chain			
		11.5°	13.5°	21°	19°
		with used timing chain (from approx. 20 000 km)			
		13.5°	15.5°	19°	17°
617.950[3]) 617.951 617.952	05[4])	with new timing chain			
		9°	15°	27°	16°
		with used timing chain (from approx. 20 000 km)			
		11°	17°	25°	14°

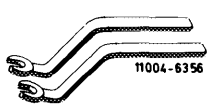
[1]) Camshaft code number is punched into rear end of camshaft.
[2]) (USA) up to model year 1979.
[3]) (USA) model year 1980.
[4]) Camshaft made of chilled cast iron.

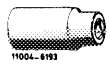
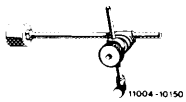
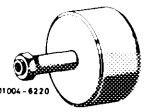
Valve clearance	with engine cold (approx. 20 °C)	with engine warm (60 °C ± 15 °C)
Intake	0.10[1])	0.15[1])
Exhaust	0.35	0.40

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

Tightening torques	Nm
Nuts for cylinder head cover	15
Necked-down screw for camshaft sprocket	80
Closing plug for chain tensioner	90

Special tools

Valve adjusting wrench 14 mm (2 each)		 11004-6356	615 589 00 01 00
Holding wrench for valve spring retainer		 11004-7118	615 589 00 03 00
Slip gage holder, red		 11004-6364	617 589 00 40 00
Slip gage blades	0.10 mm thick 0.15 mm thick	 11004-6369	617 589 00 23 00 617 589 01 23 00

Socket 27 mm, 1/2" square, for rotating engine		001 589 65 09 00
Dial gage holder		363 589 02 21 00
Impact puller for bearing bolt (basic unit)		116 589 20 33 00
Threaded bolt for impact puller M 6, 50 mm long		116 589 01 34 00

Conventional tool

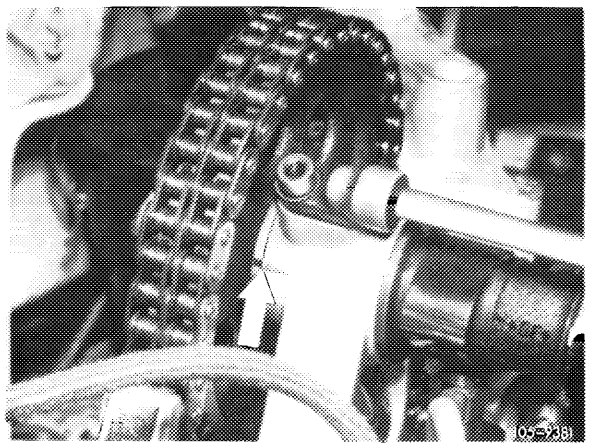
Dial gage A 1 DIN 878	e.g. made by Mahr, D-7300 Esslingen Order No. 810

Note

During assembly jobs, alignment of the markings (arrow) in ignition TDC position of 1st cylinder will be sufficient.

In special cases, e.g. during complaints about performance, check and adjust begin of opening at intake valve of 1st cylinder.

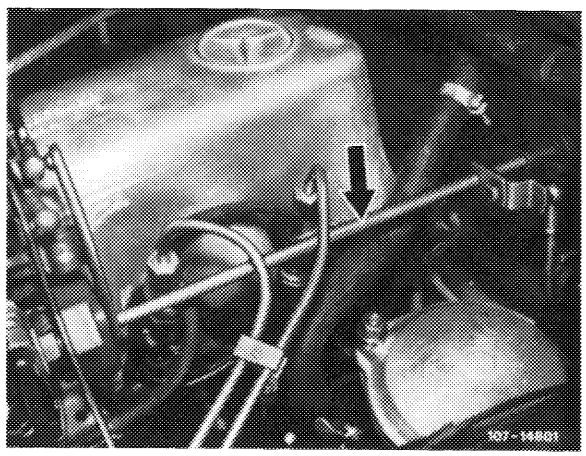
Timing is measured at 2 mm valve lift. For this purpose, the valve clearance must be neutralized.



Checking

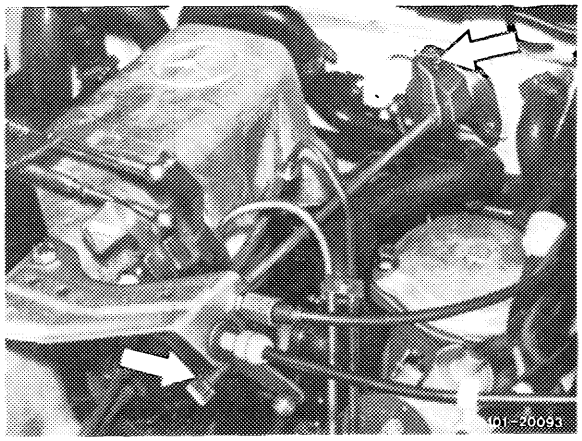
1 Unscrew pencil element glow plugs.

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



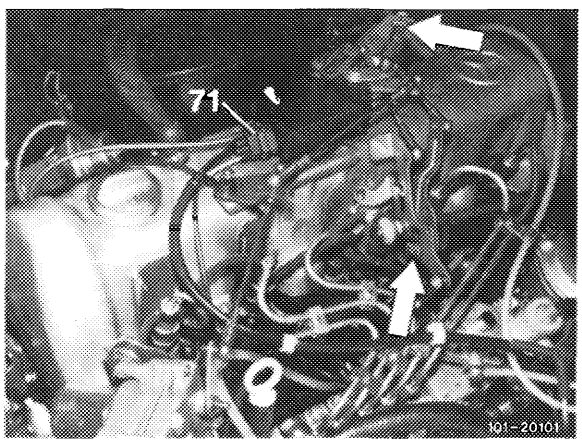
On models 116.120 and 123, pull longitudinal regulating shaft out of rubber mount in forward direction and remove in rearward direction.

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



Model 123

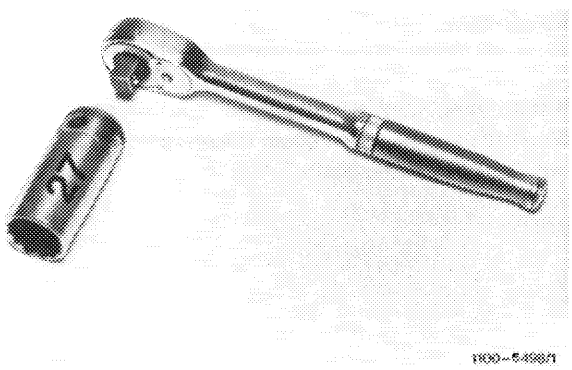
On models 123 with automatic transmission 722.303 (W 4 A 040) and 126.120, pull off central plug for vacuum lines (71) or vacuum lines. Disconnect Bowden wire, compress black plastic clip (arrow) and pull Bowden wire out of holder in rearward direction.



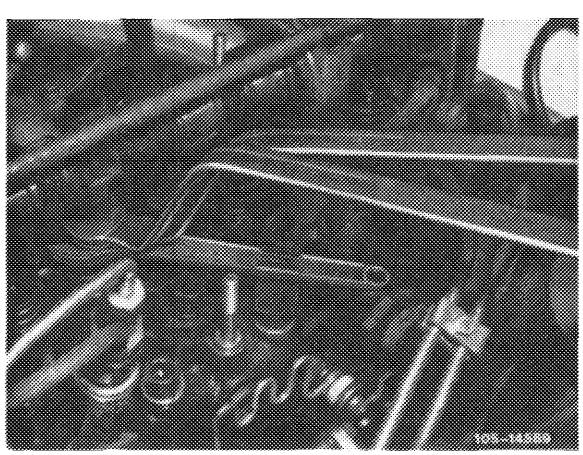
Model 126.120

3 Rotate crankshaft with tool combination until cam tip is pointing upwards.

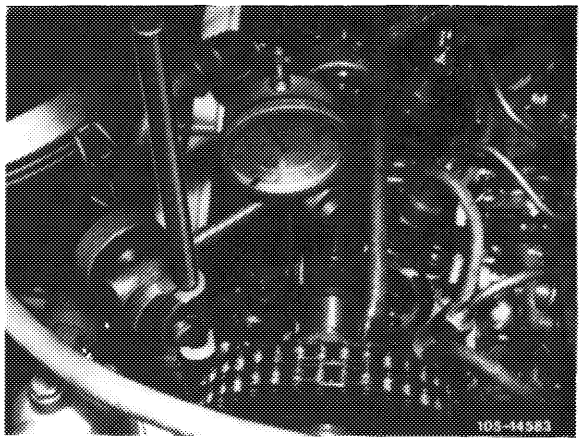
Attention!
Do not rotate engine on fastening screw of camshaft sprocket. Never rotate engine in reverse while measuring, since this will result in considerable measuring faults.



4 Just cancel valve clearance at intake valve of 1st cylinder by screwing up cap nuts (05–210).

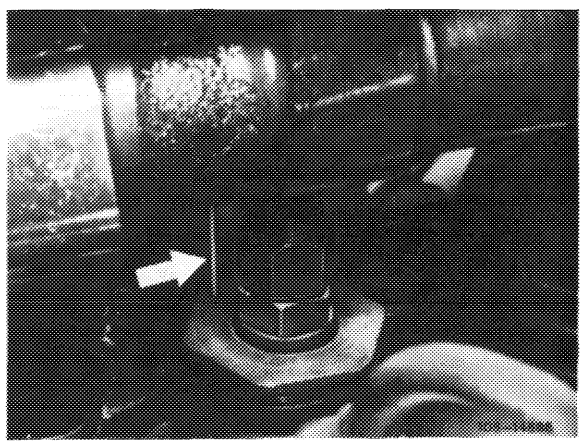


5 Screw dial gage holder with threaded sleeve to stud at front right.



6 Insert dial gage and fasten in such a manner that the feeler pin rests on valve spring retainer at a preload of 3 mm (small needle of dial gage) (arrow).

Turn dial of dial gage until large needle rests on "0".



Attention!
Feeler pin of dial gage should be seated on valve spring retainer in accurately vertical position.

7 Keep turning crankshaft in direction of rotation of engine until small needle of dial gage has gone back by 2 mm (valve lift) to 1 mm.

In this position, the value on balancing disk should be in agreement with the indicated value "intake valve opens".

Adjustment

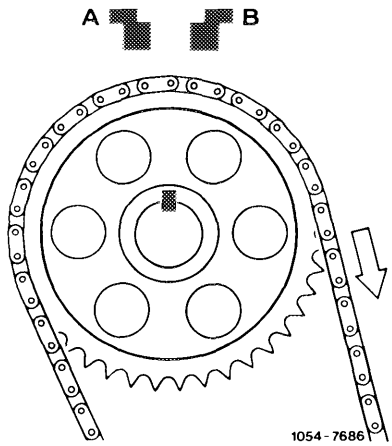
If the timing requires correction, install an offset Woodruff key or, if the chain is excessively elongated, install a new timing chain.

Woodruff keys are available in the following steps:

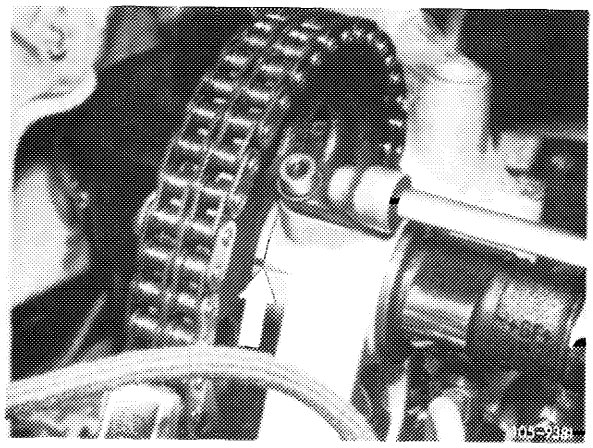
Offset mm	Part No.	for a correction of approx.
0.7	621 991 04 67	4° crankshaft
0.9	621 991 02 67	6 1/2° crankshaft
1.1	621 991 01 67	8° crankshaft
1.3	621 991 00 67	10° crankshaft

An offset by one tooth on camshaft sprocket results in approx. 18° at crankshaft.

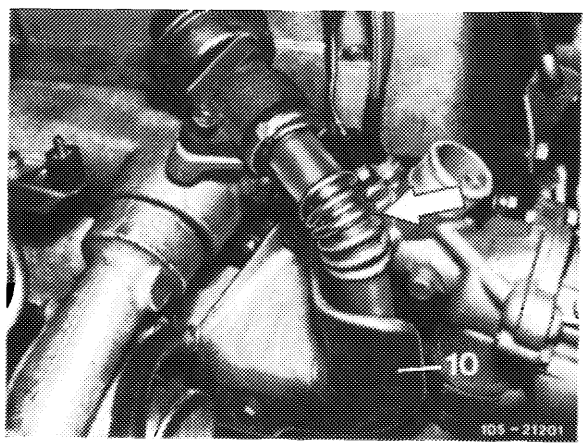
An offset of Woodruff keys to the right (in driving direction [A]) results in an earlier begin of opening, and an offset to the left (B) in a later begin of opening.



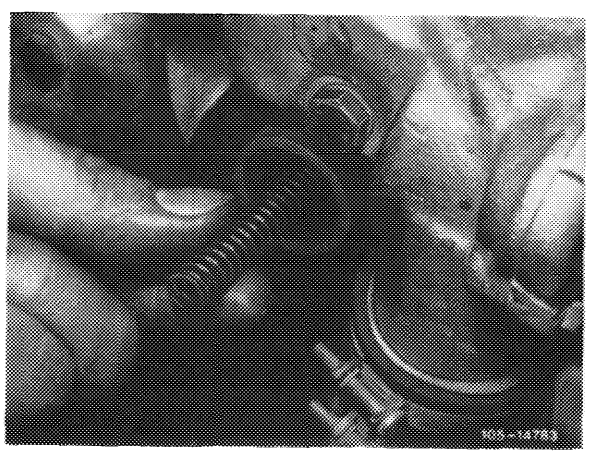
8 Set engine to ignition TDC of 1st cylinder.



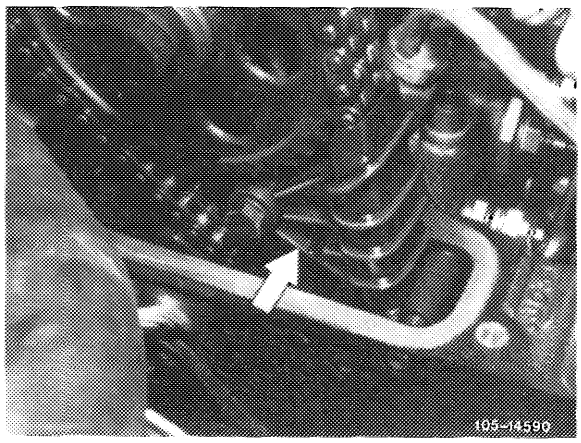
9 On engines with EGR (USA), remove pipe line between EGR valve and exhaust manifold (arrow). Unscrew shielding plate (10) for this purpose.

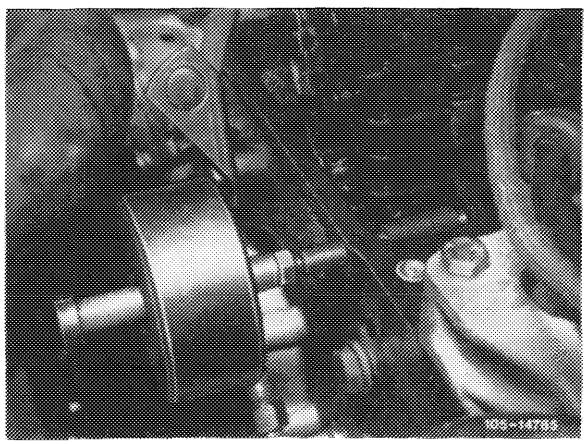


10 Unscrew closing plug of chain tensioner and remove compression spring (05–310).

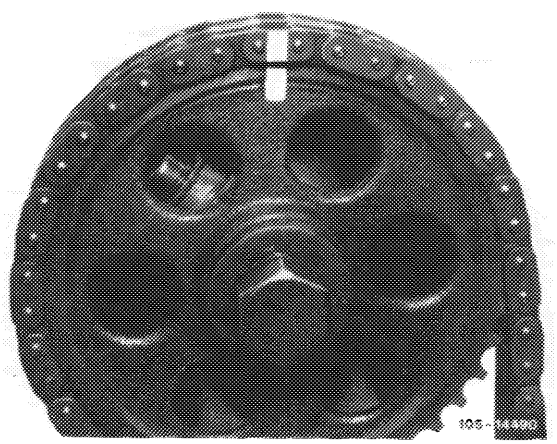


11 Remove slide rail in cylinder head. Pull out bearing bolt by means of impact puller.



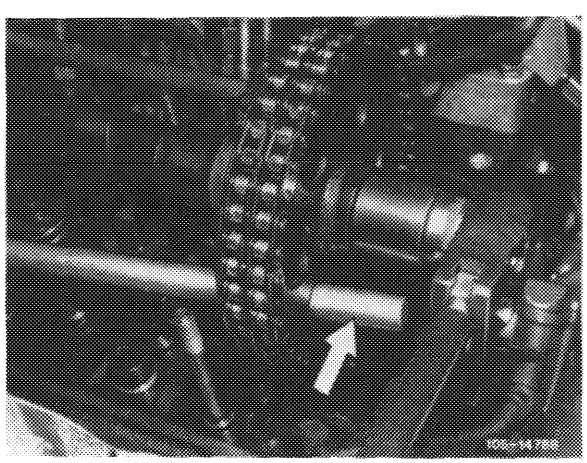


12 Mark camshaft sprocket and timing chain in relation to each other.



13 Remove camshaft sprocket.

To loosen necked-down screw of camshaft sprocket, apply counterhold with a screwdriver or steel pin.



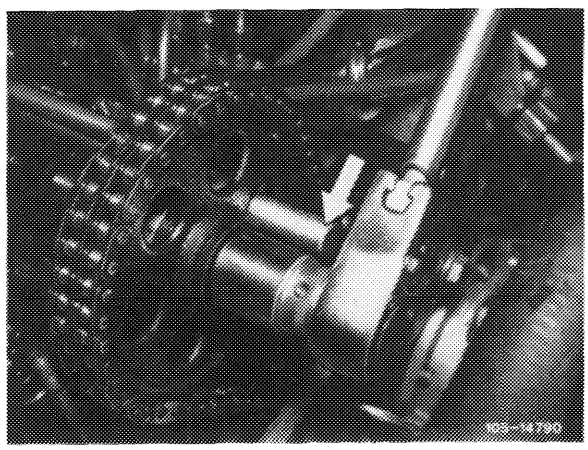
14 Place rag under camshaft and remove Woodruff key.

15 Insert selected Woodruff key.

16 Mount camshaft sprocket while paying attention to color marks.

Do not tighten necked-down screw.

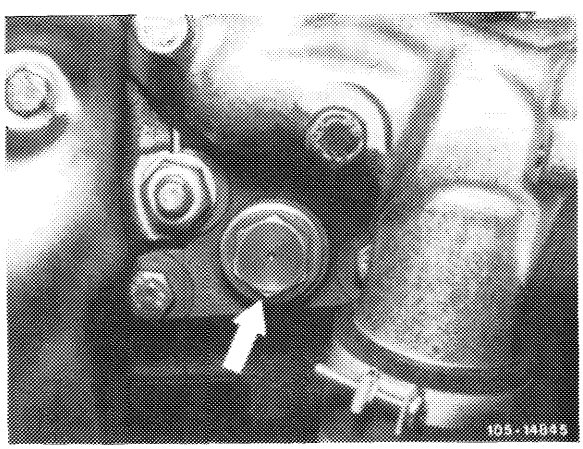
17 Repeat item 6 and 7.



18 Tighten necked-down screw for fastening camshaft sprocket to 80 Nm. For this purpose, apply counterhold to camshaft sprocket by means of a screwdriver or a steel pin.

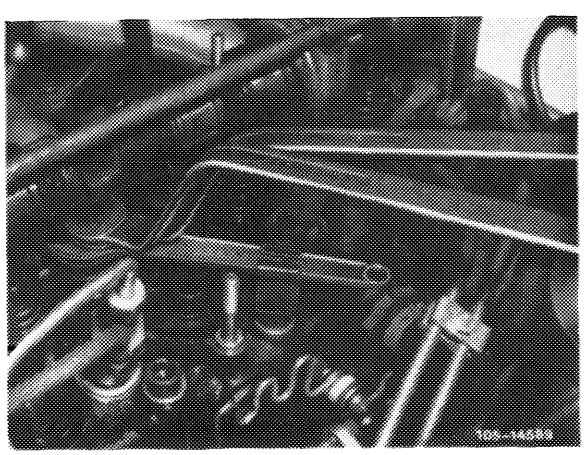
19 Install slide rail.

20 Place compression spring into chain tensioner and tighten closing plug to 90 Nm.



21 Unscrew dial gage holder.

22 Adjust valve clearance at intake valve of 1st cylinder (05–210).



23 On engines with EGR (USA), install pipe line between EGR valve and exhaust manifold. Screw on shielding plate.

24 Mount cylinder head cover.

Timing at 2 mm valve lift

Engine	Camshaft code number[1])	Intake valve opens after TDC	Intake valve closes after BDC	Exhaust valve opens before BDC	Exhaust valve closes before TDC
617.950[2])	00 08[4])	with new timing chain			
		11.5°	13.5°	21°	19°
		with used timing chain (from approx. 20 000 km)			
		13.5°	15.5°	19°	17°
617.950[3]) 617.951 617.952	05[4])	with new timing chain			
		9°	15°	27°	16°
		with used timing chain (from approx. 20 000 km)			
		11°	17°	25°	14°

[1]) Camshaft code number is punched into rear end of camshaft.
[2]) (USA) up to model year 1979.
[3]) (USA) model year 1980.
[4]) Camshaft made of chilled cast iron.

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.

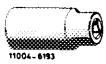
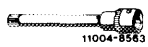
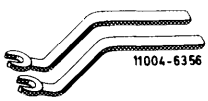
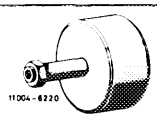
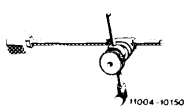
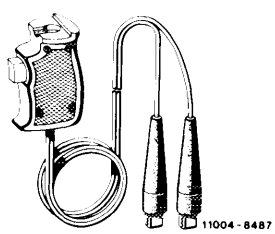
Data

Permissible runout of center bearing journal and camshaft sprocket seat when mounting camshaft in outer bearing journals	Camshaft code number	00	05, 08
	Camshaft sprocket seat	0.020	0.025
	2nd bearing point	0.030	0.030
	3rd bearing point	0.025	0.030
Scleroscope hardness of cams		70–82	64–75

Tightening torques		Nm
Nuts for cylinder head cover		15
Camshaft bearing bolts (hex. socket cylinder head bolts)		100
Camshaft bearing bolts (double hex. socket cylinder head bolts)	1st stage	40
	2nd stage	70
	3rd stage	90°
	4th stage	90°

Nuts M 8 for camshaft bearings	25
Necked-down screw for camshaft sprocket	80
Rocker arm bearing brackets to cylinder head	40

Special tools

Socket 27 mm, 1/2" square, for rotating engine		001 589 65 09 00
Screwdriver socket 10 mm, 1/2" square, 140 mm long for hex. socket cylinder head bolts		000 589 05 07 00
Screwdriver socket 1/2" square, 140 mm long for double hex. socket cylinder head bolts		617 589 00 10 00
Valve adjusting wrench 14 mm (2 each)		615 589 00 01 00
Holding wrench for valve spring retainer		615 589 00 03 00
Impact puller for bearing bolt (basic unit)		116 589 20 33 00
Threaded bolt for impact puller M 6, 50 mm long		116 589 01 34 00
Dial gage holder		363 589 02 21 00
Contact handle for rotating engine (component of compression pressure recorder 001 589 46 21 00)		001 589 46 21 08

Conventional tool

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

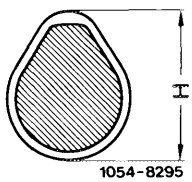
Note

When installing a new camshaft, also renew rocker arms on principle.

Of rocker arms with carbide facing, replace damaged rocker arms only.

The larger cylinder charge required for engine 617.950 (USA) model year 1980 with increased output and on engines 617.951/952 has been obtained by increasing the valve lift.

For this purpose, the intake and exhaust cams on camshaft have been modified with regard to height (H) and shape.



Valve lift on engine 617.950 (USA) model year 1980 with increased output and on engines 617.951/952.

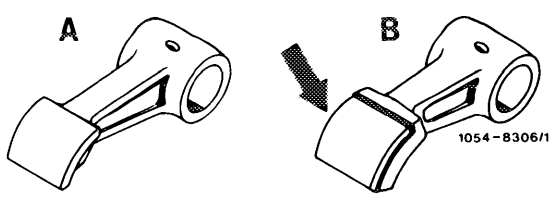
Intake	10.0 mm
Exhaust	10.4 mm

Valve lift on engine 617.950 (USA) without increased output up to model year 1979.

Intake and exhaust 8.5 mm

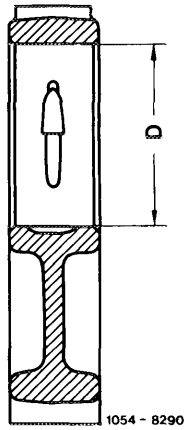
Since the above measures result in higher loads on camshafts, a different materials pairing between camshaft and rocker arm has been required.

Camshafts of engine 617.950 (USA) model year 1980 with increased output and of engines 617.951/952 (code number 05) are made of chilled cast iron, and the sliding surface of the respective rocker arms is provided with a brazed-on carbide facing (B, arrow).



A Rocker arm inductance-hardened and hard-chromed
B Rocker arm with carbide facing

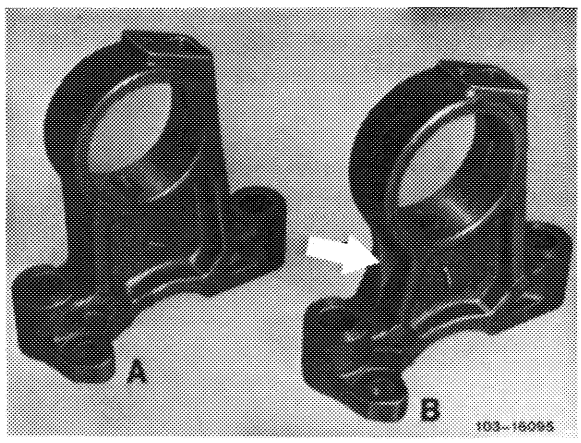
Because of the larger valve lift (higher cams) and in order to permit installation of camshaft, the bearing diameter (D) at camshaft bearings 2, 3 and 4 had to be increased by 2.5 mm. Accordingly, the diameter of bearing journals 2, 3 and 4 of camshaft has also been increased by 2.5 mm.



Camshaft bearings 2, 3 and 4

Engines without increased output D = 46.5 mm
Engines with increased output D = 49.0 mm

In addition, camshaft bearings 2, 3 and 4 have been reinforced (B).



On the other hand, the diameter of the first camshaft bearing and the first camshaft bearing journal has remained the same.

Since the wear characteristics of camshafts made of chilled cast iron are better than those made of malleable cast iron, the malleable cast iron camshaft (code number 00) for engine 617.950 (USA) for model year 1979 without increased output has been replaced by the chilled cast iron camshaft (code number 08) (refer to table).

This camshaft also includes the rocker arms with carbide facing.

Installation: June 1979

Model	Engine	Engine end No.	Chassis end No.
116.120	617.950	010606	010351

The chilled cast iron camshafts (code number 05 and 08) may be installed only together with the carbide-faced rocker arms.

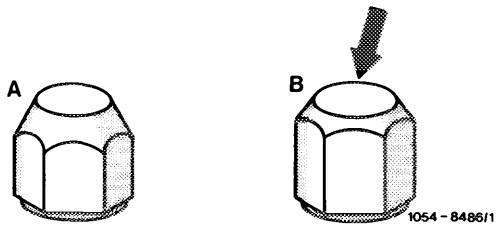
Rocker arms with carbide facing may not be installed together with malleable cast-iron camshaft (code number 00).

It is also not permitted to install engine 617.950 (USA) model year 1980 with increased output and engines 617.951/952 on engine 617.950 (USA) up to model year 1979.

Simultaneously with the changeover to chilled cast iron camshaft and rocker arms with carbide facing, the cap nuts in upper range were reinforced and hard-chromed (B).

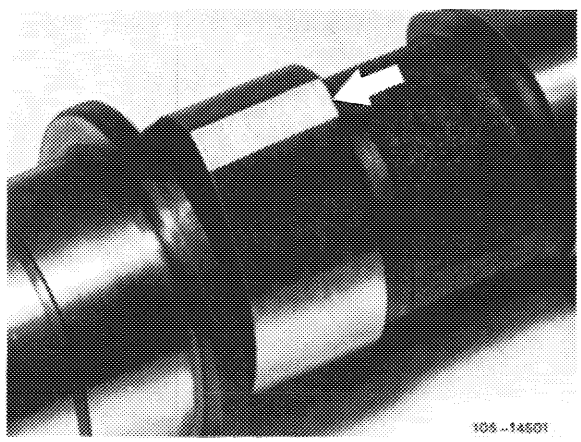
They may be installed on all rocker arm versions.

On the other hand, the non-chrome-plated cap nut may not be used for rocker arm with carbide facing.



A Cap nut without chrome plating
B Cap nut with chrome plating

Chilled cast iron camshafts are sensitive to fracture and should not be knocked against, struck or thrown.



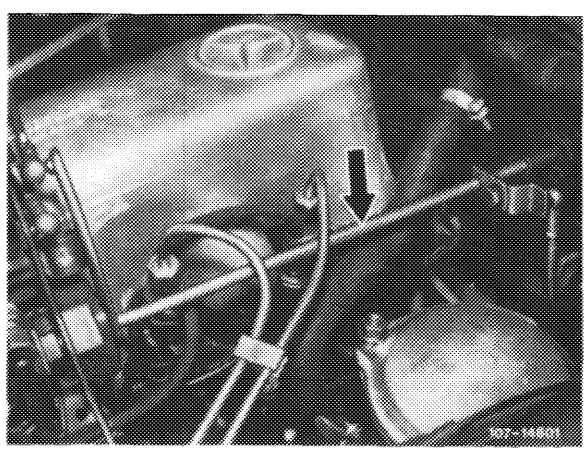
Camshafts on which flats are showing up on cams (arrow) should be replaced.

The timing should be checked on engines after a long period of operation (extensive elongation of chain) (05–215).

Worn out camshaft bearing journals may be reground. The required camshaft bearings are available in two repair stages (05–225).

Removal

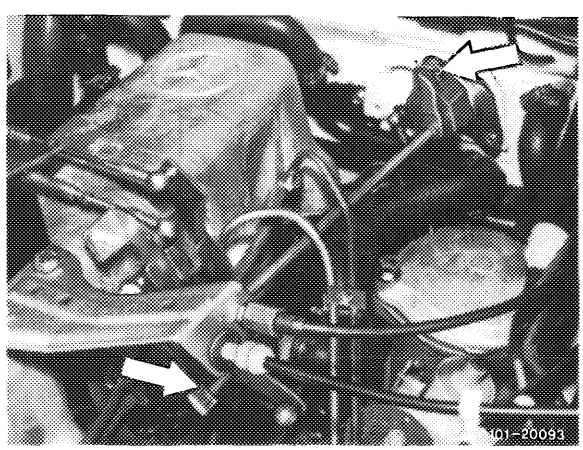
1 Disconnect regulating linkage to remove cylinder head cover. Pull out locking eye of longitudinal regulating shaft (arrow).



Model 116.120

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

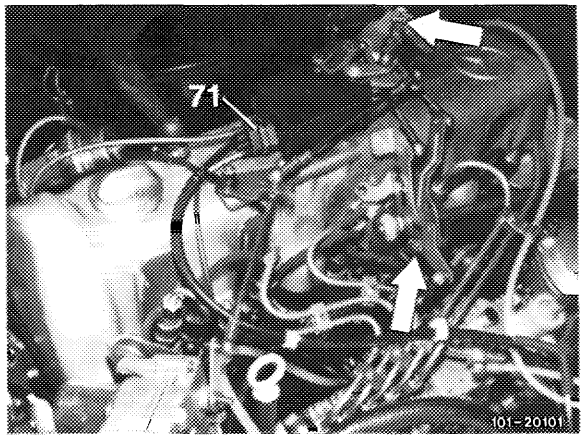
On model 126.120, pull longitudinal regulating shaft out of guide lever in rearward direction and remove in forward direction.



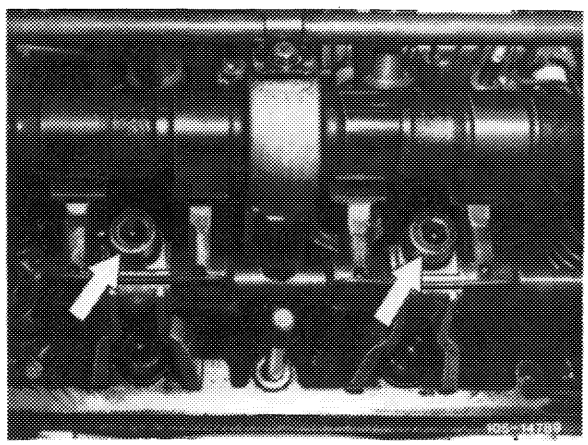
Model 123

On models 123 with automatic transmission 722.303 (W 4 A 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.

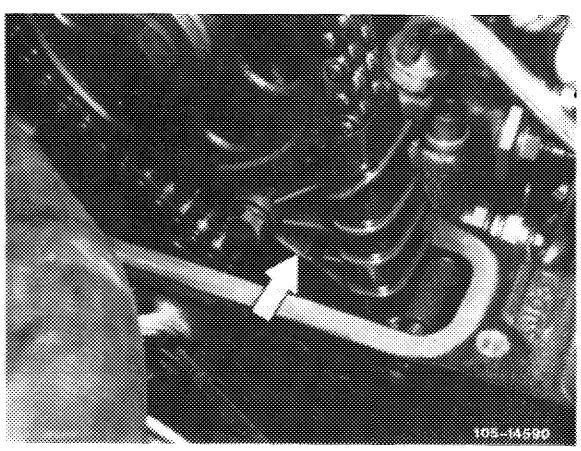
Model 126.120

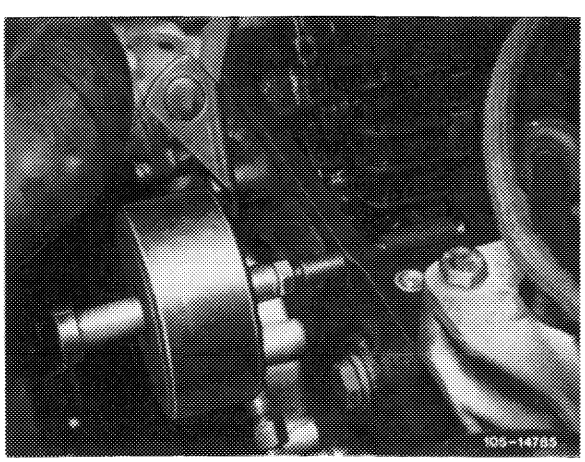


2 Remove rocker arms together with rocker arm brackets (05–235).

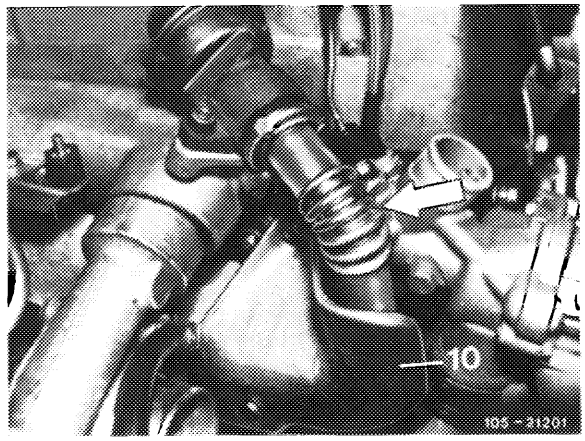


3 Remove slide rail in cylinder head. Pull out bearing bolt by means of impact puller.

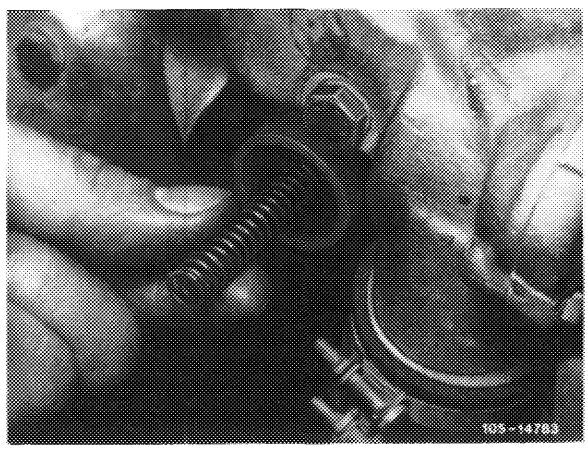




4 On engines with EGR (USA), remove pipe line between EGR valve and exhaust manifold (arrow). Unscrew shielding plate (10) for this purpose.

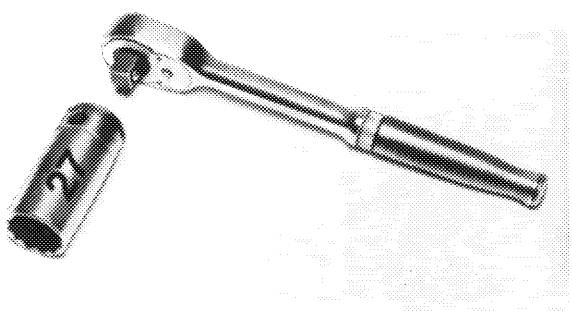


5 Unscrew closing plug of chain tensioner and remove compression spring (05–310).

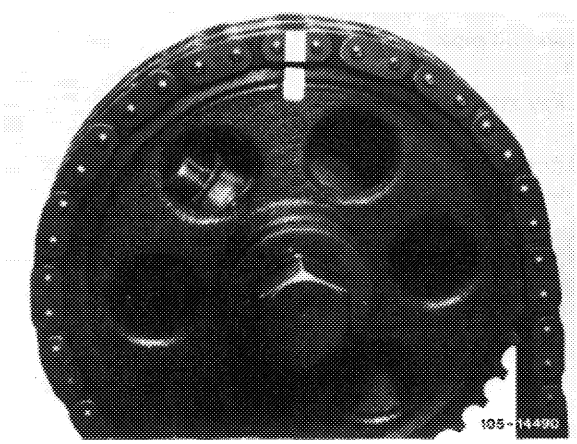


6 Set crankshaft to ignition TDC.

Rotate crankshaft with tool combination for this purpose.

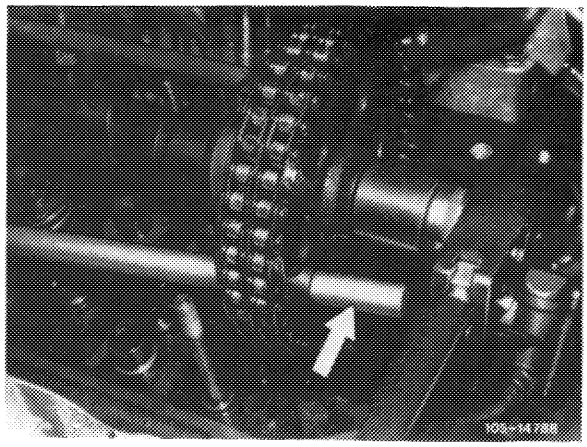


7 Mark camshaft sprocket and timing chain in relation to each other.

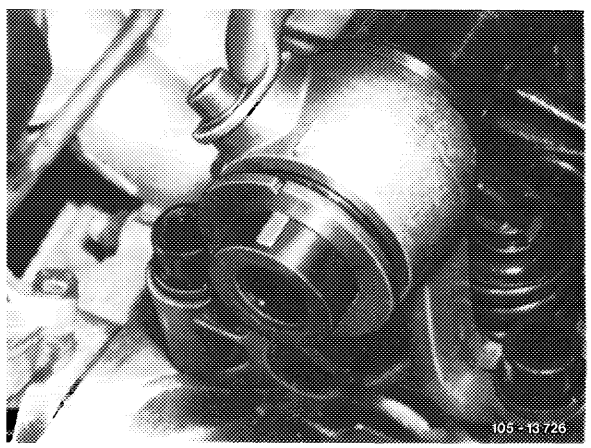


8 Remove camshaft sprocket.

To loosen necked-down screw, apply counterhold to camshaft sprocket by means of a screwdriver or a steel bolt.

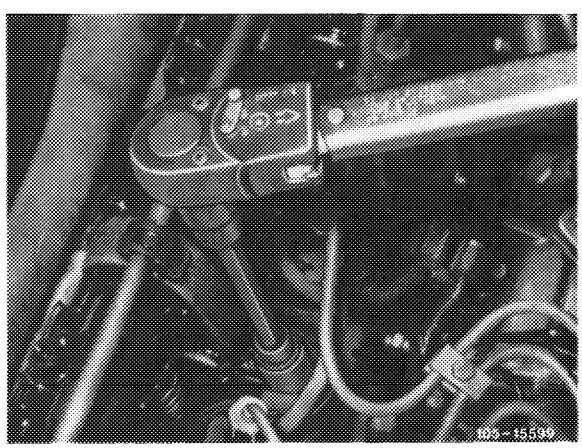


9 Remove compensating washer.



10 Unscrew camshaft bearing screws by means of screwdriver socket (10 mm).

Unscrew nuts M 8.



11 Remove camshaft together with camshaft bearings and oil pipe.

Pay attention to dowel pins.

Loosen stuck camshaft bearings by means of light blows with a plastic hammer.

12 Pull camshaft out of camshaft bearings in rearward direction.

Installation

13 Provide camshaft bearings, camshaft bearing journals and cams with engine oil.

14 Slip camshaft from the rear into camshaft bearings.

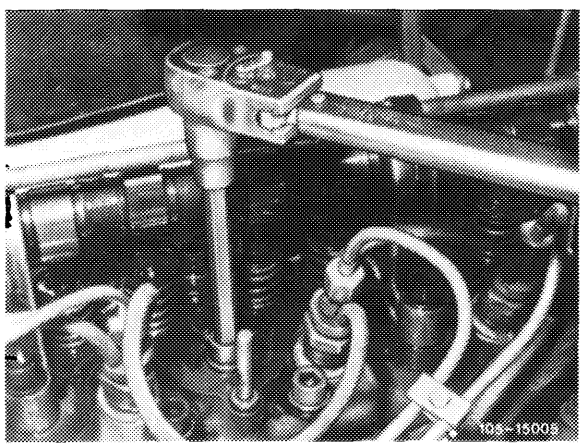
15 Mount camshaft with camshaft bearings and oil pipe.

Pay attention to dowel pins.

16 Tighten camshaft bearing bolts (cylinder head bolts) from inside out as specified (refer to table).

On engines with hex. socket cylinder head bolts, slightly loosen the remaining 14 cylinder head bolts also from inside out **individually** and tighten to 100 Nm.

Tighten M 8 nuts to 25 Nm.



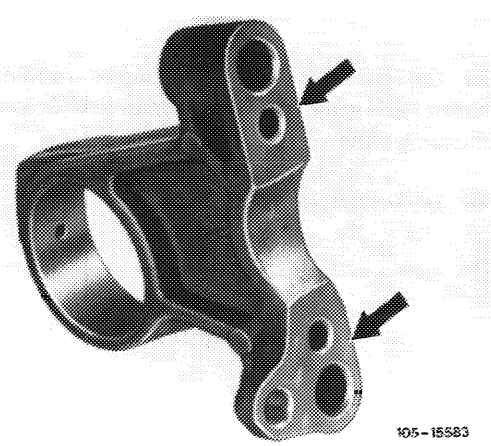
17 Rotate camshaft manually to check for easy operation.

If camshaft is **hard** to rotate, proceed as follows:

Loosen camshaft bearings individually. Then rotate camshaft each time.

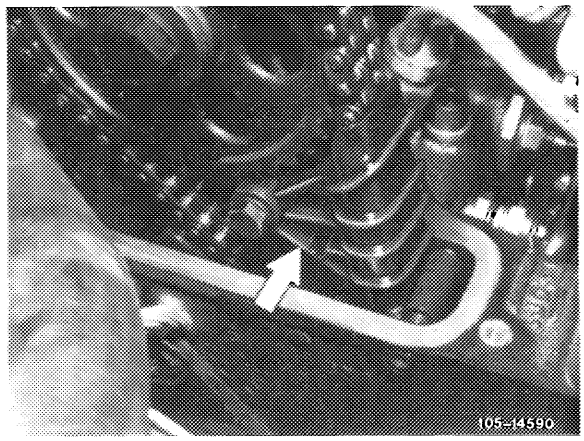
Repeat until the binding bearing point is found. Depending on sag of camshaft, touch up pertinent camshaft bearing at base (arrows) on a surface plate.

18 Slip compensating washer on journal for camshaft sprocket.



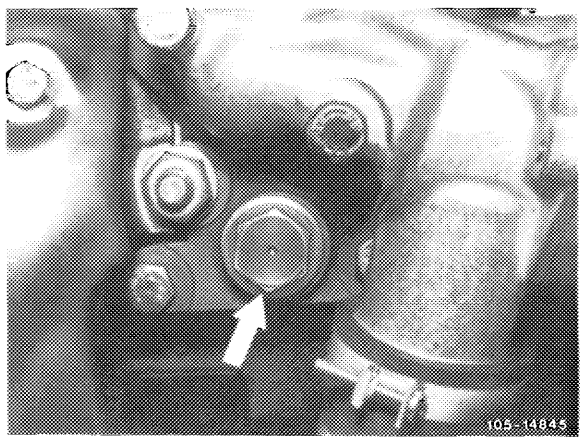
19 Mount camshaft sprocket. Pay attention to color marks.

Tighten necked-down screw to 80 Nm. For this purpose, apply counterhold to camshaft sprocket by means of a screwdriver or steel bolt.

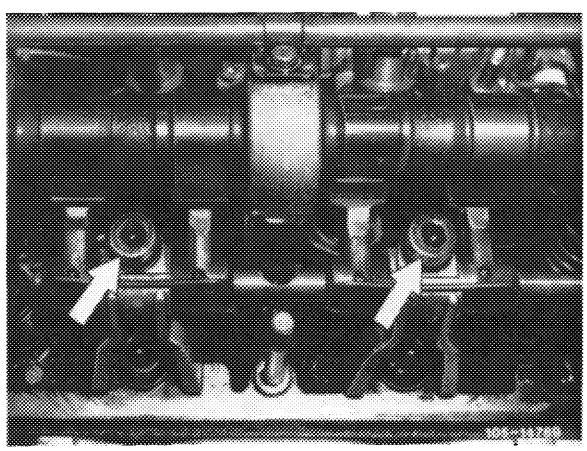


20 Install slide rail.

21 Place compression spring into chain tensioner and tighten closing plug to 90 Nm.



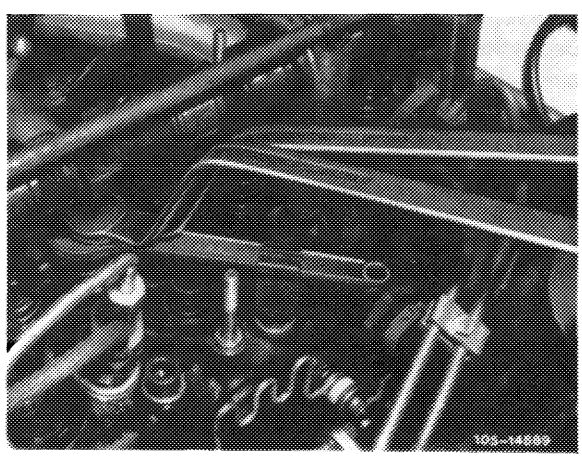
22 Install rocker arms together with rocker arm bearing brackets (05–235).



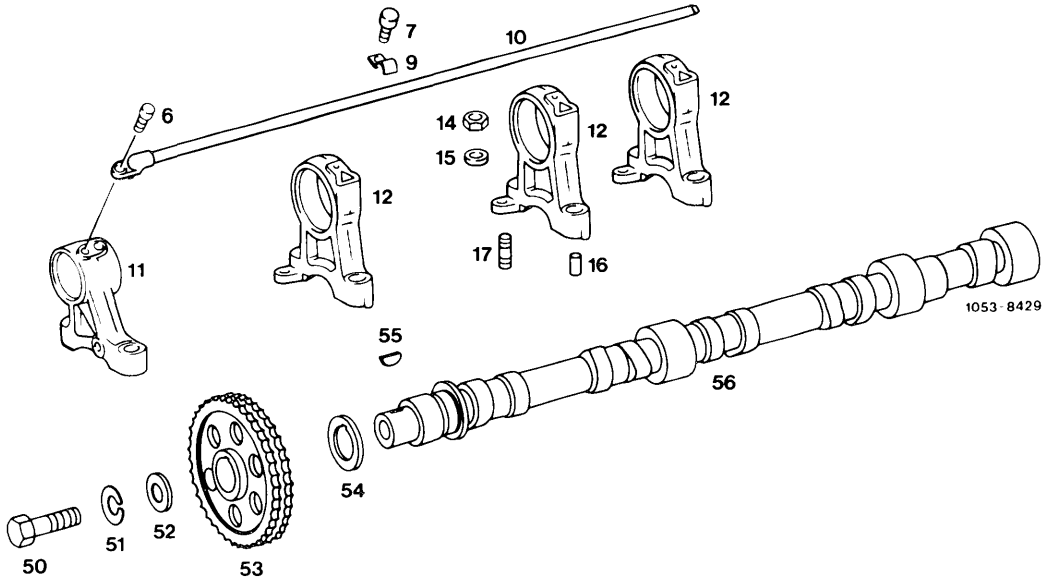
23 Adjust valve clearance (05–210).

24 On engines with EGR (USA), install pipe line between EGR valve and exhaust manifold. Screw on shielding plate.

25 Mount cylinder head cover.



Camshaft and camshaft bearings



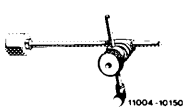
6 Combination screw M 6 x 12
7 3 combination screws M 5 x 10
9 3 fastening clamps
10 Oil pipe
11 Camshaft bearing crank end
12 Camshaft bearing
14 4 nuts M 8
15 4 washers 8.4
16 8 cylindrical pins 8 x 8
17 4 studs M 8 x 18
50 Necked-down screw M 14 x 1.5 x 40
51 Snap ring B 14
52 Washer
53 Camshaft sprocket
54 Compensating washer
55 Woodruff key
56 Camshaft

Data

Roughness of camshaft bearing journals			0.003	
Permissible runout of center bearing journals and camshaft sprocket seat when mounting camshaft at outer bearing journals	Camshaft code number[1])	00	05, 08	
	Camshaft sprocket seat	0.020	0.025	
	2nd bearing point	0.030	0.030	
	3rd bearing point	0.025	0.030	
Scleroscope hardness of cams		70–82	64–75	
Bearing points (Fig.)		a	b, c and d	
Standard dimension	Camshaft bearing dia.	35.00 / 35.02	46.50 / 46.52	49.00 / 49.02 [2])
	Journal dia.	34.95 / 34.93	46.45 / 46.43	48.95 / 48.93 [2])
Intermediate stage	Camshaft bearing dia. (color code grey)	34.90 / 34.92	46.40 / 46.42	48.90 / 48.92 [2])
	Journal dia.	34.85 / 34.83	46.35 / 46.33	48.85 / 48.83 [2])
Repair stage I	Camshaft bearing dia. (color code red)	34.75 / 34.77	46.25 / 46.27	48.75 / 48.77 [2])
	Journal dia.	34.70 / 34.68	46.20 / 46.18	48.70 / 48.68 [2])
Width A of journal a (Fig.)		34.00 / 34.04	—	
Bearing play	radial		0.050–0.084	
	axial		0.07–0.15	

[1]) Code number is punched into rear end of camshaft.
[2]) Camshaft bearings and journal dia. on engine 617.950 (USA) model year 1980 with increased output and engines 617.951/952.

Special tool

Dial gage holder for end play of camshaft (2 each)	 11004-10150	363 589 02 21 00

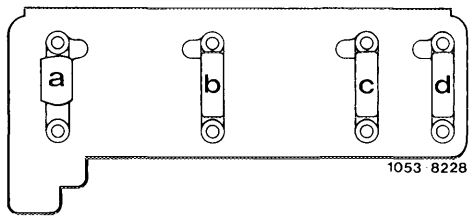
Conventional tool

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

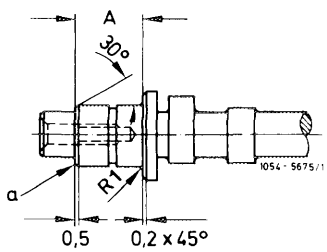
Note

In the event of repairs, regrind camshaft in accordance with available camshaft bearings.

Camshaft bearing journals are not hardened.



If dimension A is exceeded when grinding 1st bearing journal, also regrind face a.

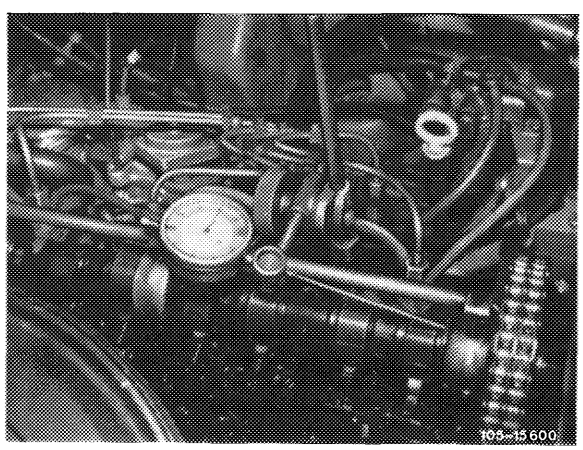


Measuring end play

1 Screw on dial gage holder with threaded sleeve at front left.

2 Position dial gage at approx. 3 mm preload against thrust flange of camshaft.

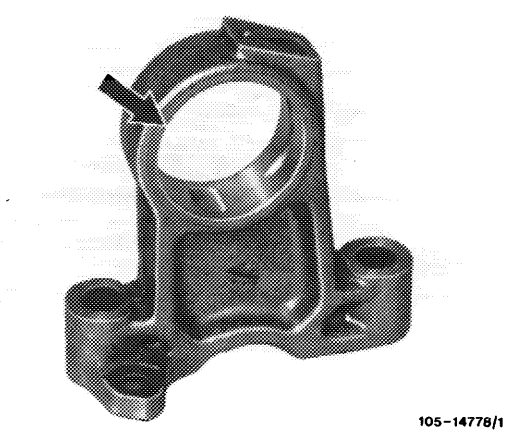
3 Push camshaft toward the rear and set large needle to zero.



4 Push camshaft forward and determine end play.

Note: If the end play is too low, touch up 1st camshaft bearing at its face surfaces (arrow).

If the end play is too high, regrind face a on 1st bearing journal of camshaft.

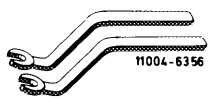
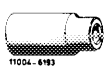
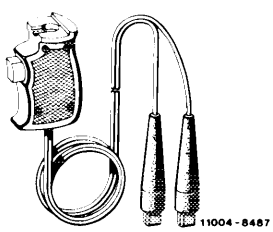


Valve clearance	with engine cold (approx. 20 °C)	with engine warm (60 °C ± 15 °C)
Intake	0.10[1])	0.15[1])
Exhaust	0.35	0.40

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

Tightening torques	Nm
Nuts for cylinder head cover	15
Rocker arm bearing brackets to cylinder head	38

Special tools

Valve adjusting wrench 14 mm (2 each)	 11004-6356	615 589 00 01 00
Holding wrench for valve spring retainer	 11004-7118	615 589 00 03 00
Socket 27 mm, 1/2" square, for rotating engine	 11004-6183	001 589 65 09 00
Contact handle for rotating engine (component of compression pressure recorder 001 589 46 21 00)	 11004-8487	001 589 46 21 08

Note

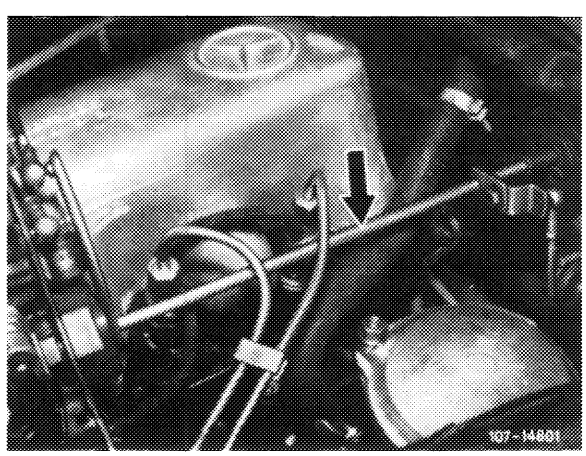
Always install rocker arm at the same spot from where it has been removed.

If the rocker arms are renewed, also renew camshaft.

On rocker arms with carbide facing, renew damaged rocker arm only.

Removal

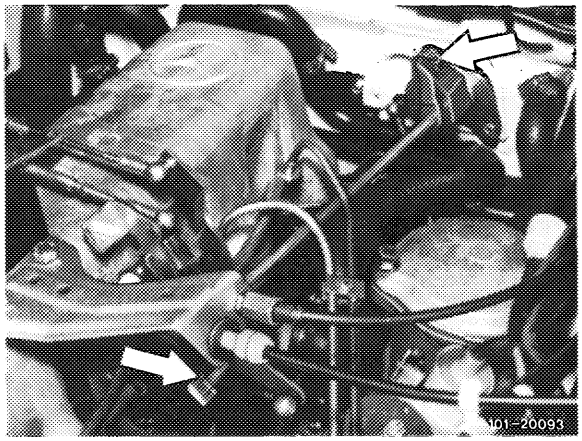
1 Disconnect regulating linkage to remove cylinder head cover. Pull out locking eye of longitudinal regulating shaft (arrow).



Model 116.120

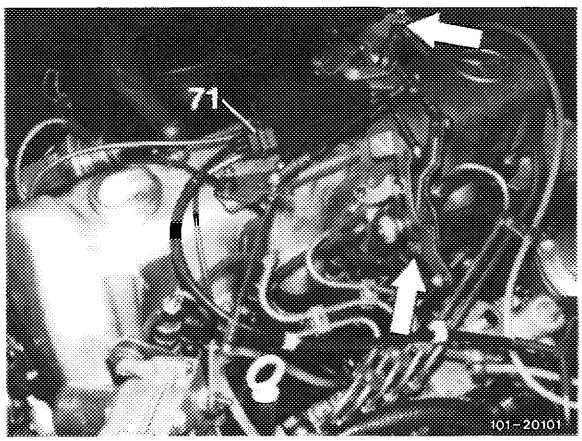
On models 116.120 and 123, pull longitudinal regulating shaft out of rubber mount in forward direction and remove in rearward direction.

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



Model 123

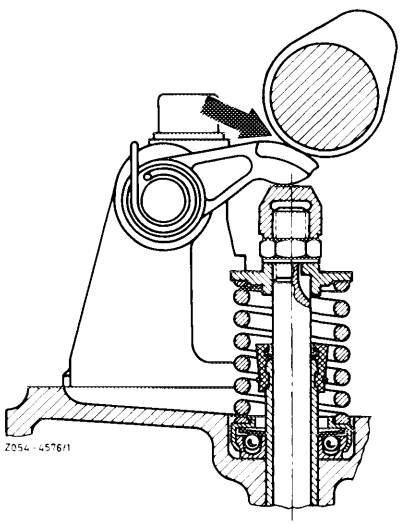
On models 123 with automatic transmission 722.303 (W 4 A 040) and 126.120, pull out central plug of vacuum lines (71) or vacuum lines. Disconnect Bowden wire, compress black plastic clip (arrow) and pull Bowden wire out of holder in rearward direction.

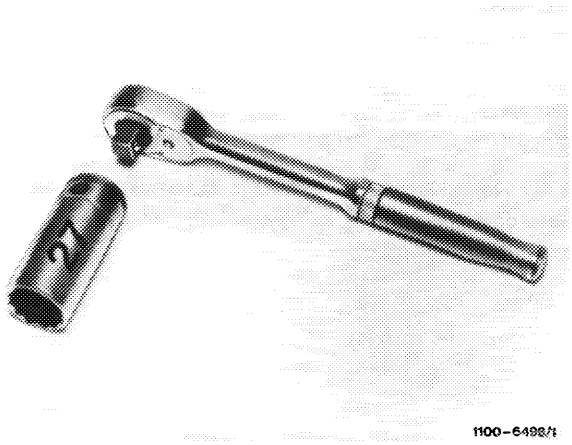


Model 126.120

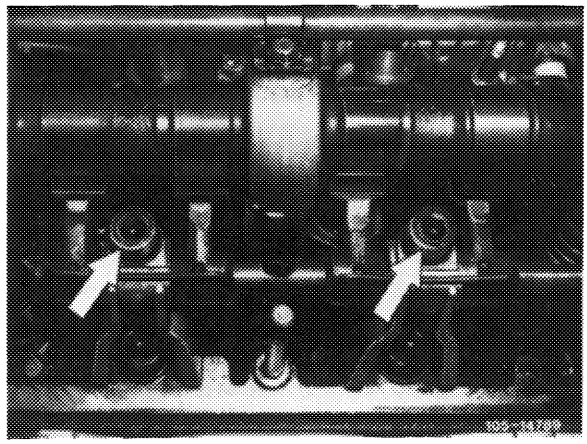
2 Set camshaft in such a manner that the rocker arm is free of load. That is, the cam tips should point away from rocker arms.

For this purpose, rotate the crankshaft by means of the tool combination.



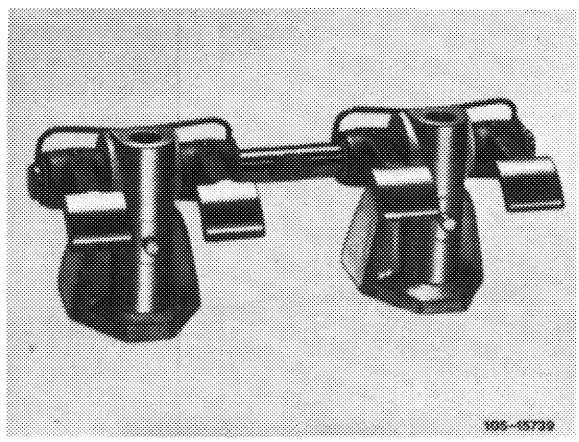


3 Screw out fastening screws of rocker arm bearing brackets (arrows).



4 Completely remove rocker arm group in upward direction.

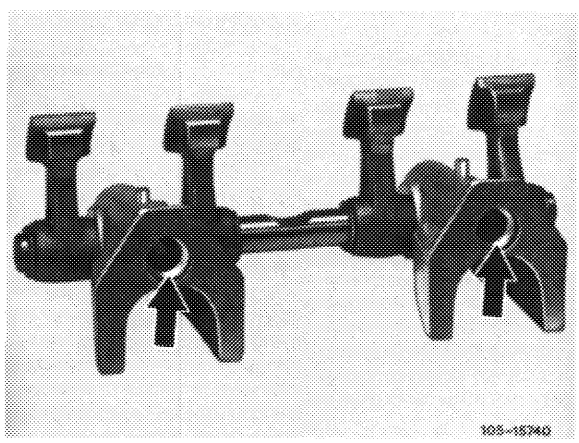
Loosen stuck camshaft bearings by means of light blows with a plastic hammer.



Installation

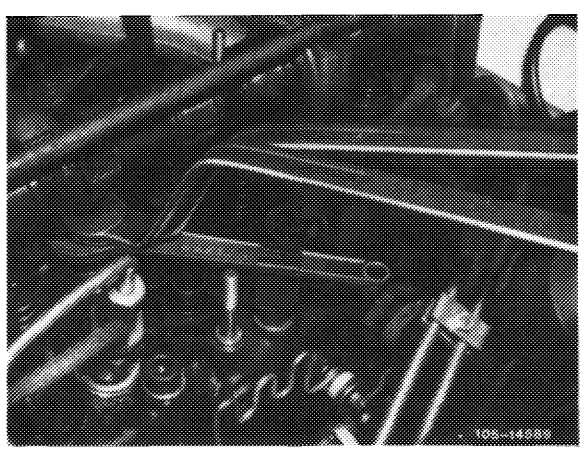
5 Set complete rocker arm group and screw down.

Note: The rocker arm bearing brackets are located by means of fitted sleeves (arrows).



6 Adjust valve clearance (05–210).

7 Mount cylinder head cover.



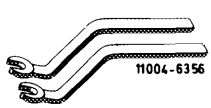
Valve clearance	with engine cold (approx. 20 °C)	with engine warm (60 °C ± 15 °C)
Intake	0.10[1])	0.15[1])
Exhaust	0.35	0.40

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

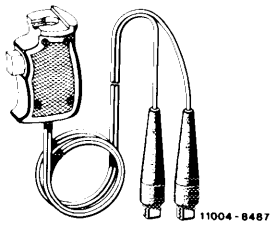
Rocker arms, rocker arm brackets and shaft		
Basic bore in rocker arm		14.00 / 14.02
OD of bushing	(open bushing) ≈	14.03 / 14.05
ID of bushing	(open bushing)	——
	final dimension	12.00 / 12.02
Dia. of rocker arm shaft		11.98 / 11.96
Radial play of rocker arm on shaft		0.02–0.06
Bore in rocker arm bearing bracket		11.98 / 12.00
Width of rocker arm bearing brackets		24.07–24.20

Tightening torques	Nm
Nuts for cylinder head cover	15
Rocker arm bearing brackets to cylinder head	38

Special tools

Valve adjusting wrench 14 mm (2 each)	 11004-6356	615 589 00 01 00
Holding wrench for valve spring retainer	 11004-7118	615 589 00 03 00
Socket 27 mm, 1/2" square, for rotating engine	 11004-6193	001 589 65 09 00

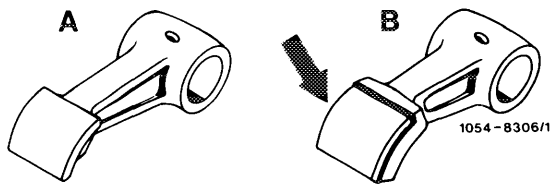
Contact handle for rotating engine
(component of compression pressure
recorder 001 589 46 21 00)



001 589 46 21 08

Note

There are two rocker arm versions:



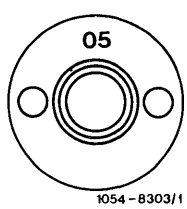
1st version

Rocker arm with inductance-hardened and hard-chromed running surface (A) for camshaft made of malleable cast iron (code number 00).

2nd version

Rocker arm with brazed-on carbide facing as running surface (B, arrow), for camshafts made of chilled cast iron (code number 05 and 08).

Code number is punched into rear end of camshaft.



Attention!
Do not mix up rocker arms, since this will lead to destruction of cam and of rocker arm running surface.

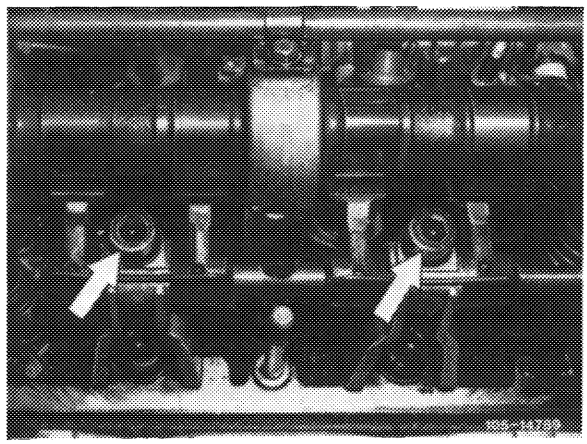
During renewal, make sure whether rocker arm has a bushing or not.

Rocker arms without bushing should be scrapped.

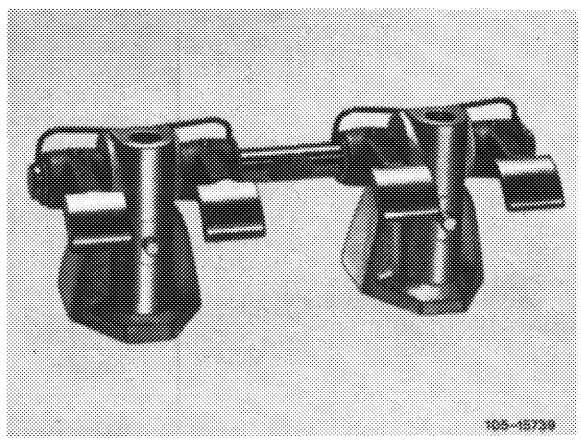
On rocker arms with bushings, bushing can be renewed.

Removal

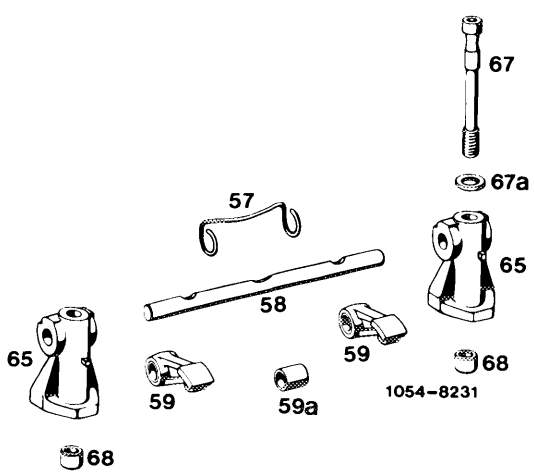
1 Completely remove rocker arm groups (05–235).



2 Push down tensioning springs of rocker arm brackets.



3 Pull tensioning spring (57), bearing brackets (65) and rocker arm (59) from rocker arm shaft (58).



57 Tensioning spring
58 Rocker arm shaft
59 Rocker arm
59a Rocker arm bearing bushing
65 Bearing bracket
67 Screw
67a Washer
68 Fitted sleeve

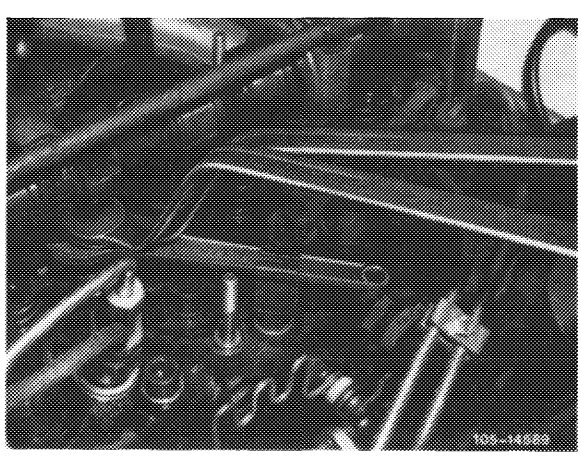
Installation

4 Slip tensioning spring (57), rocker arm (59) and bearing brackets (65) on rocker arm shaft (58).

5 Slip tensioning spring with second eye on rocker arm shaft and push into groove of bearing brackets.

6 Completely install rocker arm groups (05–235).

7 Adjust valve clearance (05–210).

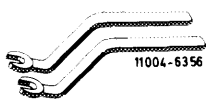
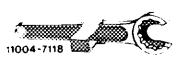
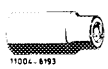
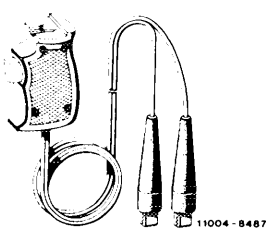


Valve clearance	with engine cold (approx. 20 °C)	with engine warm (60 °C ± 15 °C)
Intake	0.10[1])	0.15[1])
Exhaust	0.35	0.40

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

Tightening torques	Nm
Nuts for cylinder head cover	15
Rocker arm bearing brackets to cylinder head	38

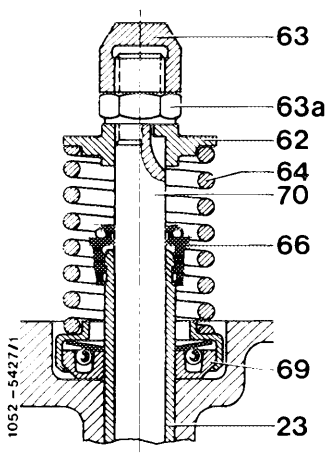
Special tools

Valve adjusting wrench 14 mm (2 each)		615 589 00 01 00
Holding wrench for valve spring retainer		615 589 00 03 00
Socket 27 mm, 1/2" square, for rotating engine		001 589 65 09 00
Contact handle for rotating engine (component of compression pressure recorder 001 589 46 21 00)		001 589 46 21 08

Note

Each valve has one valve spring (64) and one rotocap (69).

On engines with long service life, it is recommended to renew rotocaps at the same time.



23 Valve guide
62 Valve spring retainer
63 Cap nut
63a Counternut
64 Valve spring
66 Valve stem seal
69 Rotocap
70 Valve

Valve springs with higher spring tension are installed on engine 617.950 since January 1979 and on engines 617.951/952 since start of series (05–260).

On engine 617.950 (USA) starting model year 1980 with increased output and on engines 617.951/952, do not install valve spring, part No. 180 053 06 20.

On the other hand, on engine 617.950 (USA) up to model year 1980 with increased output, valve spring part No. 615 053 01 20 may also be installed.

Start of series

Engine	Starting chassis No.
617.950	006303
617.951/952	start of series

Identification:

Valve spring, part No. 180 053 06 20, two green or purple-green color dots.

Valve spring, part No. 615 053 01 20, two yellow or purple-yellow color dots.

Renew damaged cap nuts (63).

Cap nuts are available in three versions:

1st version

Cap nut with small supporting surface (A).

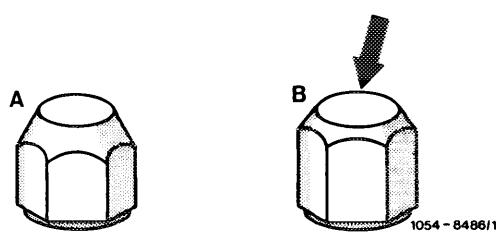
2nd version

Cap nut reinforced in upper range, with larger supporting surface (B).

3rd version

Cap nut reinforced in upper range and hard-chromed.

Identification: silver colored.



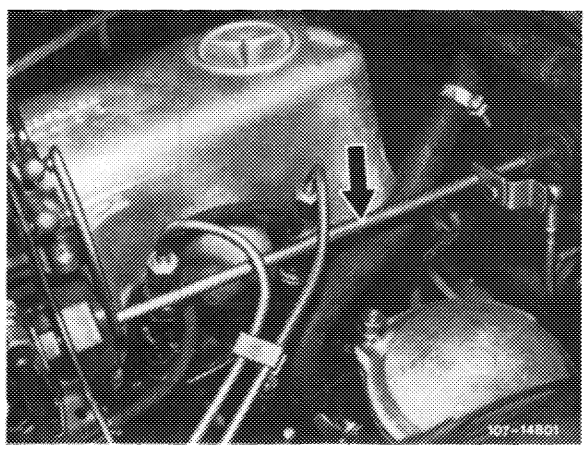
On engines with chilled cast iron camshaft and rocker arms with carbide facing, only the hard-chromed cap nut may be installed.

The hard-chromed cap nut can also be installed on engines with chilled cast iron camshafts and rocker arms with inductance-hardened and hard-chromed running surface.

Spare parts (ET) Sindelfingen will keep only hard-chromed cap nuts in stock.

Removal

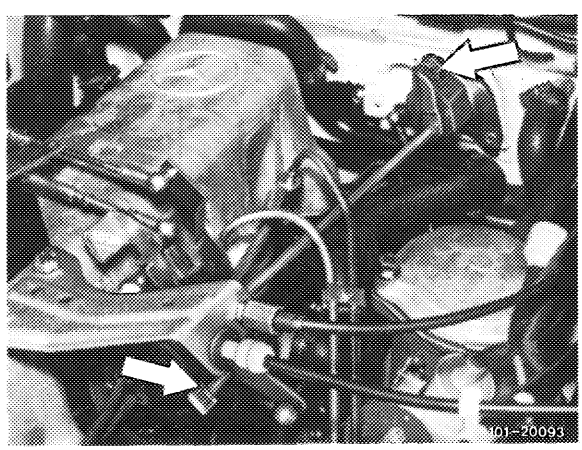
1 Disconnect regulating linkage to remove cylinder head cover. Pull out locking eye of longitudinal regulating shaft (arrow).



Model 116.120

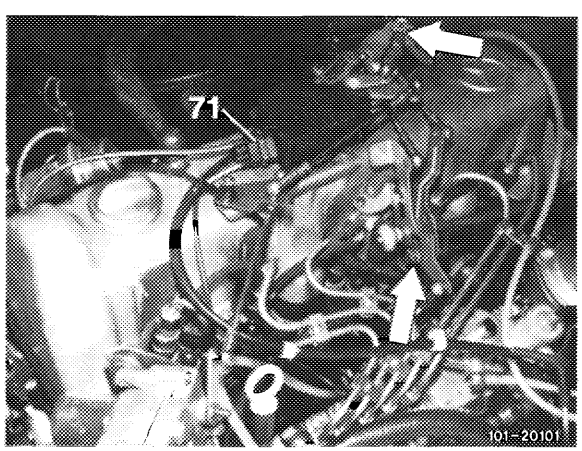
On models 116.120 and 123, pull longitudinal regulating shaft out of rubber mount in forward direction and remove in rearward direction.

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



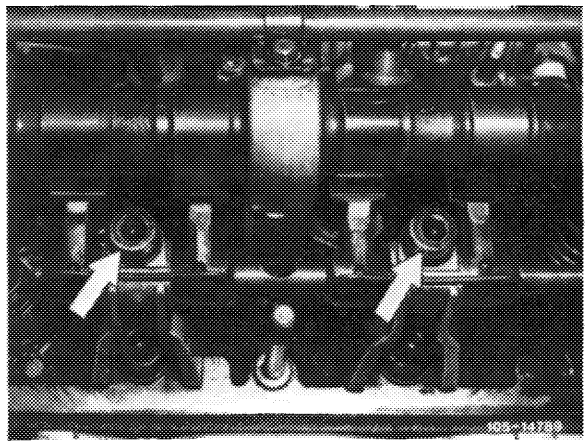
Model 123

On models 123 with automatic transmission 722.303 (W 4 A 040) and 126.120, disconnect 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.



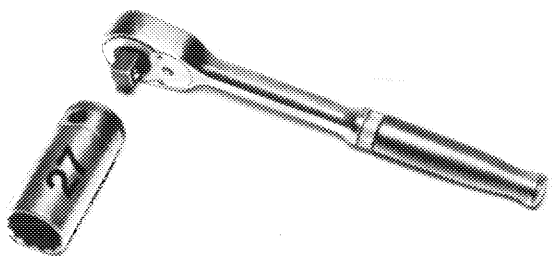
Model 126.120

2 Remove rocker arm with rocker arm bearing brackets (05–235).



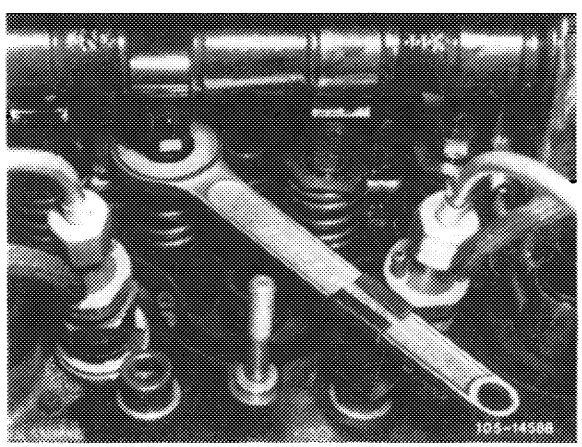
3 Set piston of respective cylinder to ignition TDC.

For this purpose, rotate crankshaft with tool combination.



1100-6498/1

4 Place holding wrench on valve spring retainer.



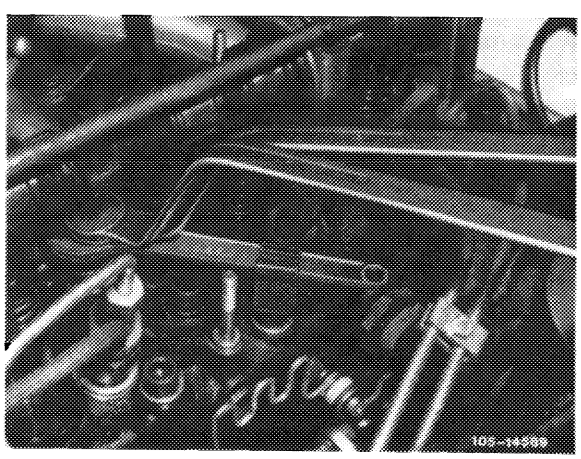
5 Unscrew cap nut (63) by means of valve adjusting wrench.

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

6 Unscrew counternut (63a).

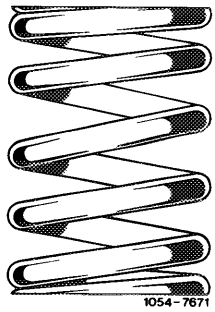
7 Remove valve spring retainer and valve spring.

8 Check valve spring, renew according to condition (05–260).



Installation

9 Insert valve spring with narrow coils toward cylinder head (color dots at top).



10 Mount valve spring retainer.

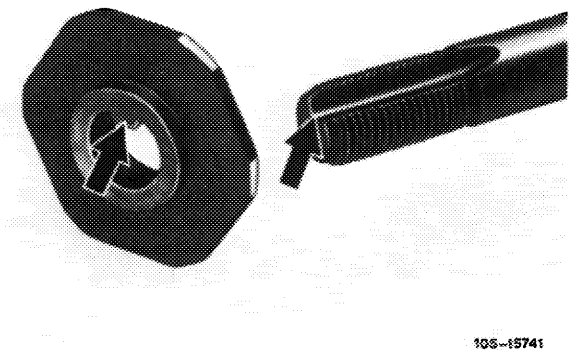
Lug on valve spring retainer (arrow) should be seated in groove on valve stem.

11 Screw on counternut and cap nut.

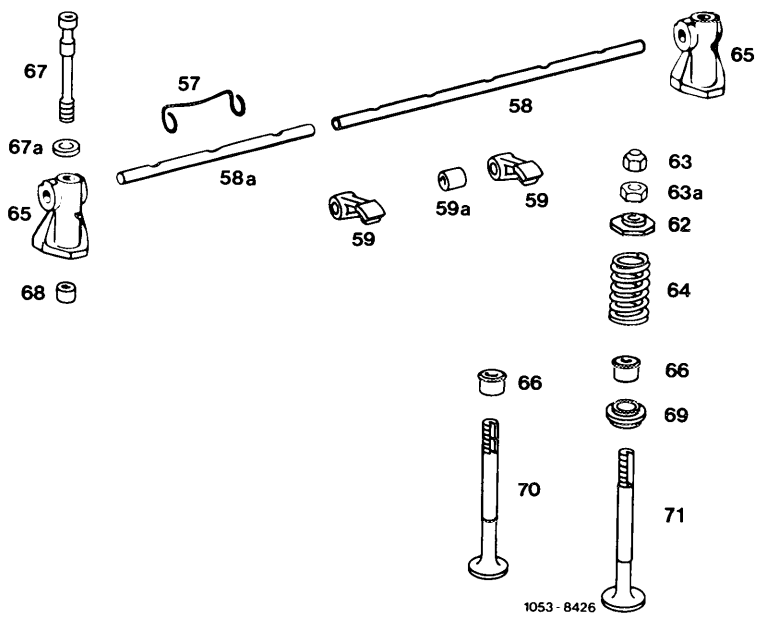
12 Install rocker arm with rocker arm bearing brackets (05–235).

13 Adjust valve clearance (05–210).

14 Mount cylinder head cover.



Valve timing



57 Tensioning spring
58 Rocker arm shaft
58a Rocker arm shaft
59 Rocker arm
59a Rocker arm bearing bushing
62 Valve spring retainer
63 Cap nut
63a Counternut
64 Valve spring
65 Bearing bracket
66 Valve shaft seals
67 Screw
67a Washer
68 Fitted sleeve
69 Rotocap
70 Intake valve
71 Exhaust valve

Valve spring data

Part No.	Color code	OD mm	Wire dia. mm	Length unloaded mm	Spring force at preloaded length When new N	Limit value N
180 053 06 20	green or purple	30.2	3.8	50.5	29.9 463—530	417
615 053 01 20[1])	yellow-yellow or purple-yellow	30.4	3.9	51.2	28.0 589	530

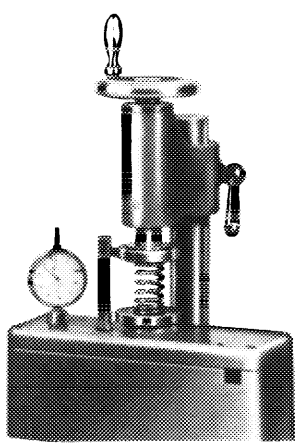
[1]) Valve spring of engine 617.950 (USA) model year 1980 with increased output and of engines 617.951/952.

Checking

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

2 Check spring force at specified length.

3 Renew valve springs if below limit value.



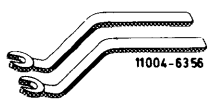
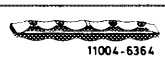
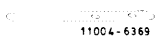
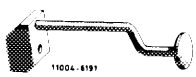
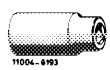
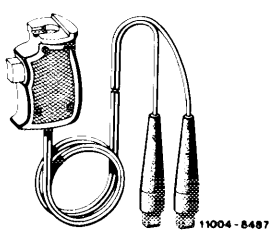
R 05/6385

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

Valve adjusting wrench 14 mm (2 each)		 11004-6356	615 589 00 01 00
Holding wrench for valve spring retainer		 11004-7118	615 589 00 03 00
Slip gage holder, red		 11004-6364	617 589 00 40 00
Slip gage blades	0.10 mm thick 0.15 mm thick 0.20 mm thick 0.35 mm thick 0.40 mm thick	 11004-6369	617 589 00 23 00 617 589 01 23 00 117 589 00 23 00 617 589 03 23 00 617 589 04 23 00
Assembly mandrel for valve stem seals Intake and exhaust		 11004-6191	617 589 00 43 00
Socket 27 mm, 1/2" square, for rotating engine		 11004-6193	001 589 65 09 00
Contact handle for rotating engine (component of compression pressure recorder 001 589 46 21 00)		 11004-8487	001 589 46 21 08

Conventional tool	
Cylinder leak tester	e.g. made by Bosch, EFAW 210 A made by SUN, CLT 228

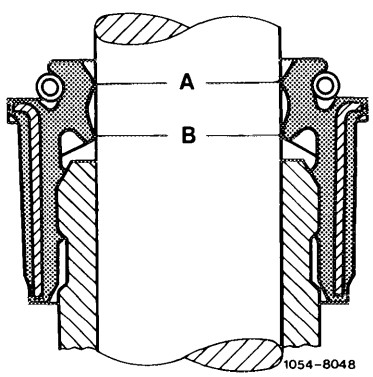
Note

Valve stem seals of intake and exhaust valves are of different design and should not be mixed up. They are differently colored to show difference.

Intake valve stem seal — **black**

Exhaust valve stem seal — **green**

In addition to oil wiper lip (A), the valve stem seals also have a gas sealing lip (B).



A Oil wiper lip
B Gas sealing lip

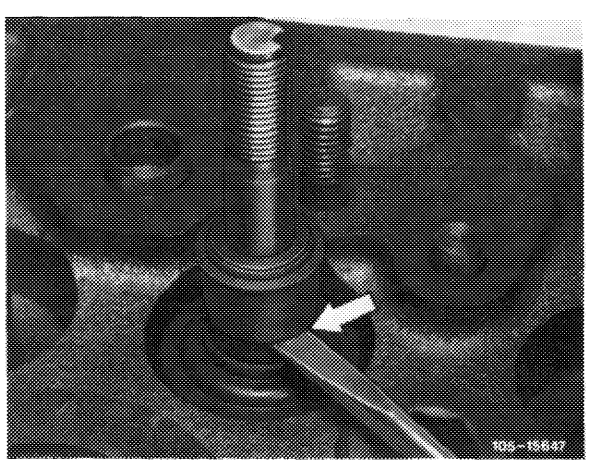
Renewing

1 Remove rocker arms with rocker arm brackets (05–235).

2 Remove valve springs (05–250).

3 Force off valve stem seals with a screwdriver or pull off with pliers.

Attention!
Do not damage valve stem and valve guide.

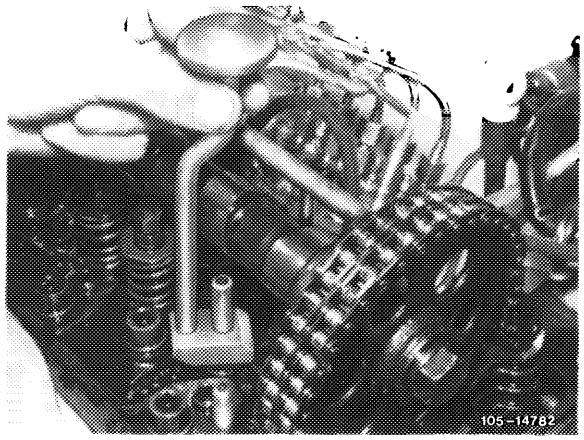


4 Lubricate new valve stem seals and mount by means of assembly mandrel.

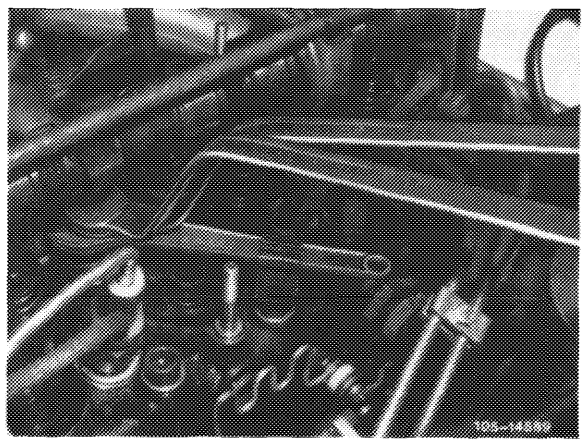
For this purpose, be sure to place an assembly sleeve on valve stem.

5 Install valve springs (05–250).

6 Install rocker arms with rocker arm bearing brackets (05–235).



7 Adjust valve clearance (05–210).



Data		Intake valve	Exhaust valve
Valve retainer dia.		39.7–39.9	34.1–34.3
Valve stem dia.		9.92–9.94	
Valve length		131.5	
Code number on stem end		E 617 00	A 617 00 27
Filled-in sodium		without	with
Valve seat plating		valve seat nitride-hardened	
Height "h" of valve retainer	when new	2.54	2.49
	limit value	2.0	2.0
Adjusting angle for machining valves		30° + 15'	
Permissible runout at valve stem and valve seat max.		0.03	
Valve shaft wear (wear limit)		0.05	

Conventional tools

Valve cone grinder or valve cone machining tool	e.g. made by Matra-Werke GmbH D-6000 Frankfurt/Main 8 e.g. made by Hunger, D-8000 München

Note

Exhaust valves are filled with sodium.

When scrapping valves, pay attention to safety rules. Do not melt valves filled with sodium, since there is a risk of explosion, and do not use such valves for making tools (punch, etc.), without first removing filled-in sodium.

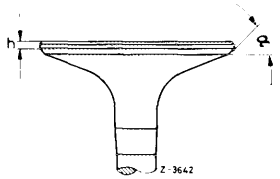
Be careful when removing sodium from valve, since sodium mixed with water and watery solutions reacts heavily explosive, while the resulting hydrogen gas may cause fires.

Sodium from cut-up or broken-up valves can be neutralized in a mixture comprising 2 liters of spirit of alcohol and 1 liter of water put into a vessel and placed in the open air.

Valves filled with sodium can be collected and shipped for neutralizing to: Garantieprüfstelle Werk Stuttgart-Untertürkheim.

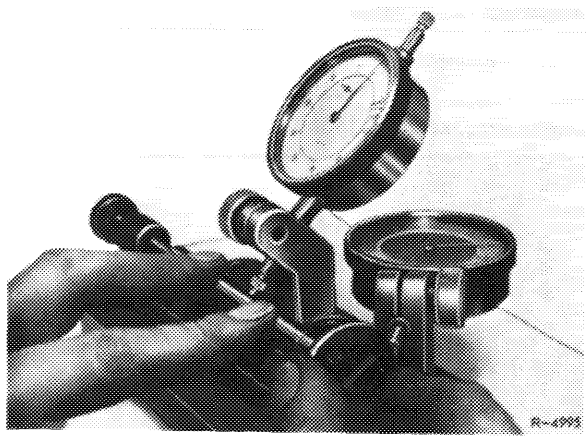
Checking and machining

1 Clean valves and check visually.



Valves with a burnt valve retainer, with insufficient height "h" of valve retainer and valves with worn out or scored valve stem should be replaced.

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

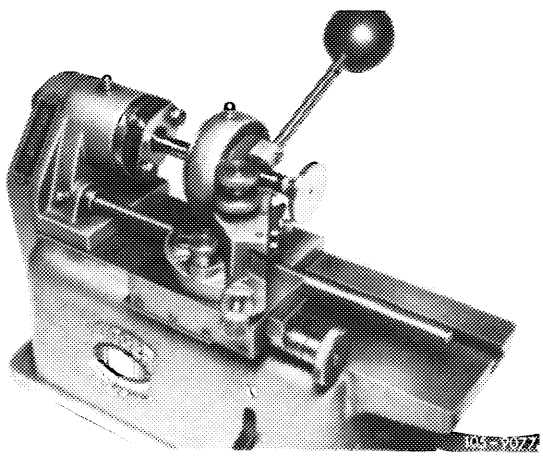


3 Machine valve seat.

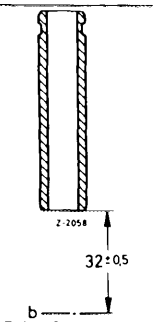
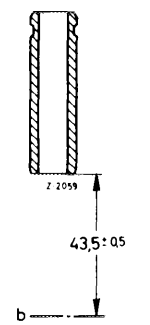
Refer to operating instructions of machining tool and make sure of a 30° adjusting angle.

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

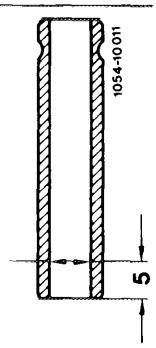
As soon as the limit values are attained, replace valve.



Data

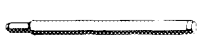
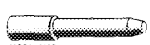
Valve guide	Part No.	Version	Color code	OD	Bore in cylinder head	Overlap	Valve guide ID	Length	Shape of valve guide
Intake	621 053 15 29 616 053 00 29[1])	Normal dimension	–	14.04 14.03	14.00 14.02	+ 0.01 up to + 0.04	10.000 10.015	61 60[1])	
	621 053 16 29 616 053 01 29[1])	Repair stage	red	14.24 14.23	14.20 14.22				
Exhaust	621 053 36 30 616 053 00 30[1])	Normal dimension	–	14.04 14.03	14.00 14.02			49.5 48.5[1])	
	621 053 37 30 616 053 01 30[1])	Repair stage	red	14.24 14.23	14.20 14.22				

Tight fit test pressure	3000–3500 N
Wear limit of valve guide ID (measuring point 5 mm above valve guide bottom edge)	0.20



[1]) These valve guides are 1 mm shorter (refer to note).

Special tools[1])

Inspection mandrel 10 mm dia.		615 589 00 21 00
Knock-out mandrel 10 mm dia.		615 589 01 15 00
Knock-in mandrel 10 mm dia.		615 589 00 15 00
Special reamer 0.99 H 7		000 589 11 53 00
Manual reamer for repair stage 14.2 dia.		115 589 00 53 00

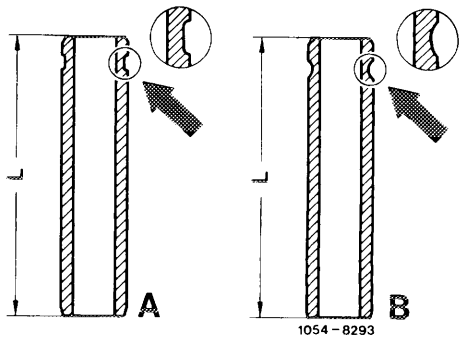
[1]) Same for intake and exhaust.

Note

The valve guides 61 mm or 49.5 mm long have been replaced by valve guides 60 mm or 48.5 mm long.

In addition to their length, the valve guides are also different with regard to the shape of their grooves (arrows).

A Valve guide = 61 mm or 49.5 mm long
B Valve guide = 60 mm or 48.5 mm long



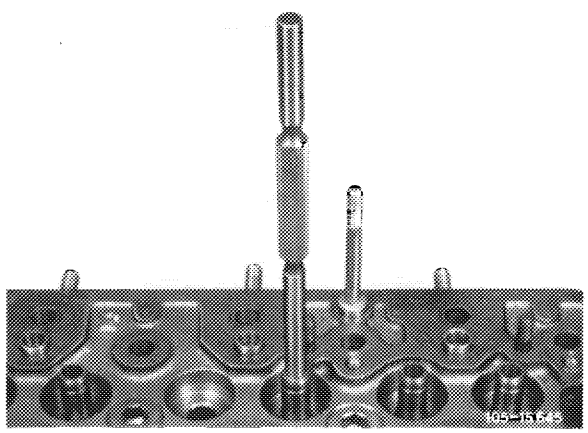
On engine 617.950 (USA) model year 1980 with increased output and on engines 617.951/952 only the shorter valve guides (B) may be installed in view of the larger valve lift.

Checking

1 Clean valve guide.

2 Measure bore by means of a plug gage or an internal measuring instrument 5 mm above bottom edge of valve guide.

If the not go end of plug gage can be easily and completely inserted, replace valve guide.

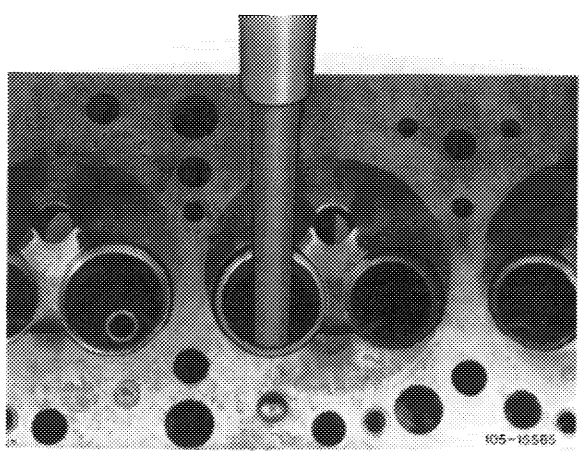


Renewing

3 Force-out valve guide by means of knock-out mandrel.

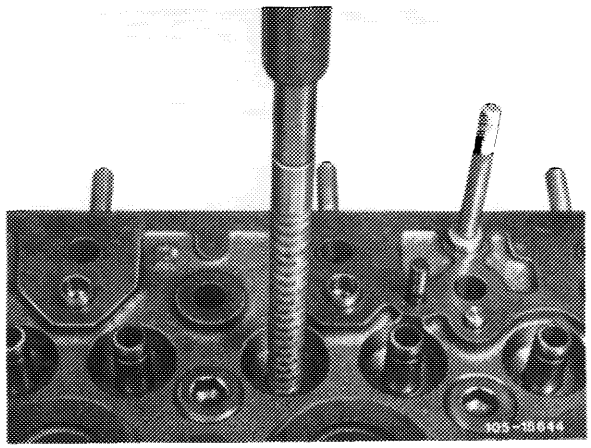
4 Check basic bore in cylinder head for score marks.

Normally dimensioned valve guides can be inserted without machining basic bore, if the specified overlap is still available (refer to item 6).

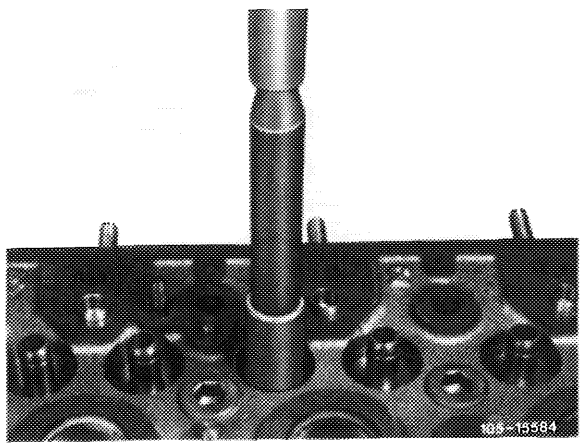


5 When using repair stage valve guides, press respective manual broach through basic bore in cylinder head.

Pressing of manual broach through basic bore can be performed on a column-type drilling machine or a hydraulic press. An important requirement is that the hand broach is inserted vertically in relation to base of cylinder head. The spindle of the column-type drilling machine or of the hydraulic press should be free of play.

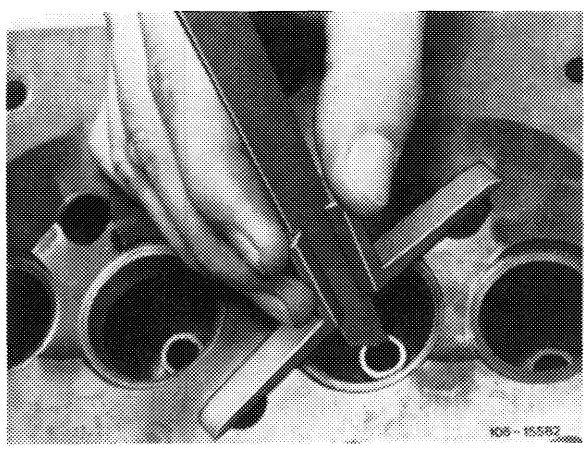


6 Coat valve guides with tallow and press-in by means of knocking-in mandrel until the dimension between cylinder head parting surface and valve guide underside named on table has been attained.



7 Check tight fit of valve guide with cylinder head cooled down only.

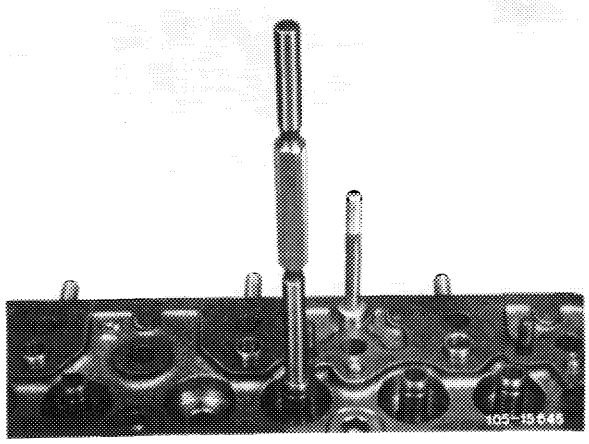
Test pressure of tight fit 3500 N.



8 Check ID of valve guide with plug gage.

The go end should still slip in.

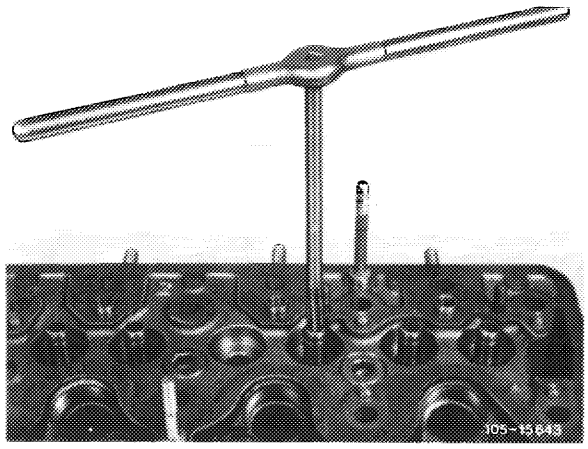
The not go end should merely touch.



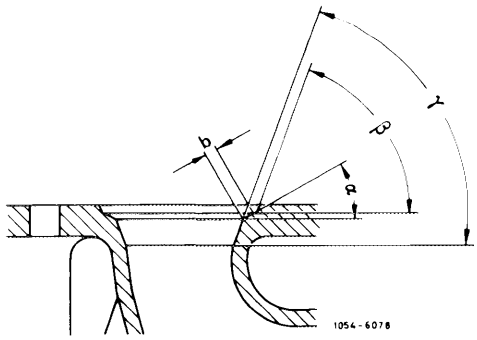
9 Slide valve into valve guide.

If the valve can be slipped in with difficutly only or not at all, ream valve guide by means of reamer.

10 Machine (refinish) valve seats (05–291).

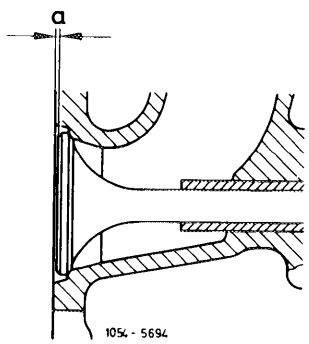


Data	Intake	Exhaust
Valve seat width b	1.3–1.6	2.5–2.9
Valve seat angle α	30°	
Correction angle top β	60°	
Correction angle bottom γ	60°	
Permissible runout of valve seat	0.03	



Minimum distance "a" with new valves and new valve seats	
Intake	+ 0.17 to – 0.23
Exhaust	+ 0.12 to – 0.28

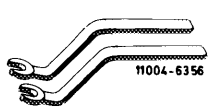
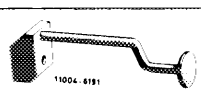
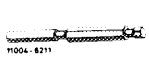
Maximum distance "a" with new valves and machined (refinished) valve seats	
Intake	1.0
Exhaust	



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

Valve stem wear (wear limit)	0.05

Special tools

Valve adjusting wrench 14 mm (2 each)		615 589 00 01 00
Holding wrench for valve spring retainer		615 589 00 03 00
Assembly mandrel for valve stem seals Intake and exhaust		617 589 00 43 00
Plug gage 10 mm dia. for intake and exhaust valve guide		615 589 00 21 00

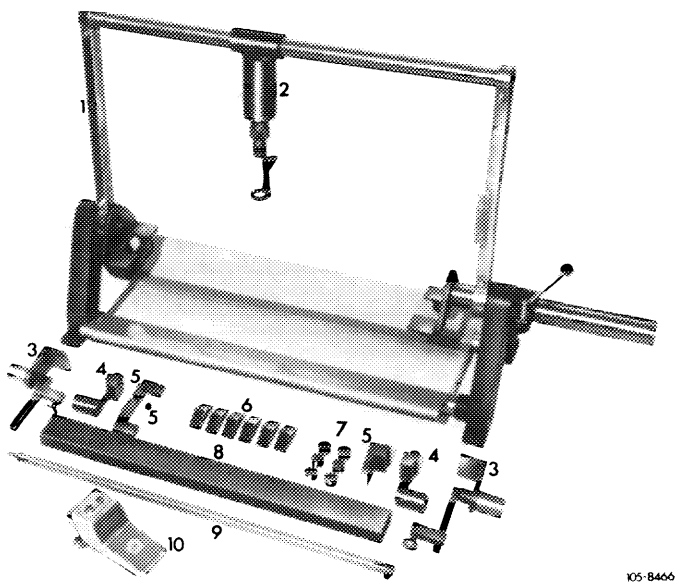
Conventional tools

Cylinder head clamping fixture	e.g. made by Christ, D-6801 Neckarhausen Order No. DBK 60–2
Valve seat machining tool	e.g. made by Hunger, D-8000 München Type VDNSL 1/45/30, order No. 236.03.308
Test kit for valve seats	e.g. made by Hunger, D-8000 München Order No. 216.93.300

Note

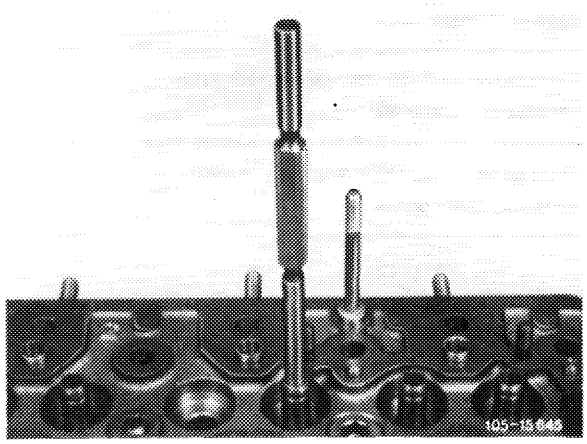
Clamp cylinder head into clamping fixture for disassembly and machining.

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



Machining valve seats

1 Check valve guides and replace, if required (05–285).

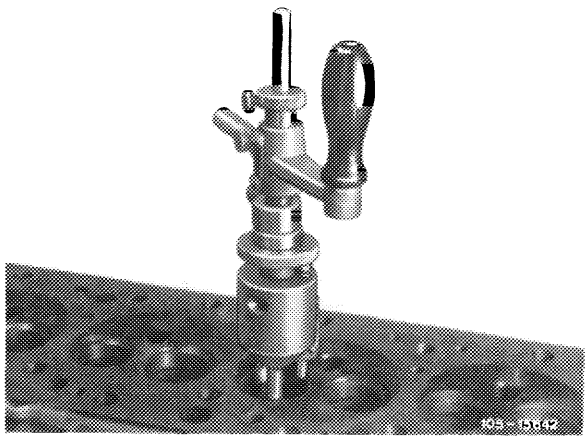


2 Machine valve seat (30°) (refer to operating instructions of tool manufacturer).

Attention!
Release pilot (013) only after runout of valve seat has been checked.

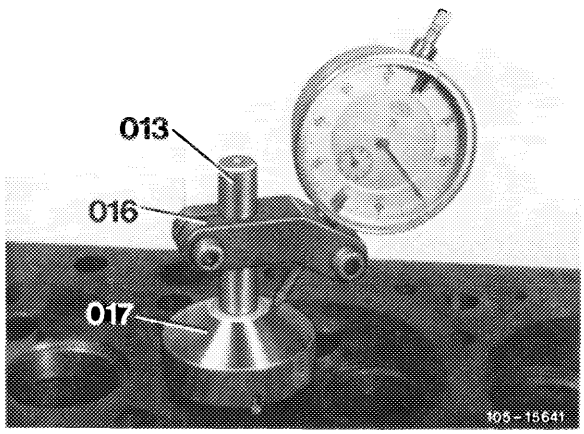
3 Measure valve seat width b and correct below to 60°, if required.

If required, also correct clearance (β) to 60°.



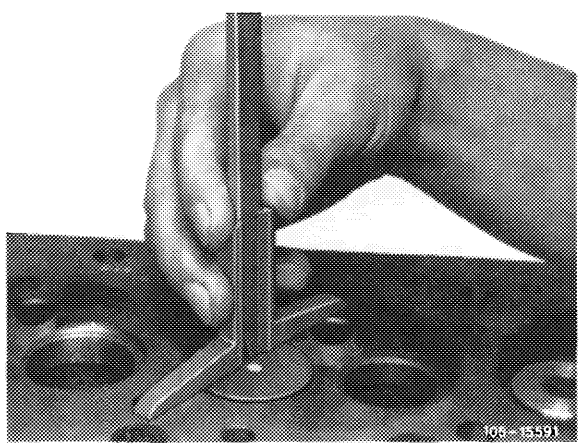
4 Check runout of valve seat.

For this purpose, slip test sleeve (017) with dial gage holder (016) and dial gage on pilot (013) and rotate test sleeve. The permissible runout of 0.03 mm should then not be exceeded.



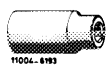
013 Pilot
016 Dial gage holder
017 Test sleeve

5 Introduce new valve and measure max. distance a.



Tightening torques	Nm
Nuts for cylinder head cover	15
Closing plug for chain tensioner	90

Special tool

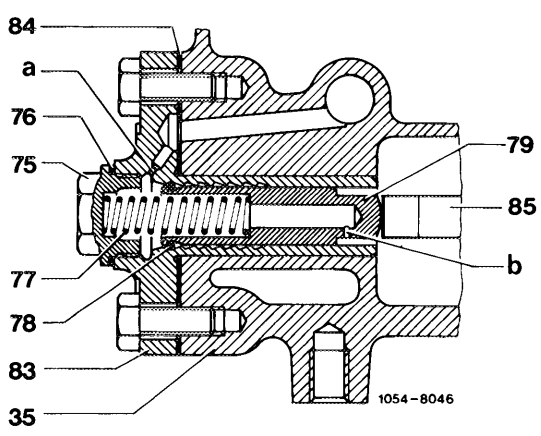
Socket 27 mm, 1/2" square, for rotating engine		001 589 65 09 00

Note

This engine is provided with a hydraulic detent chain tensioner without valve.

The pressure required for tensioning timing chain comprises the force of the compression spring (77) and the oil pressure in chain tensioner, in dependence of engine oil pressure.

In the event of shock-type loads, a throttle bore (a) of 1.5 mm dia. in oil feed and a throttle bore (b) of 1.3 mm dia. in thrust bolt prevents fast flowing-off of oil.



35	Cylinder head	83	Chain tensioner housing
75	Closing plug	84	Gasket
76	Sealing ring	85	Tensioning rail
77	Compression spring		
78	Detent spring	a	Throttle bore 1.5 mm dia.
79	Pressure bolt	b	Throttle bore 1.3 mm dia.

The chain tensioner housing (83) holds a detent and on pressure bolt (79) a detent spring (78).

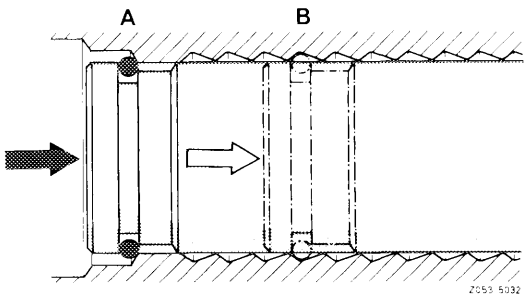
The pressure bolt moves forward from detent to detent in accordance with elongation of chain. Travel to the rear is limited by detents. As a result, the pressure bolt cannot be pushed back when the engine is stopped. Any jumping of the loose timing chain or any chain noise when the engine is started is therefore eliminated.

The oil required for operation of chain tensioner is provided via first camshaft bearing, the cylinder head bolt bore at front right and a transverse duct in cylinder head.

During assembly and test jobs on chain drive, the chain tensioner need not be removed. In such cases it will be enough to remove the compression spring (77) (item 3, 4, 11 and 12).

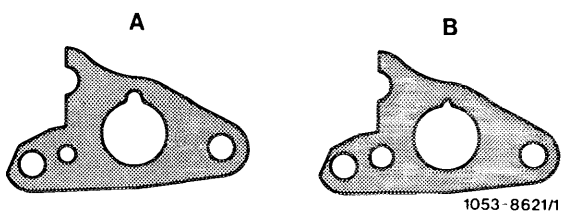
If, on the other hand, parts of the chain drive are renewed, remove chain tensioner and set pressure bolt into assembly position.

When installing a new chain tensioner, also pay attention to assembly position (A). If the pressure bolt is too far forward (in last detent), the timing chain is extensively tensioned or the detent spring (78) is stuck in detent.



A Chain tensioner in assembly position
B Chain tensioner in operating position

On engine 617.950 starting with engine end No. 006223, the chain tensioner gasket (B) has been installed for reasons of standardization with engines 615, 616 and 617.912. On engines 617.951/952 from start of series.



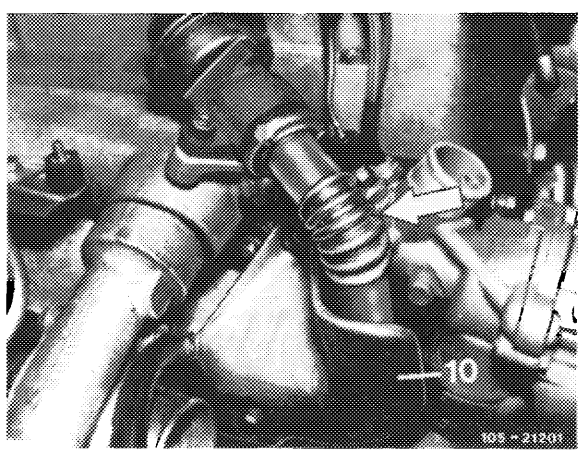
1053-8621/1

A 1st version
B 2nd version

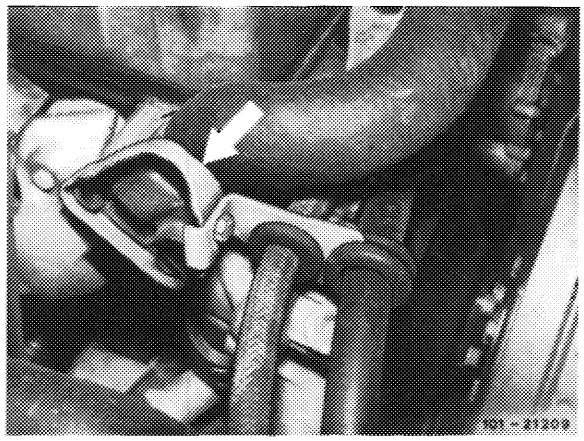
Removal

1 Drain coolant.

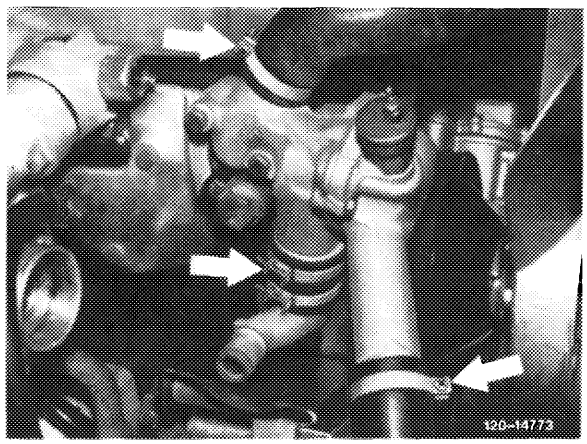
2 On engines with EGR (USA), remove pipe line between EGR valve and exhaust manifold (arrow). For this purpose, unscrew shielding plate (10).



3 On model 123 with level control, unscrew line holder on thermostat housing (arrow).

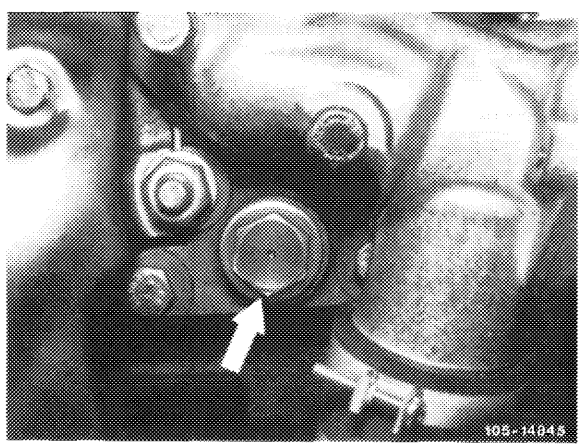


4 Remove thermostat housing.



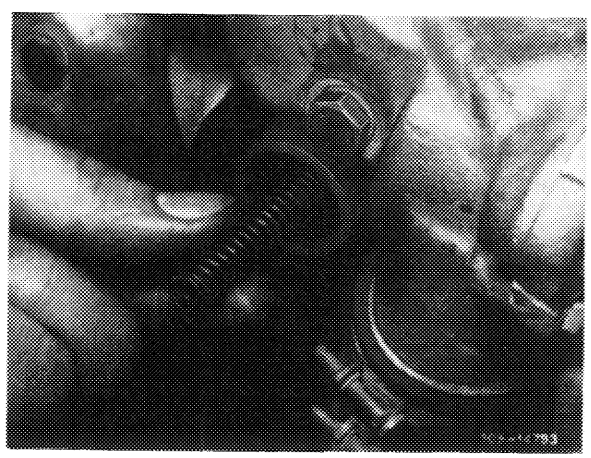
5 Unscrew closing plug (75) of chain tensioner.

Attention!
Closing plug is under pressure of compression spring (77).



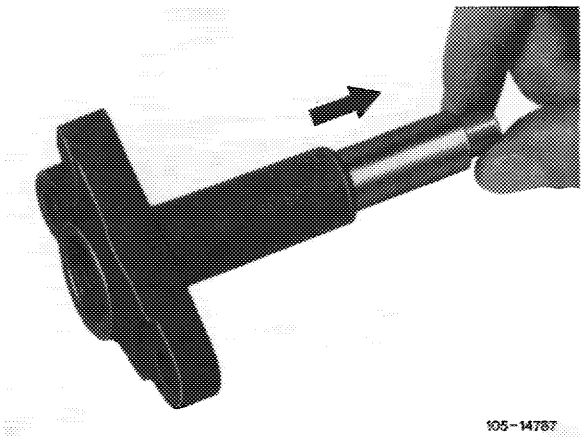
6 Remove compression spring (77).

7 Unscrew chain tensioner housing and pull out.



8 Pull out pressure bolt (79) in forward direction.

9 Thoroughly clean all parts.

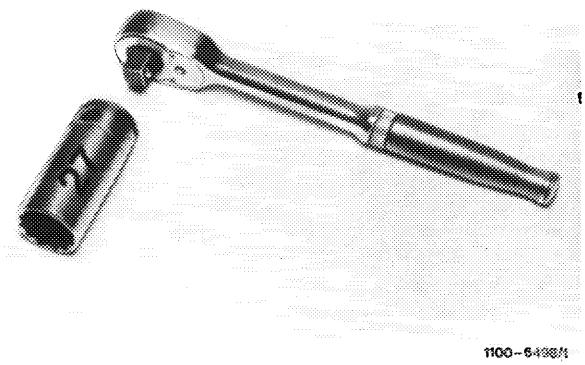


105-14787

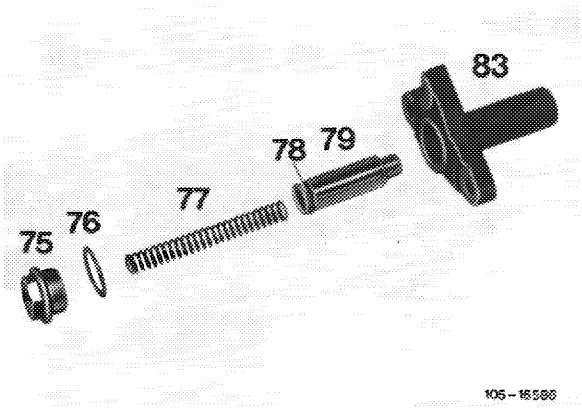
Installation

Note: Prior to installing chain tensioner, the chain drive must be completely mounted.

10 Rotate engine with tool combination in direction. of rotation once, so that timing chain is under tension.



11 Insert chain tensioner housing (83) with new gasket (84) and tighten.



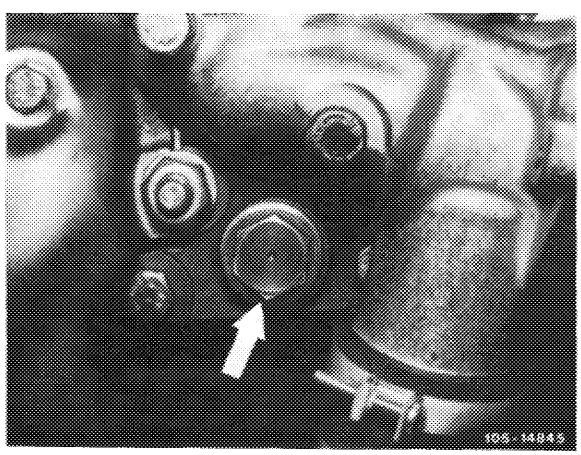
75 Closing plug
76 Sealing ring
77 Compression spring
78 Detent spring
79 Pressure bolt
83 Chain tensioner housing

12 Place pressure bolt (79) on assembly detent.

13 Insert compression spring (77).

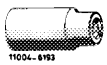
14 Position closing plug (75) with new sealing ring (76) and tighten to 90 Nm.

15 For further installation proceed vice versa to removal.



Tightening torques	Nm
Nuts for cylinder head cover	15
Closing plug for chain tensioner	90

Special tool

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

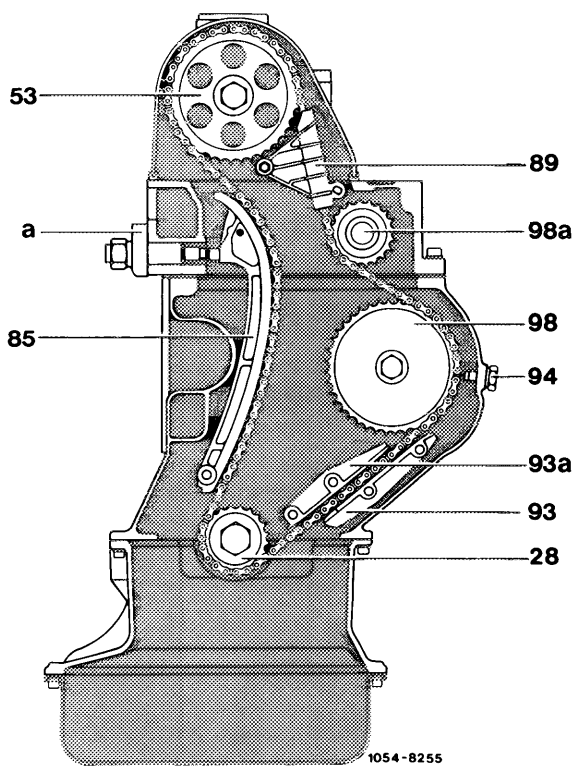
Note

The split timing chain with connecting link is used 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, always install an endless timing chain.

Check sprockets for score marks and pitting.

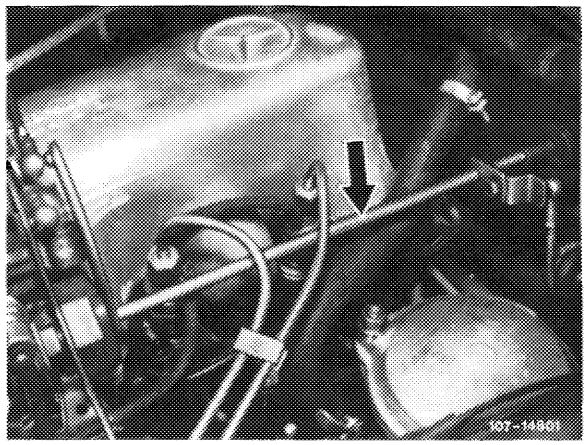


28 Crankshaft sprocket
53 Camshaft sprocket
85 Tensioning rail
89 Slide rail
93 Outer slide rail
93a Inner slide rail
94 Chain locking screw
98 Injection timer
98a Guide wheel
a Chain tensioner

Renewal

1 Unscrew pencil element glow plugs.

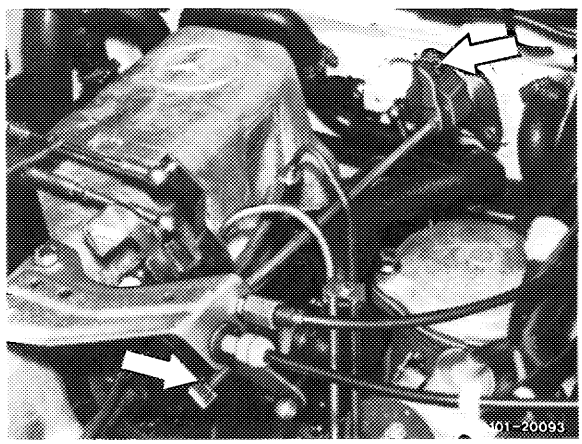
2 Disconnect regulating linkage to remove cylinder head cover. Pull out locking eye of longitudinal regulating shaft (arrow).



Model 116.120

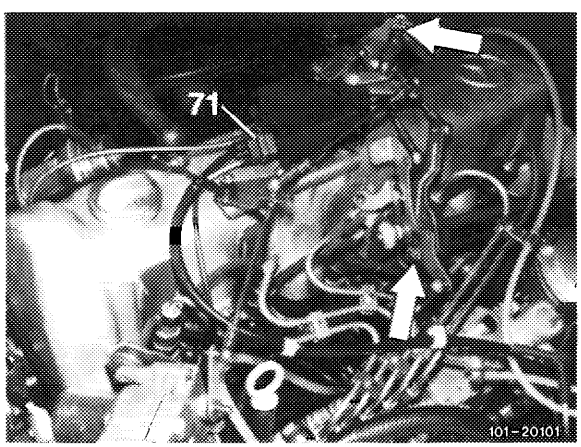
On models 116.120 and 123, pull longitudinal regulating shaft out of rubber mount in forward direction and remove in rearward direction.

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



Model 123

On models 123 with automatic transmission 722.303 (W 4 A 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

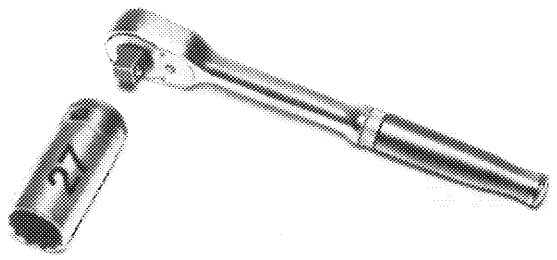
3 Remove chain tensioner (05–310).

4 Cover chain box with a rag and grind off both chain bolts on one link of timing chain.

5 Connect new timing chain to old timing chain, while simultaneously pushing out opened link (Fig. item 7).

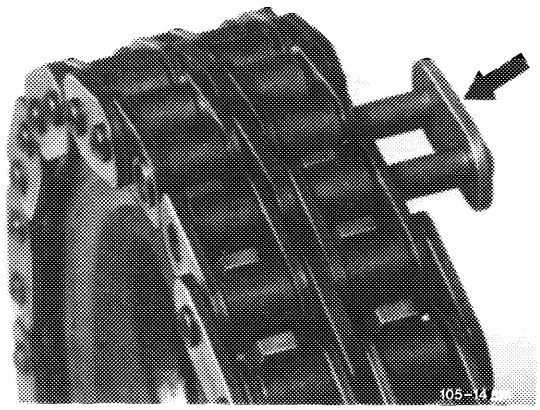
6 Turn crankshaft with tool combination slowly in direction of rotation of engine, while simultaneously pulling up the old timing chain until the connecting link comes to rest at uppermost position of camshaft sprocket.

Attention!
Timing chain should be in mesh with camshaft and crankshaft sprocket during rotation.

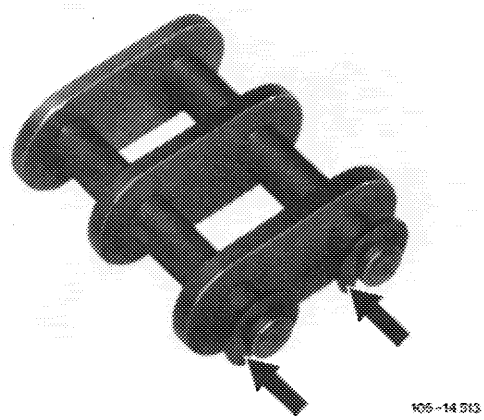


1100-6193/1

7 Disconnect old timing chain and connect the ends of the new timing chain by means of a connecting link. Mount lock washers.



Note: Insert new connecting link from the rear so that the lock washers can be seen from the front (arrows).

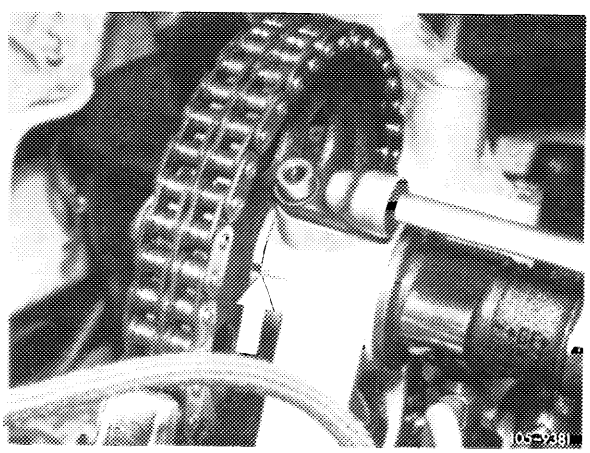


8 Rotate crankshaft and check adjusting marks at TDC position of engine.

Note: If the adjusting marks are not in alignment, check timing of camshaft (05–215) and begin of delivery of injection pump (07.1–110).

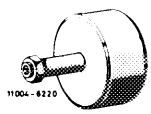
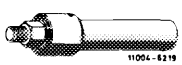
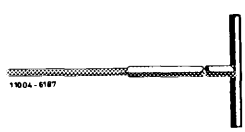
9 Install chain tensioner (05–310).

10 Screw in pencil-type glow plugs and mount cylinder head cover.



Tightening torques	Nm
Nuts for cylinder head cover	15
Closing plug for chain tensioner	90
Necked-down screw for camshaft sprocket	80

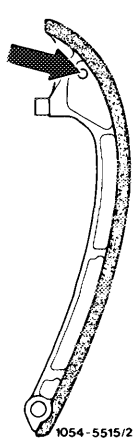
Special tools

Impact puller for bearing bolt (basic unit)		116 589 20 33 00
Threaded bolt M 8, 150 mm long for impact puller		616 589 00 34 00
Threaded bolt M 6, 50 mm long for impact puller		116 589 01 34 00
Puller for bearing bolt		115 589 20 33 00
Threaded bolt M 8, 30 mm long for puller		115 589 00 34 00
Screwdriver (Allen wrench) with tommy handle for hex. socket screws 6 mm, 440 mm long		116 589 03 07 00
Socket 27 mm, 1/2" square, for rotating engine		001 589 65 09 00

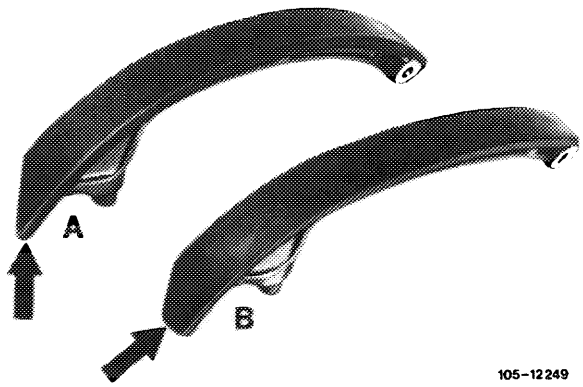
Note

To avoid mixups with tensioning rail of 4-cylinder gasoline engines, the tensioning rails have been marked.

The tensioning rail of the 4-cylinder gasoline engine is wider at upper end (B) and has no bore in upper part (arrow).



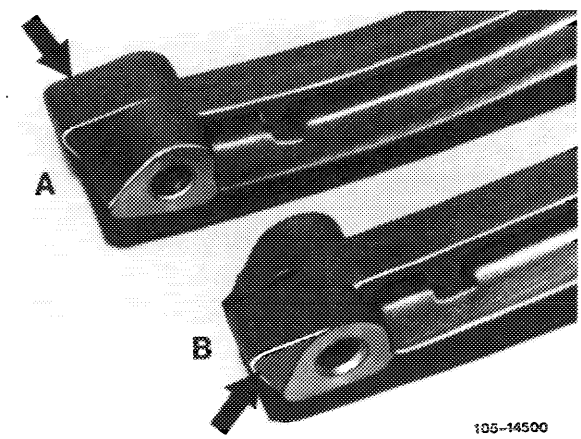
On the other hand, the tensioning rail of this engine is pointed at upper end (A) and has an 8 mm bore in upper part.



A Tensioning rail diesel engines
B Tensioning rail gasoline engines

In addition, a lug has been cast-on to lower end of tensioning rail to avoid confusion.

The lug on the tensioning rail of this engine is located in direction of cylinder 1 and on tensioning rail of 4-cylinder gasoline engine in direction of balancing disk.



A Tensioning rail diesel engines
B Tensioning rail gasoline engines

In the periods June – August and September – October 1980 a tensioning rail made by another manufacturer has been installed.

This tensioning rail is not available as a spare part.

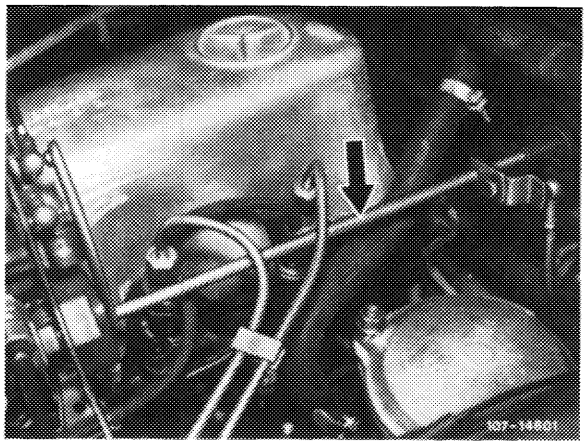
Start of series

Model	Chassis end No.
116.120	026904–028634
123.193	000001–000031 000166–000384
126.120	000001–000100 000955–001657

Removal

1 Remove radiator and fan.

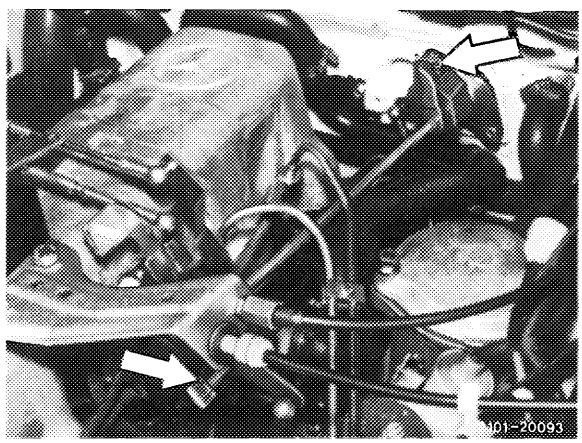
2 Disconnect regulating linkage to remove cylinder head cover. Pull out locking eye of longitudinal regulating shaft (arrow).



Model 116.120

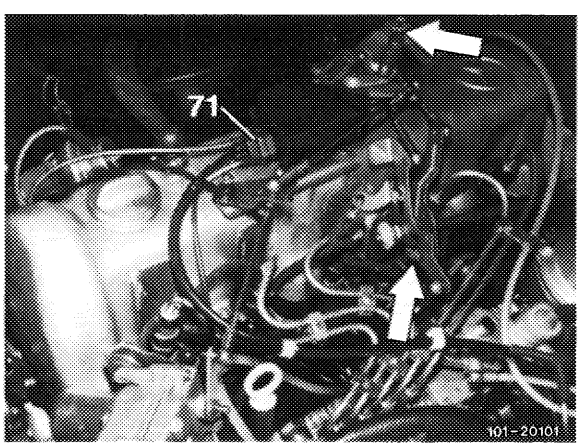
On models 116.120 and 123, pull longitudinal regulating shaft out of rubber mount in forward direction and remove in rearward direction.

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



Model 123

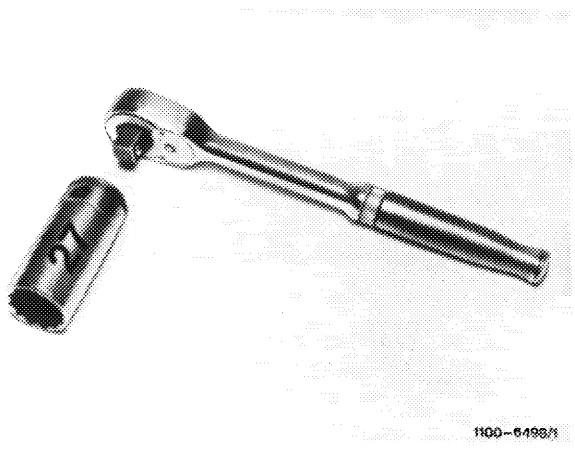
On models 123 with automatic transmission 722.303 (W 4 A 040) and 126.120, pull off central plug for vacuum lines (71) or vacuum lines. Disconnect Bowden wire, compress black plastic clip (arrow) and pull Bowden wire out of holder in rearward direction.



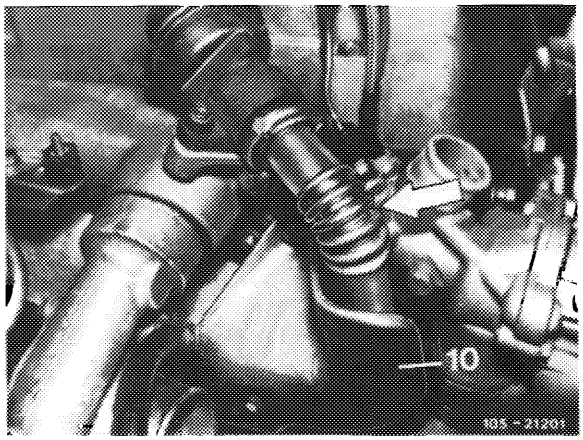
Model 126.120

3 Remove pulley and vibration damper (03–340).

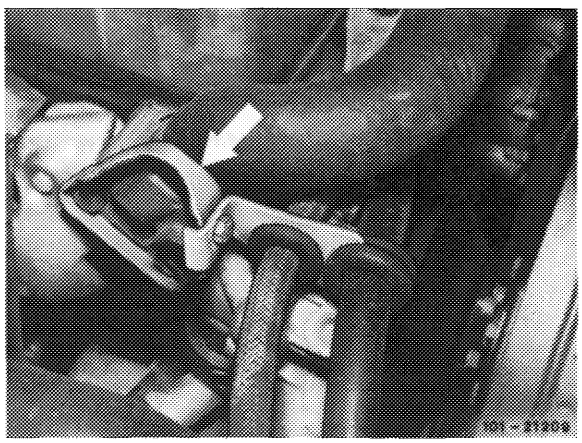
4 Rotate crankshaft with tool combination until recess in balancing disk is in front of bearing bolt of tensioning rail (Fig. item 12).



5 On engines with EGR (USA), remove pipe line between EGR valve and exhaust manifold (arrow). For this purpose, unscrew shielding plate (10).

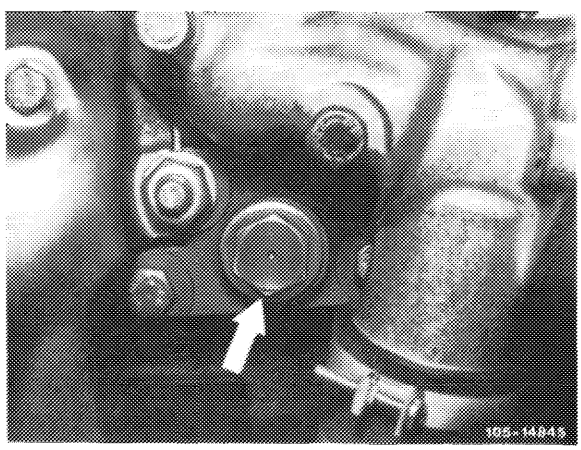


6 On model 123 with level control, unscrew line holder on thermostat housing (arrow).

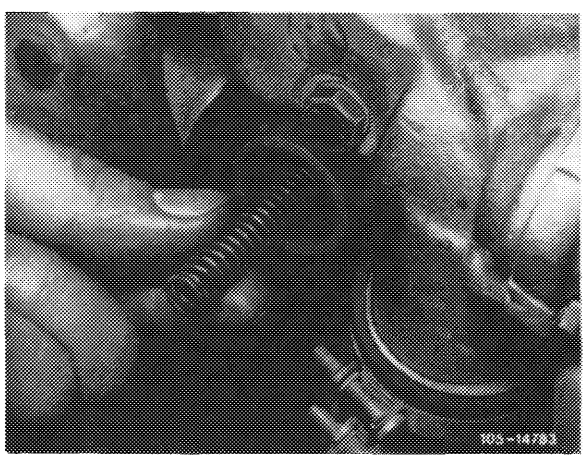


7 Unscrew closing plug of chain tensioner.

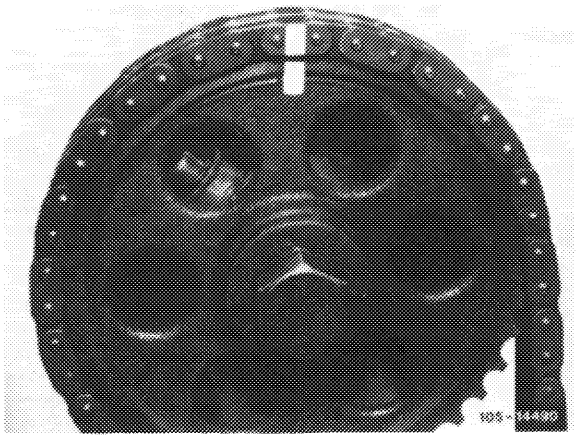
Attention!
The closing plug is under pressure of compression spring.



8 Remove compression spring in chain tensioner.

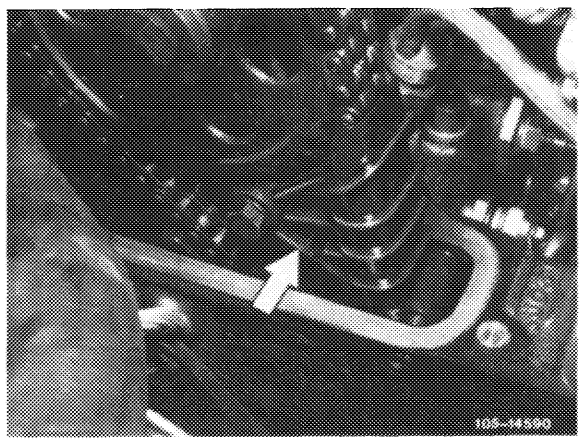


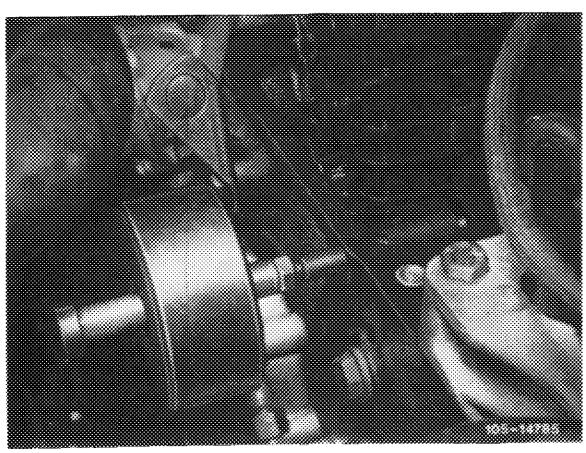
9 Mark camshaft sprocket and timing chain in relation to each other.



10 Remove slide rail in cylinder head.

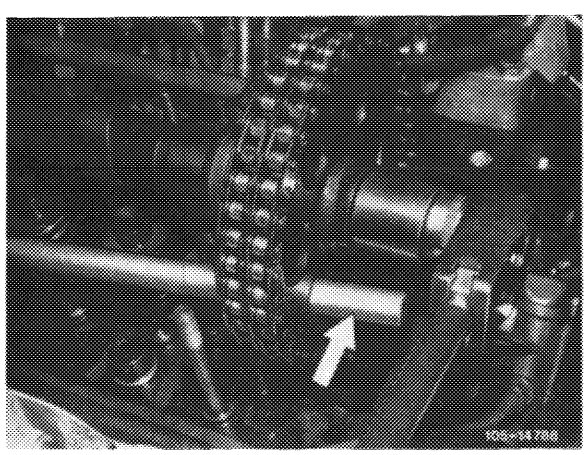
Pull out bearing bolt by means of impact puller.



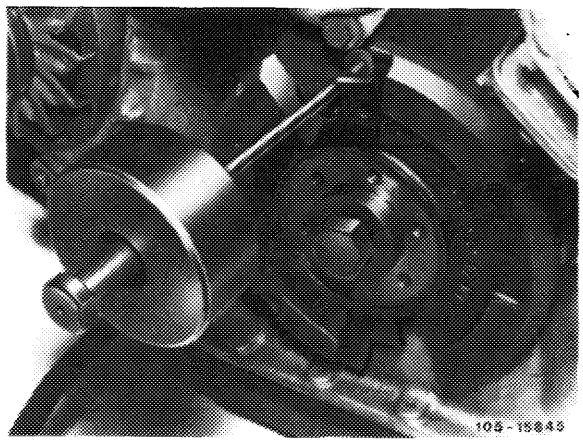


11 Remove camshaft sprocket.

For loosening necked-down screw, apply counterhold to camshaft sprocket by means of a screwdriver or steel bolt.



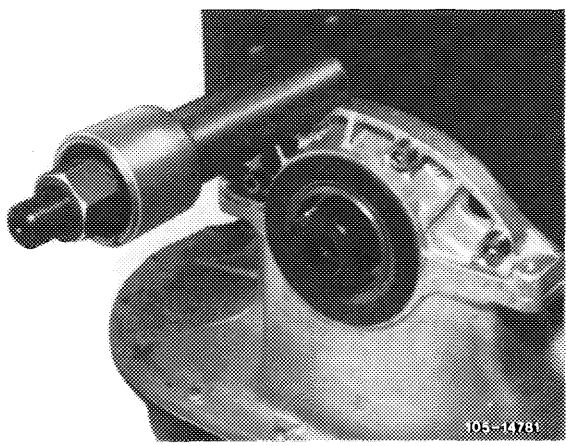
12 Knock out bearing bolt by means of impact puller.

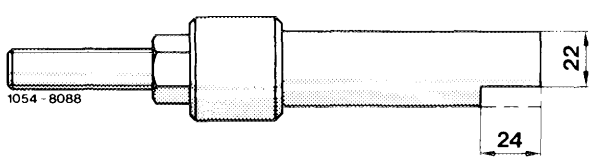


Attention!
If bearing bolt is stuck to the extent that it cannot be knocked out with impact puller, use puller part No. 115 589 20 33 00.

For this purpose, remove balancing disk and provide puller with a recess.

The recess is necessary to position the puller with cylinder crankcase cover installed.





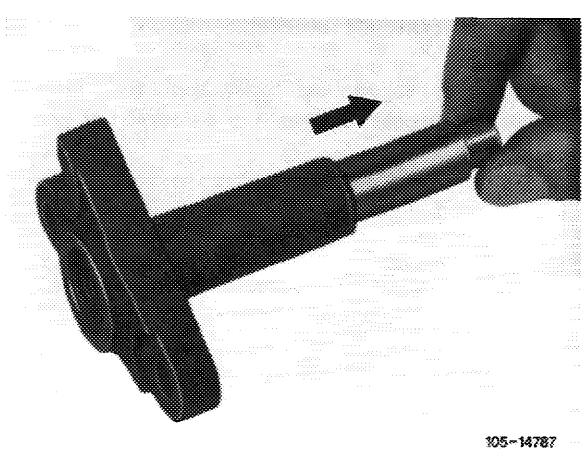
13 Remove tensioning rail in upward direction.

14 Unscrew cyl. head screw M 8 in chain box adjacent to pressure bolt of chain tensioner by means of screwdriver (Allen wrench) with tommy handle.

15 Pull out pressure bolt of chain tensioner in inward direction (arrow).

16 Clean bearing bolt.

17 Renew badly worn tensioning rails and bearing bolts.

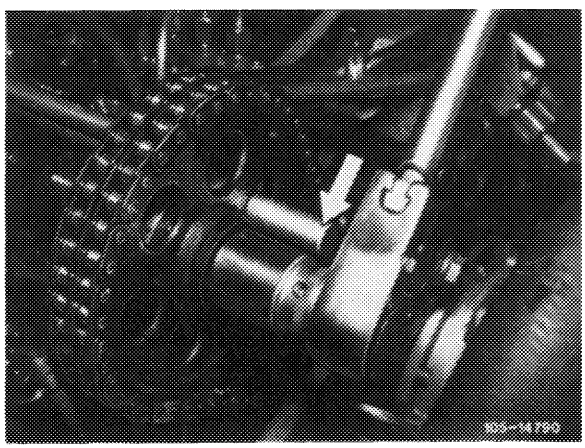


18 Coat bearing bolt on flange with sealing compound.

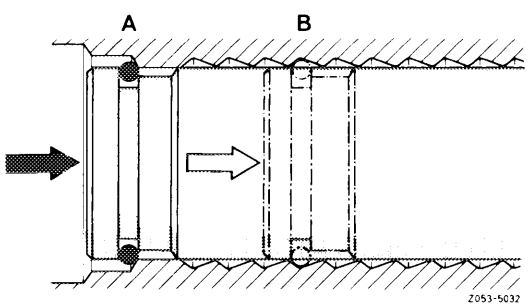
19 Position tensioning rail and knock in bearing bolt by means of impact puller.

20 Place camshaft sprocket with timing chain on camshaft, while paying attention to color marks.

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



22 Place pressure bolt of chain tensioner on assembly detent.



A Chain tensioner in assembly position
B Chain tensioner in operating position

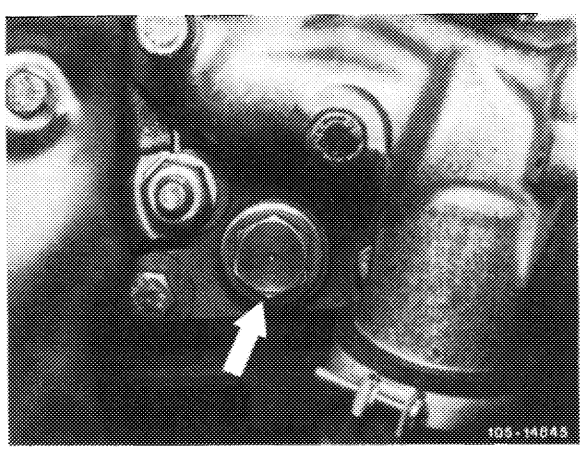
23 Insert compression spring.

24 Position closing plug of chain tensioner with new sealing ring and tighten to 90 Nm.

Make sure that pressure bolt is seated on thrust piece of tensioning rail.

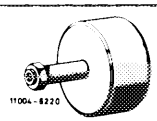
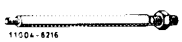
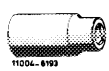
25 Screw in cyl. head bolt M 8 by means of screwdriver (Allen wrench) with tommy handle.

26 For further installation proceed vice versa to removal.



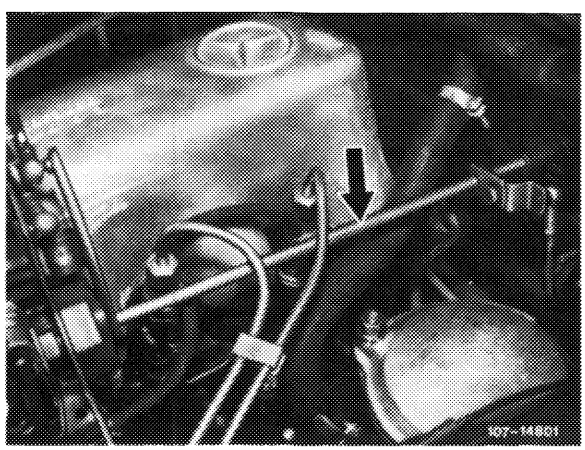
Tightening torques	Nm
Nuts for cylinder head cover	15
Necked-down screw for camshaft sprocket	80
Fastening screw for injection timer	40
Closing plug for chain tensioner	90

Special tools

Impact puller for bearing bolt (basic unit)		116 589 20 33 00
Threaded bolt M 6, 150 mm long for impact puller		116 589 02 34 00
Threaded bolt M 6, 50 mm long for impact puller		116 589 01 34 00
Socket 27 mm, 1/2" square, for rotating engine		001 589 65 09 00

Remove slide rail (89)

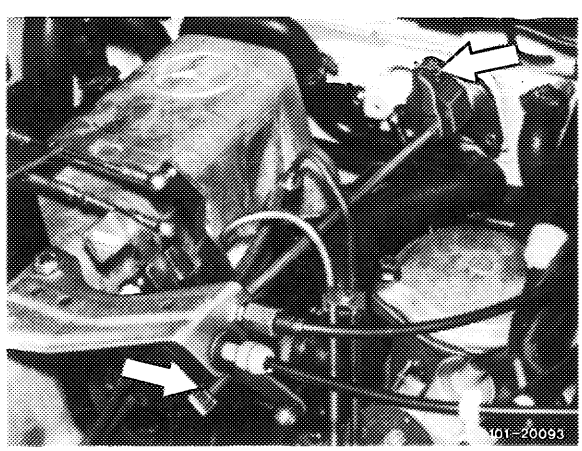
1 Disconnect regulating linkage to remove cylinder head cover. Pull out locking eye of longitudinal regulating shaft (arrow).



Model 116.120

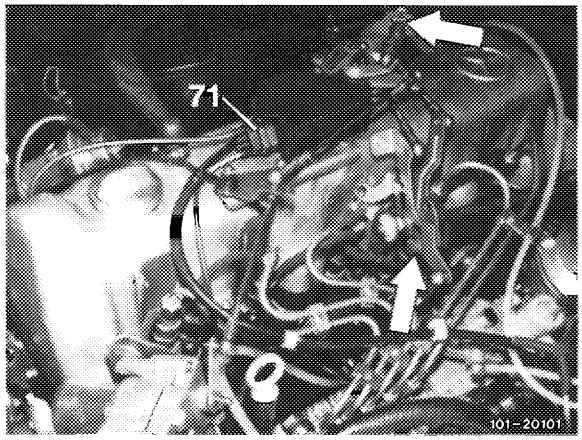
On models 116.120 and 123, pull longitudinal regulating shaft out of rubber mount in forward direction and remove in rearward direction.

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

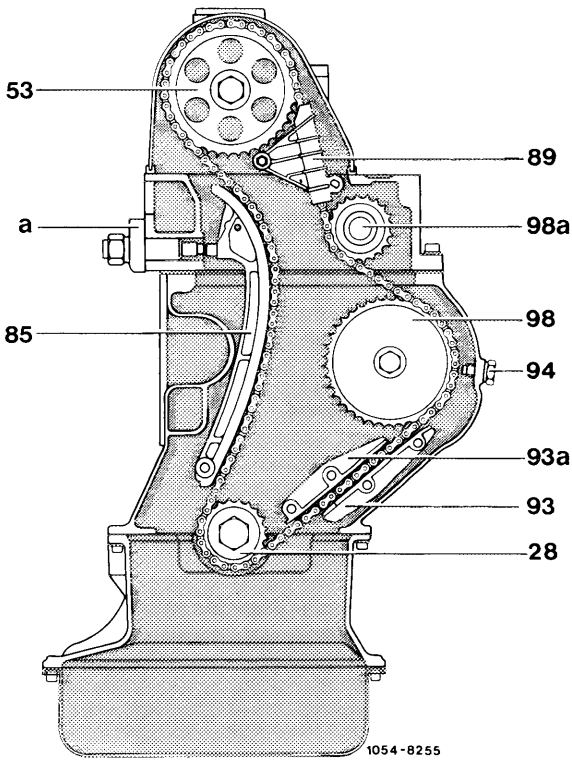


Model 123

On models 123 with automatic transmission 722.303 (W 4 A 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.



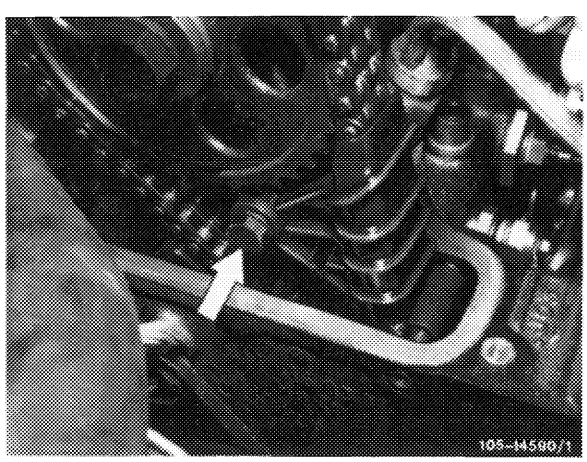
Model 126.120



28 Crankshaft sprocket
53 Camshaft sprocket
85 Tensioning rail
89 Slide rail
93 Outer slide rail
93a Inner slide rail
94 Chain locking screw
98 Injection timer
98a Guide wheel
a Chain tensioner

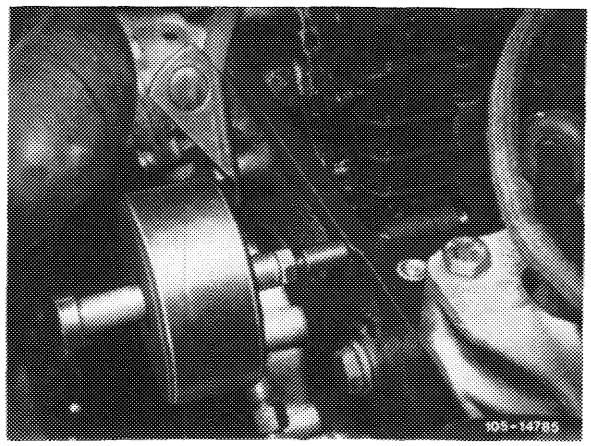
2 On model 123 with level control, remove pressure oil pump with connected lines and put aside.

3 Remove screw (arrow).



4 Pull out bearing bolt with impact puller.

5 Remove slide rail in upward direction.



Installation

6 Coat bearing bolt on flange with sealing compound.

7 Position slide rail and knock in bearing bolt by means of impact puller.

8 Screw-in screw.

9 Mount cylinder head cover.

Removing inner slide rail (93a)

1 Remove radiator and fan.

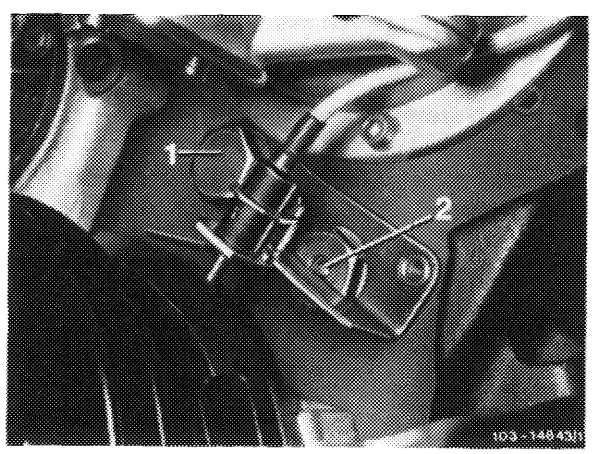
2 Remove vacuum pump (42–610).

3 Remove pulley, vibration damper and balancing disk (03–340).

4 Remove cylinder head cover (refer to Remove slide rail [89]).

5 Unscrew closing plug (1) and put adjusting pointer with TDC transmitter aside.

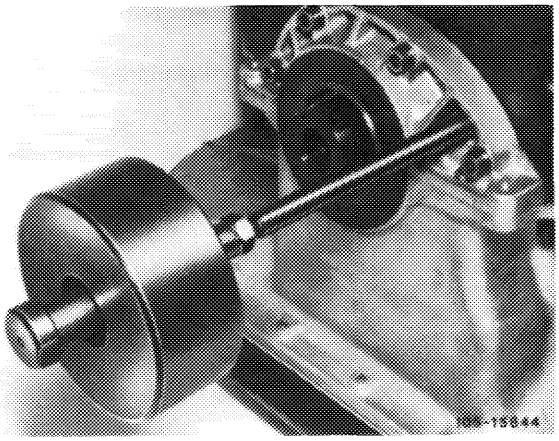
6 Remove injection timer (07.1–210).



7 Unscrew closing plug with upper bearing bolt (2) and pull out.

8 Pull out lower bearing bolt by means of impact puller.

9 Remove slide rail in upward direction.

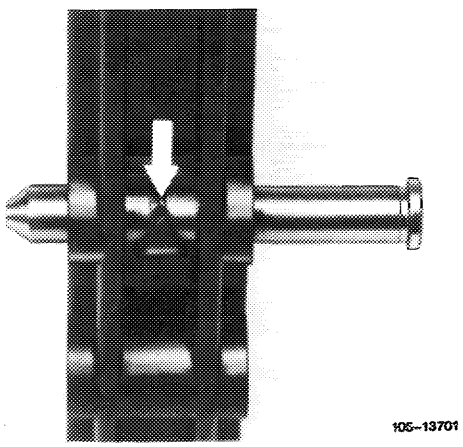


Installation

10 Coat lower bearing bolt on flange with sealing compound.

11 Position slide rail and knock in lower bearing bolt by means of impact puller.

Attention!
The locating lug of the slide rail should rest in locating groove of bearing bolt (arrow).



12 Position closing plug and screw-in.

13 Install injection timer (07.1–210).

14 Position adjusting pointer with TDC transmitter and screw on.

15 Attach vacuum pump (42–610).

16 Install pulley, vibration damper and balancing disk (03–340).

17 Install radiator and fan.

18 Mount cylinder head cover.

Removing outer slide rail (93)

1 Remove radiator and fan.

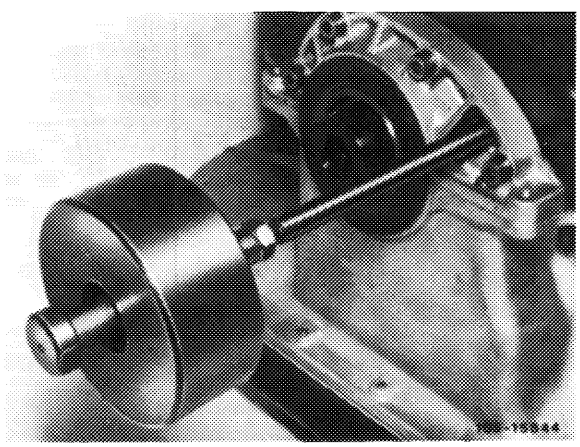
2 Remove vacuum pump (42–610).

3 Remove injection timer (07.1–210).

4 Remove cylinder head cover (refer to Remove slide rail [89]).

5 Pull out both bearing bolts of slide rail by means of impact puller.

6 Remove slide rail in upward direction.

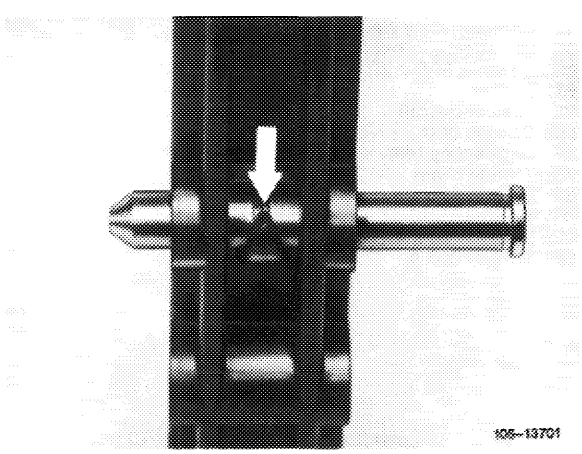


Installation

7 Coat both bearing bolts on flange with sealing compound.

8 Position slide rail and knock in bearing bolts by means of impact puller.

Attention!
Locating lug of slide rail should rest in locating groove of lower bearing bolt (arrow).



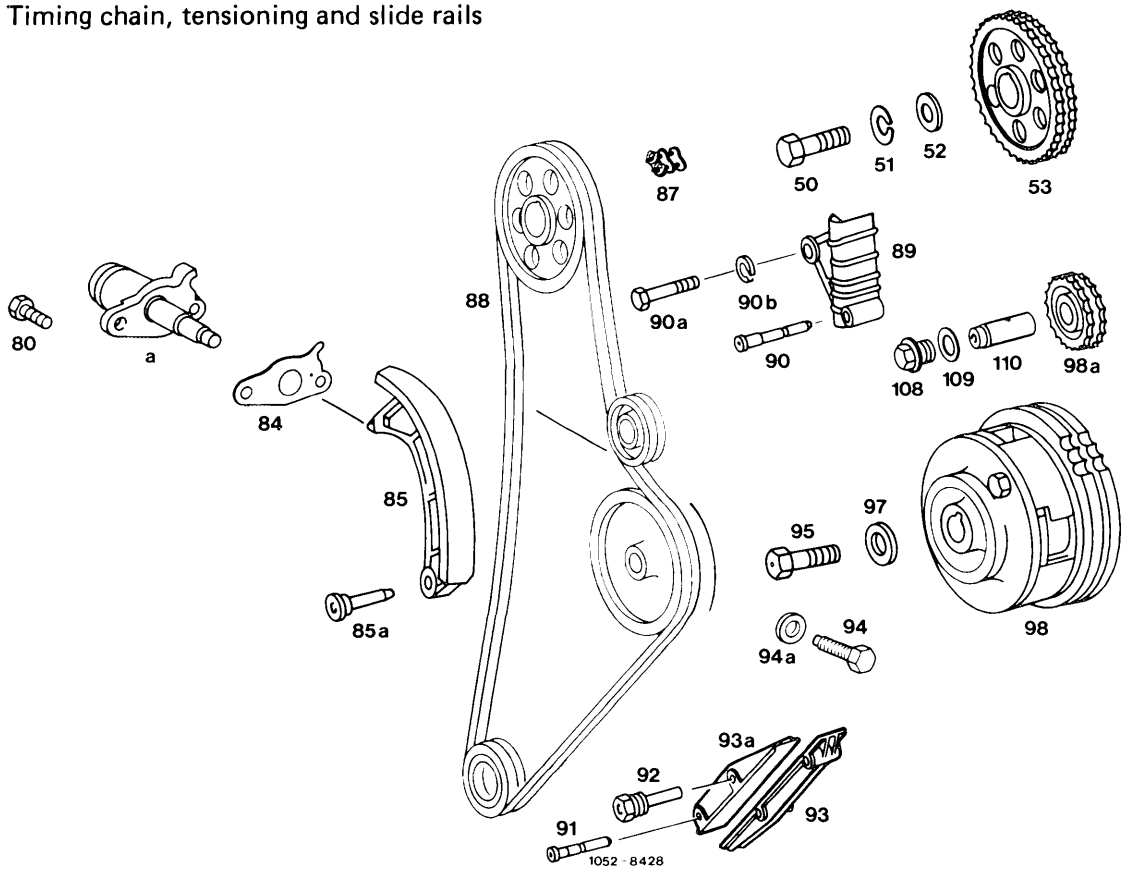
9 Install injection timer (07.1–210).

10 Attach vacuum pump (42–610).

11 Install radiator and fan.

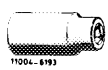
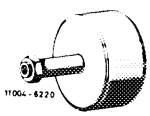
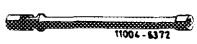
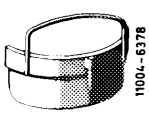
12 Mount cylinder head cover.

Timing chain, tensioning and slide rails



50 Necked-down screw M 14 x 1.5 x 40
51 Snap ring B 14
52 Compensating washer
53 Camshaft sprocket
80 2 screws M 8 x 20
84 Gasket
85 Tensioning rail
85a Bearing bolt
87 Connecting link
88 Timing chain
89 Slide rail
90 Bearing bolt
90a Screw M 8 x 50
90b Snap ring A 8
91 3 bearing bolts
92 Closing plug with bearing bolt
93 Outer slide rail
93a Inner slide rail
94 Chain locking screw
94a Sealing ring A 12 x 17
95 Screw M 10 x 45
97 Washer
98 Injection timer
98a Guide wheel
108 Closing plug
109 Sealing ring
110 Shaft
a Chain tensioner

Tightening torques	Nm
Nuts for cylinder head cover	15
Necked-down screw for camshaft sprocket	80
Fastening screw for injection timer	40
Coupling nuts for injection lines	25
Closing plug for chain tensioner	90

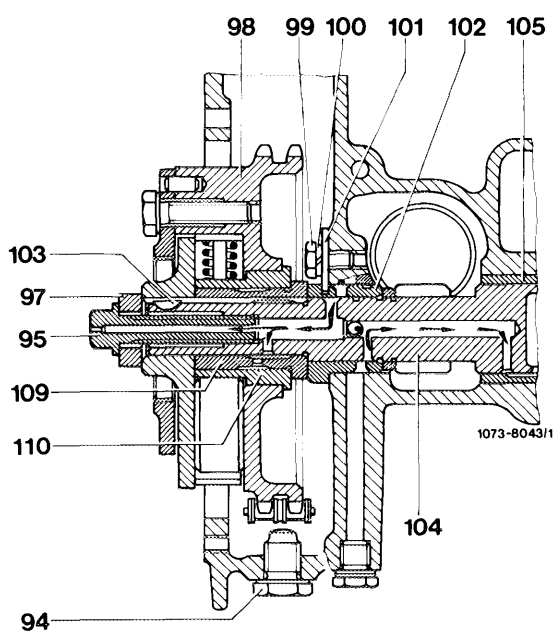
Socket 27 mm, 1/2" square, for rotating engine	 11004-6193	001 589 65 09 00
Box wrench socket, open, 17 mm, 1/2" square, for injection lines	 11004-6359	000 589 68 03 00
Impact puller for bearing bolt (basic unit)	 11004-6220	116 589 20 33 00
Threaded bolt M 6, 50 mm long for impact puller	 11004-6368	116 589 01 34 00
Articulated wrench	 11004-6372	000 589 21 07 22
Overflow pipe	 11004-6376	636 589 02 23 00
Holding plate	 11004-6378	616 589 02 40 00

Note

The injection timer is mounted on intermediate sprocket shaft with a screw M 10 x 45 (95).

On engine 617.950 with double diaphragm vacuum pump, the **screw has a hollow shaft.**

The vacuum pump is provided with the required oil through this hollow screw.

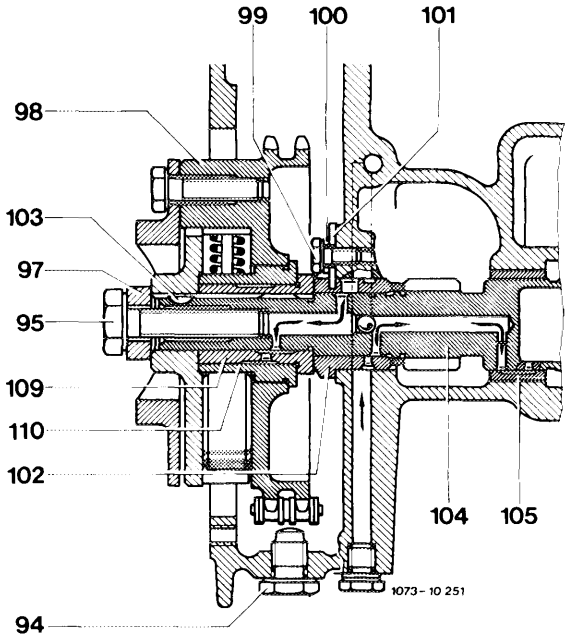


Layout of double diaphragm vacuum pump

94	Chain locking screw	101	Lock washer
95	Screw M 10 x 45	102	Bearing bushing front
97	Washer	103	Woodruff key
98	Injection timer	104	Intermediate sprocket shaft
99	Screw M 6 x 12	105	Bearing bushing rear
100	Snap ring B 6	109	Bearing bushing injection timer

On engines with piston vacuum pump, **screw (95) is not hollow.**

Do not mix up screws (95).

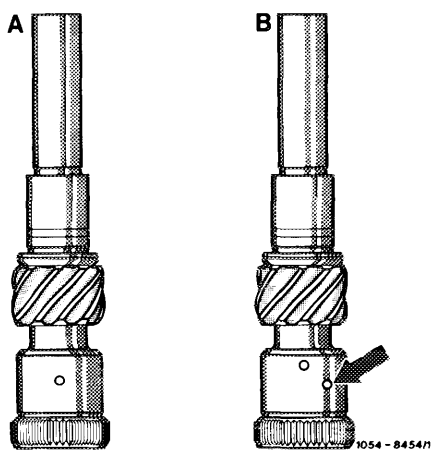


Layout with piston vacuum pump

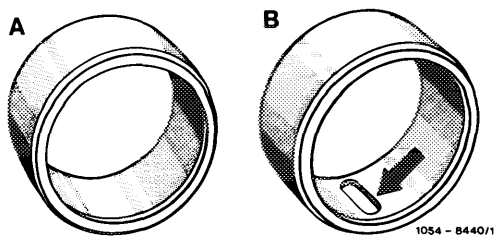
94	Locking screw	101	Lock washer
95	Screw M 10 x 45	102	Bearing bushing front
97	Washer	103	Woodruff key
98	Injection timer	104	Intermediate sprocket shaft
99	Screw M 6 x 12	105	Bearing bushing rear
100	Snap ring B 6	109	Bearing bushing

On engine 617.950 since August 1978, and on engines 617.951/952 since start of series, the intermediate sprocket shaft (B) and the rear bearing bushing (B) of engines 615, 616 and 617.912 are installed for reasons of standardization.

These parts can also be installed on engines 617.950 manufactured at an earlier date.



A Intermediate sprocket shaft 1st version
B Intermediate sprocket shaft 2nd version



A Rear bearing bushing 1st version
B Rear bearing bushing 2nd version

Removal

1 Remove fan and radiator shell.

2 Remove vacuum pump (42–610).

3 Remove injection timer (07.1–210).

4 Remove injection pump (07.1–180).

5 Pull out intermediate sprocket shaft toward the rear.

Installation

6 Insert intermediate sprocket shaft from the rear.

7 Install injection timer (07.1–210).

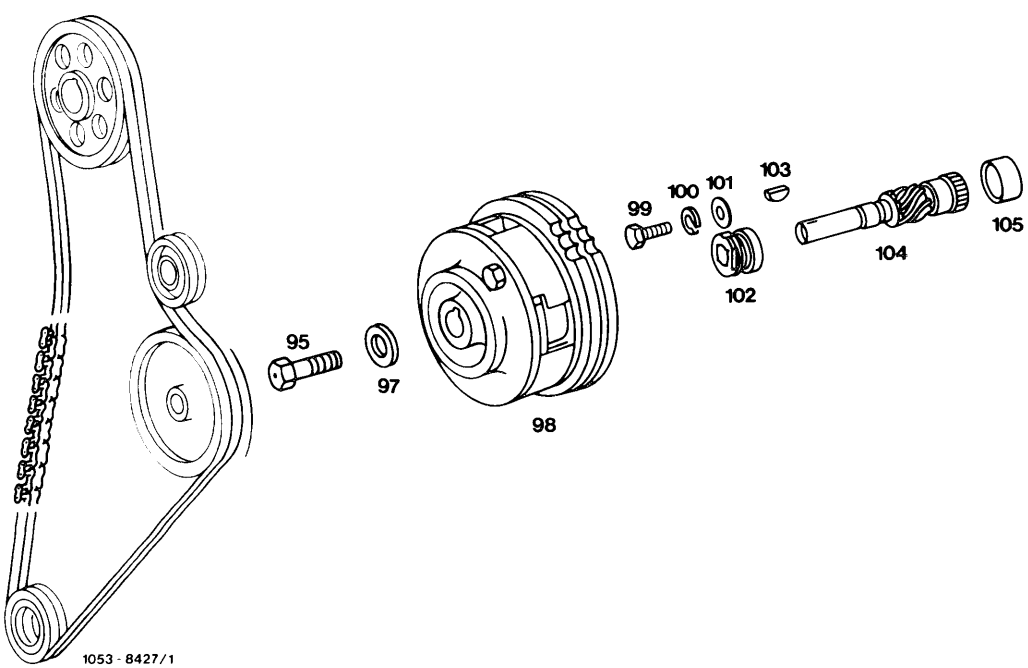
8 Install injection pump (07.1–180).

9 Check timing of camshaft (05–215) and begin of delivery (injection timing) of injection pump (07.1–110).

10 Install vacuum pump (42–610).

11 Install fan and radiator shell.

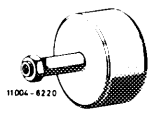
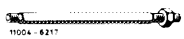
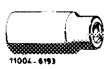
Intermediate sprocket shaft and injection timer



95 Screw M 10 x 45
97 Washer
98 Injection timer
99 Screw M 6 x 12
100 Snap ring B 6
101 Lock washer
102 Bearing bushing front
103 Woodruff key
104 Intermediate sprocket shaft
105 Bearing bushing rear

Tightening torques	Nm
Nuts for cylinder head cover	15
Necked-down screw for camshaft sprocket	80
Closing plug for chain tensioner	90
Pressure oil pump on cylinder head	10

Special tools

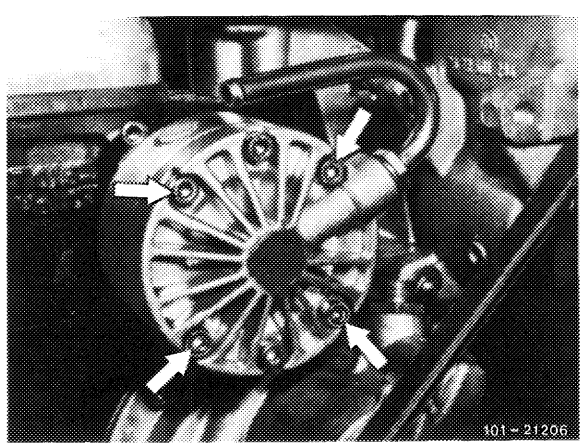
Impact puller for bearing bolt (basic unit)	 11004-6220	116 589 20 33 00
Threaded bolt M 8, 150 mm long for impact puller	 11004-6217	616 589 00 34 00
Threaded bolt M 6, 50 mm long for impact puller	 11004-6358	116 589 01 34 00
Socket 27 mm, 1/2" square, for rotating engine	 11004-6193	001 589 65 09 00

Note

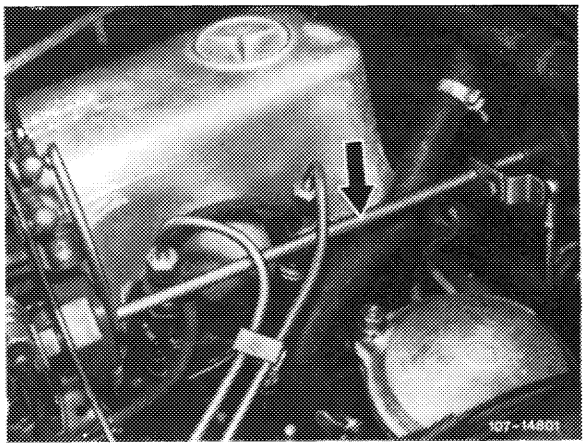
If, on model 123 with level control, the rear bearing bushing for guide wheel shaft requires renewal, make sure that the bearing bushing on basic bore projects by 1 mm. Do not install bushing flush.

Removal

1 On model 123 with level control, unscrew pressure oil pump with lines connected and put aside.



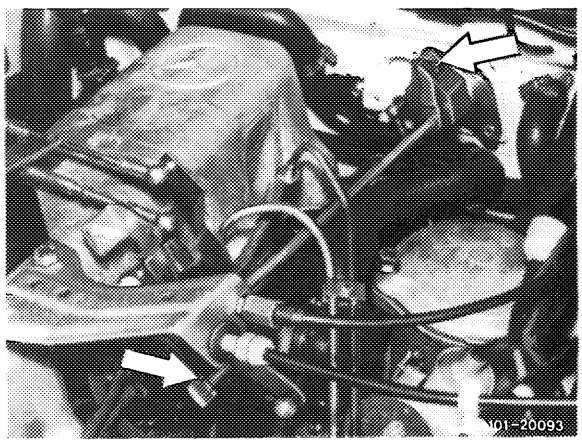
2 Disconnect regulating linkage to remove cylinder head cover. Pull out locking eye of longitudinal regulating shaft (arrow).



Model 116.120

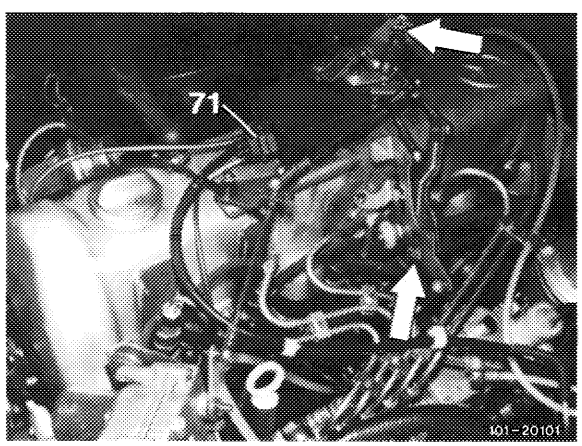
On models 116.120 and 123, pull longitudinal regulating shaft out of rubber mount in forward direction and remove in rearward direction.

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



Model 123

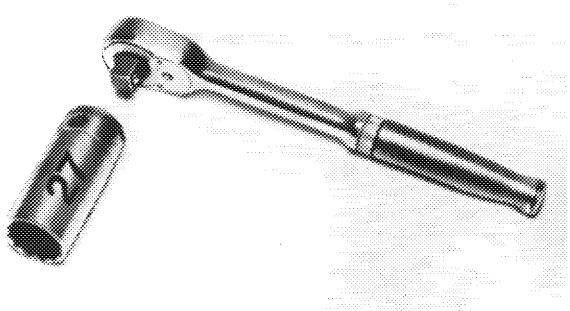
On models 123 with automatic transmission 722.303 (W 4 A 040) and 126.120, pull out central plug for vacuum lines (71) or vacuum lines. Disconnect Bowden wire, compress black plastic clip (arrow) and pull Bowden wire out of holder in rearward direction.



Model 126.120

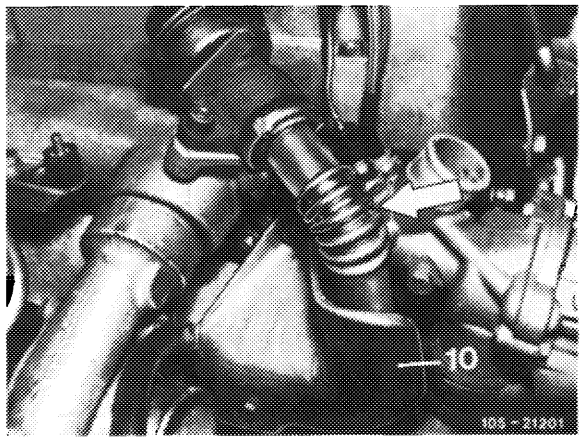
3 Set crankshaft to ignition TDC.

For this purpose, rotate crankshaft by means of tool combination.



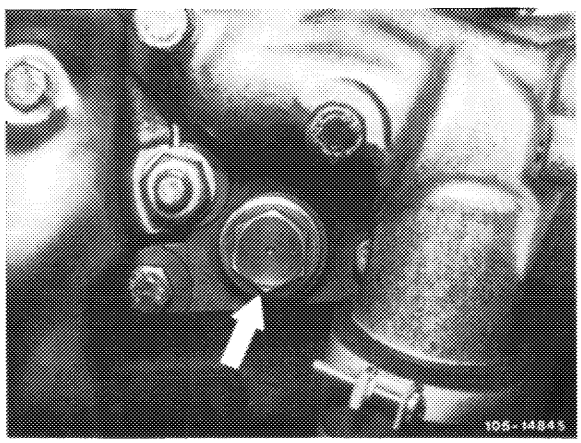
1100-6428/1

4 On engines with EGR (USA), remove pipe line between EGR valve and exhaust manifold (arrow). Unscrew shielding plate (10) for this purpose.

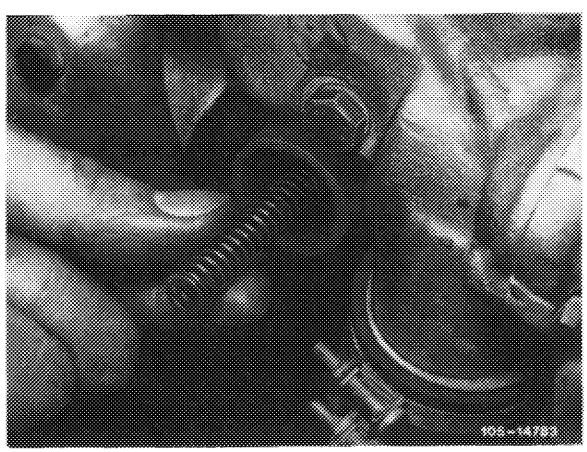


5 Unscrew closing plug of chain tensioner.

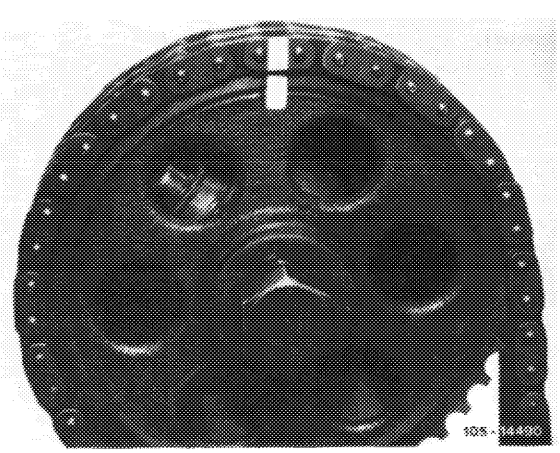
Attention!
Closing plug is under pressure of compression spring.



6 Remove compression spring in chain tensioner.

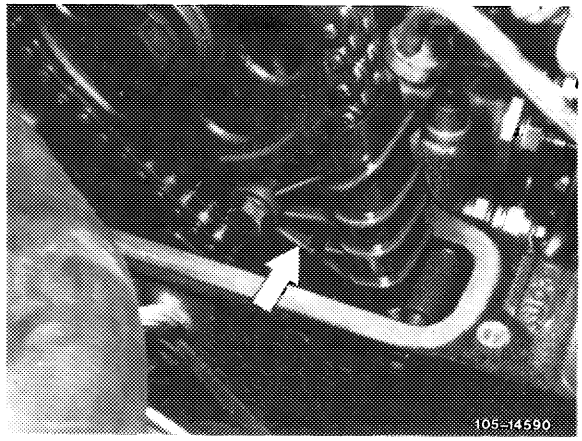


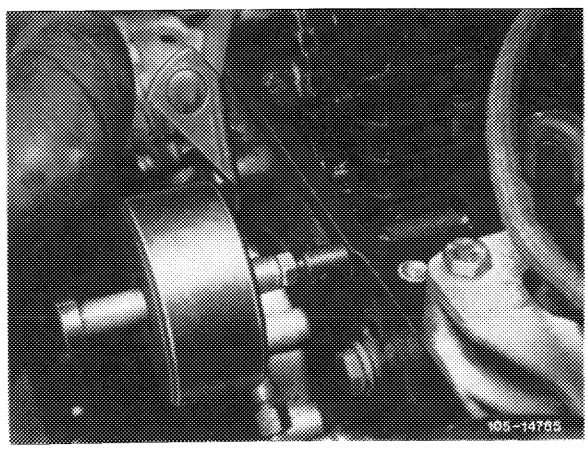
7 Mark camshaft sprocket and timing chain in relation to each other.



8 Remove slide rail in cylinder head.

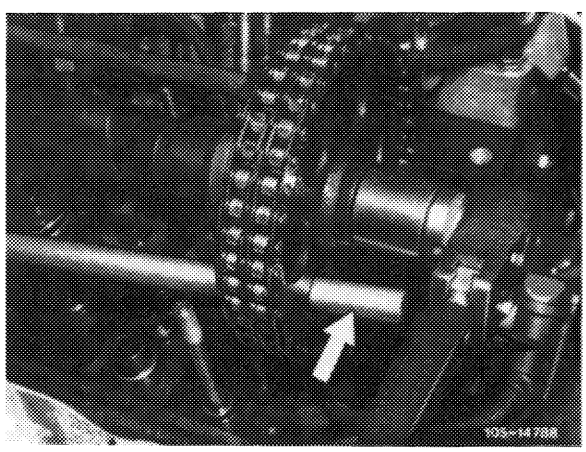
Pull out bearing bolt by means of impact puller.



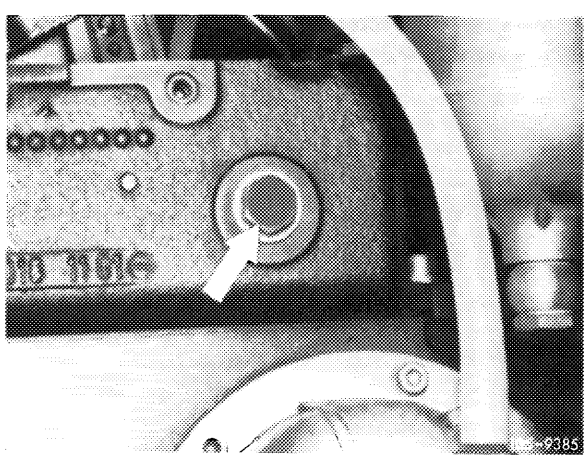


9 Remove camshaft sprocket.

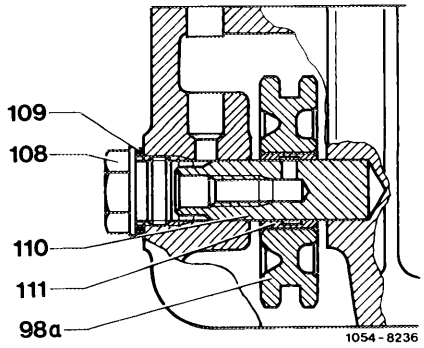
For loosening necked-down screw, apply counterhold to camshaft sprocket by means of a screwdriver or steel bolt.



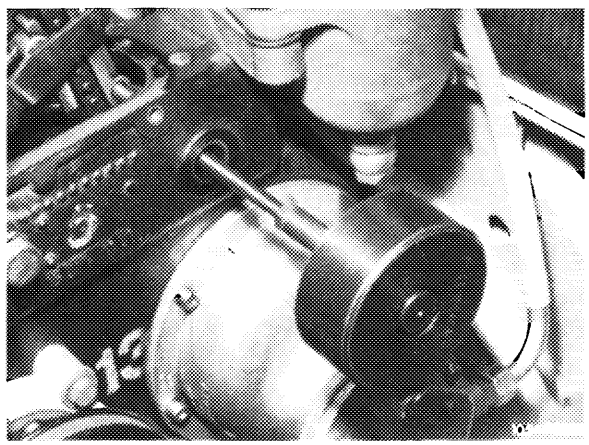
10 On engines 617.950/951, unscrew closing plug (arrow).



11 Pull out shaft (110) by means of impact puller and remove guide wheel (98a) in upward direction.

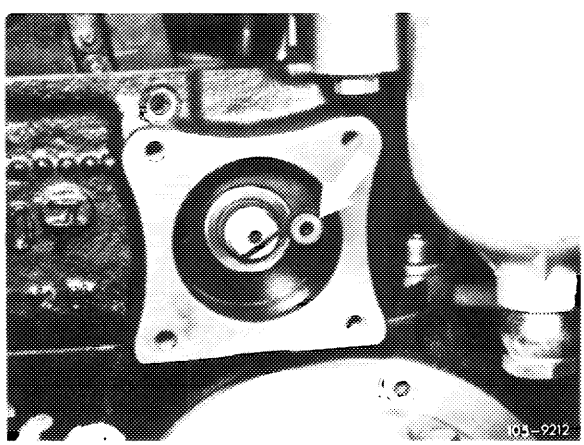


98a Guide wheel
108 Closing plug
109 Sealing ring
110 Shaft



12 On model 123 with level control, unscrew locking screw of front bearing bushing (arrow).

Pull out shaft together with bearing bushing and remove guide wheel.



Installation

13 Position guide wheel and slip in shaft.

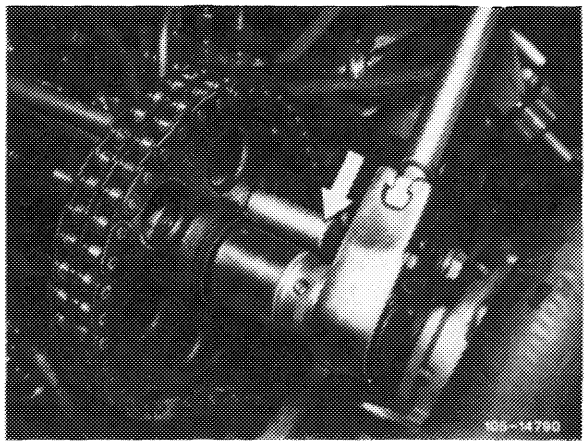
On model 123 with level control, screw in bearing bushing locking screw (arrow in Fig. item 12).

14 Screw in closing plug with new sealing ring.

On model 123 with level control, screw on pressure oil pump with new gasket.

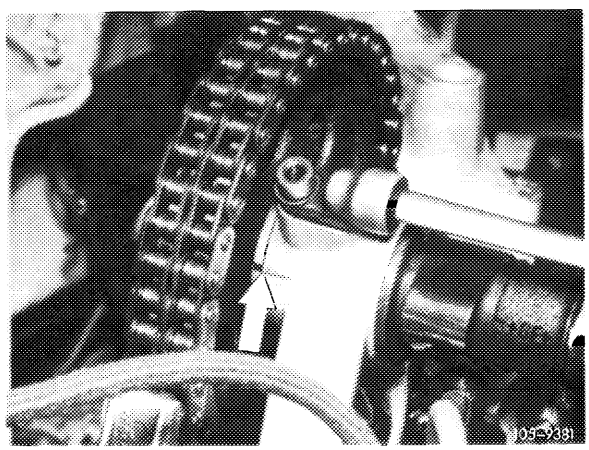
15 Mount camshaft sprocket, while paying attention to color marks.

Tighten necked-down screw to 80 Nm. For this purpose, apply counterhold to camshaft sprocket by means of a screwdriver or steel bolt.



16 Install slide rail.

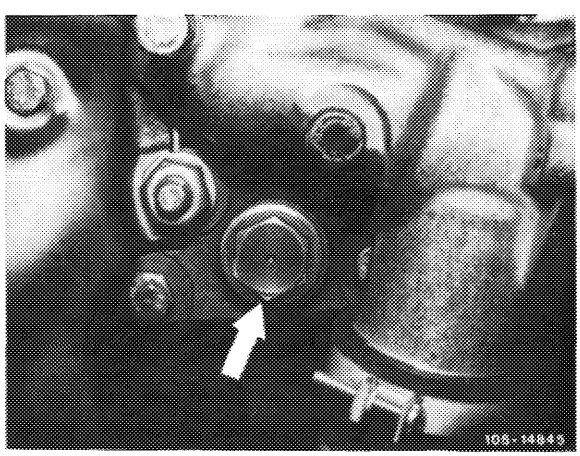
17 Rotate crankshaft and check adjusting mark in TDC position of engine.



18 Insert compression spring into chain tensioner and tighten closing plug to 90 Nm.

19 On engines with EGR (USA), install shielding plate and pipe line (Fig. item 4).

20 Mount cylinder head cover.



Model	Engine	Injection pump Bosch designation	Governor Bosch designation	Delivery pump Bosch designation	Test values[1] MB-sheet edition
Standard version up to 1980					
123.193	617.952	PES 5 MW 55/320 RS 16	RW 375/2200 MW 28–1	FP/K 22 MW 22	3.0 g 5th edition
Standard version starting 1981					
123.193	617.952	PES 5 MW 55/320 RS 16	RW 375/2200 MW 28–3[3])	FP/K 22 MW 8	3.0 m 1st edition
(USA) **1978/1979**		Identification: Green type rating plate			
116.120	617.950	PES 5 MW 55/320 RS 16	RW 375/2200 MW 22	FP/K 22 MW 8	3.0 g 4th edition
(USA) **1980**					
116.120	617.950	PES 5 MW 55/320 RS 16	RW 375/2200 MW 22 RW 375/2200 MW 28[2])	FP/K 22 MW 22	3.0 g 4th edition
(USA) **1981**					
123.193	617.952	PES 5 MW 55/320 RS 16	RW 375/2200 MW 28–1	FP/K 22 MW 22	3.0 g 5th edition
126.120	617.951				
(USA) **starting model year 1982**					
123.133 123.153 123.193	617.952	PES 5 MW 55/320 RS 16	RW 375/2200 MW 28–3[3])	FP/K 22 MW 22	3.0 g 1st edition
126.120	617.951				

(USA) starting model year 1984 California

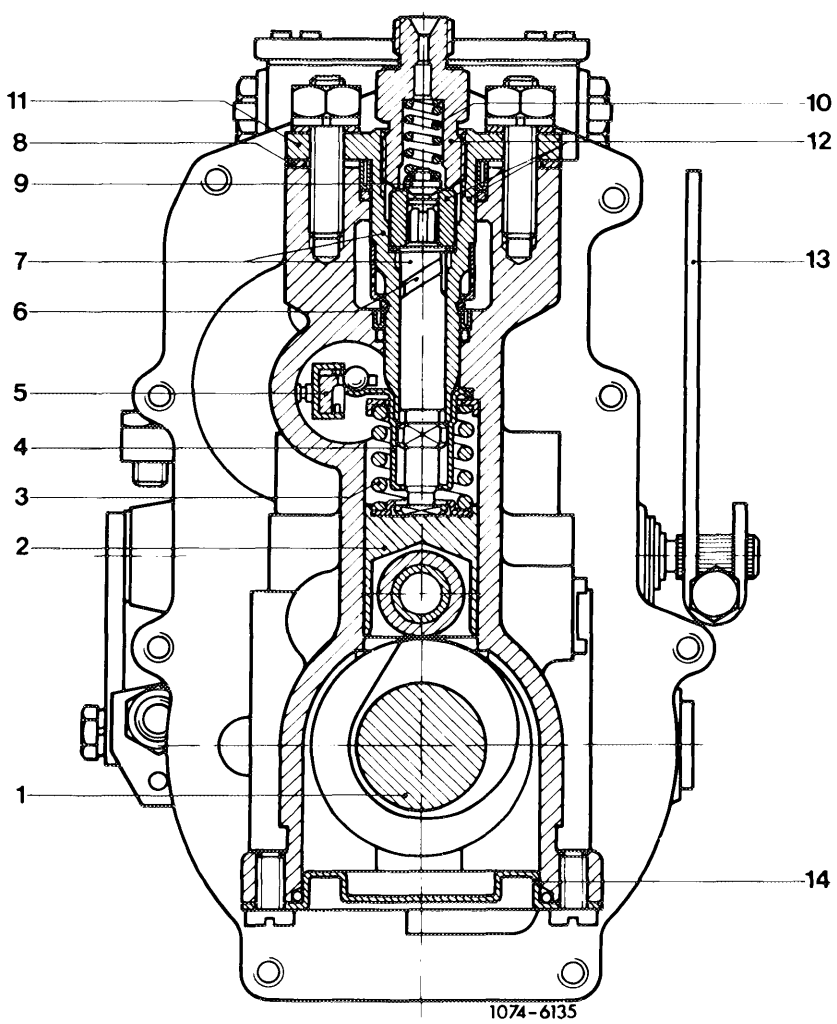
123.133 123.153 617.952 123.193	PES 5 MW 55/320 RS 16–1	RW 375/2200 MW 28–3[3])	FP/K 22 MW 22	3.0 m 1st edition
126.120 617.951				

[1]) Accurate inspection and adjustment of injection pump is possible on an injection pump test bench only. Data sheets for the various pumps are available for workshops where such a test bench is installed.
[2]) Entering production starting February 1980.
[3]) Reference impulse verification (RIV), dynamic checking of injection timing (begin of delivery) possible.

Layout of injection pump

The layout of the injection pump is essentially the same as that of the M injection pump. On the other hand, the element assembly (12) is mounted to injection pump housing by means of holding flange (11).

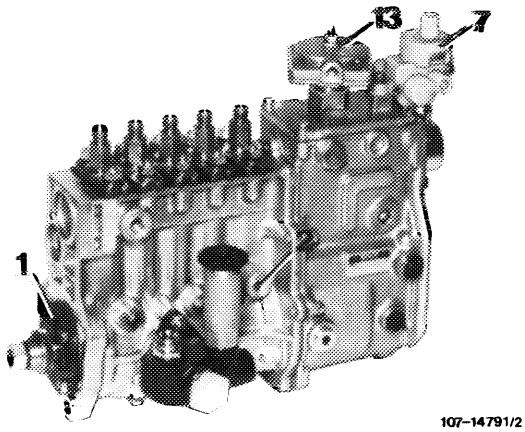
The fastening nuts of the element assembly should never be loosened, since otherwise the basic adjustment of the respective element will be changed and renewed adjustment on the bench will be required.



1 Camshaft
2 Roller tappet
3 Compression spring
4 Control bushing
5 Control rod
6 Control edge
7 Element
8 Adjusting plate
9 Pressure valve
10 Pressure valve spring
11 Holding flange
12 Element assembly
13 Adjusting lever
14 Closing cover

The injection pump is connected to engine oil circuit for lubrication.

The oil inlet (2) for lubrication is at 5th pump element. The oil flows through bores (1) on sealing flange of camshaft again back into crankcase.

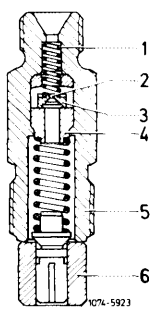


107-14791/2

1 Oil outlet
2 Oil inlet
7 Vacuum control valve
13 ALDA housing

Relief throttle in pipe connection

To reduce hydrocarbons in exhaust gas, relief throttles are installed in pipe connections of injection pump. The relief valve (2) is a platelet valve (3) opening in direction of injection nozzle with an orifice of 0.6 mm dia. The valve seat (4) is riveted into pipe connection. The relief valve permits the fuel to flow in direction of injection nozzle without obstruction. The pressure wave from injection nozzle in direction of injection pump, which is generated upon injection by the after-pumping effect of the nozzle needle when closing, is dampened by the relief throttle. This will prevent the pressure wave from subsequently flowing back to injection nozzle for re-injection. Re-injection will increase hydrocarbons in exhaust gas.



1 Compression spring
2 Relief throttle
3 Platelet valve
4 Valve seat
5 Pipe connection
6 Pressure valve carrier with pressure valve

Layout and operation of RW-governor

The governor is a idle max. speed governor with its regulating spring (11) dimensioned and set in such a manner that the governor is not regulating in partial load range, except for the purpose of torque control (refer to "Throttle control during start and at full load").

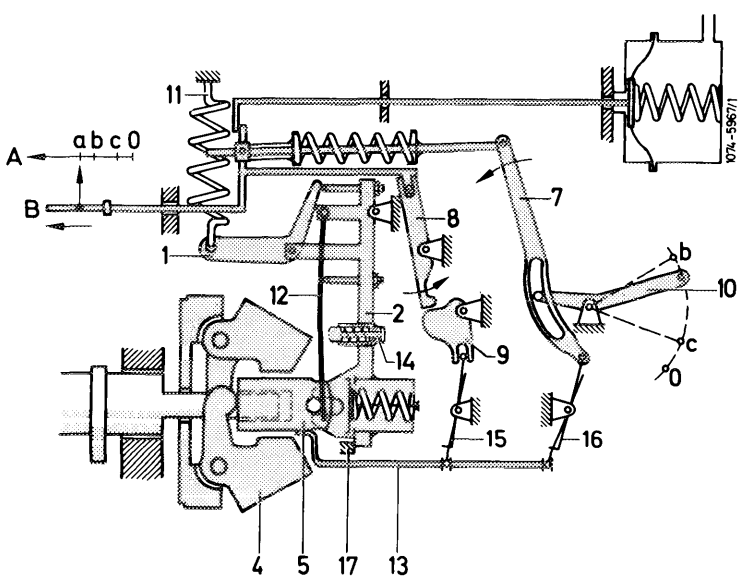
In partial load and full load range, the control rod (B) of the injection pump is operated by means of accelerator pedal only, which is connected to adjusting lever (10) of governor by means of the throttle linkage.

At increasing engine speed, as soon as the centrifugal force is higher than pressure of the regulating springs, the flyweights will move in outward direction. The movement of the flyweights is transmitted to control rod (B) by way of the sliding sleeve (5), the linkage (13) and the slotted lever (7).

As soon as max. speed is attained, the control rod is displaced in direction of stop. As a result, fuel delivery will be reduced and the engine speed will be limited. The procedure is reversed when the ingine speed drops.

Governing procedure during start

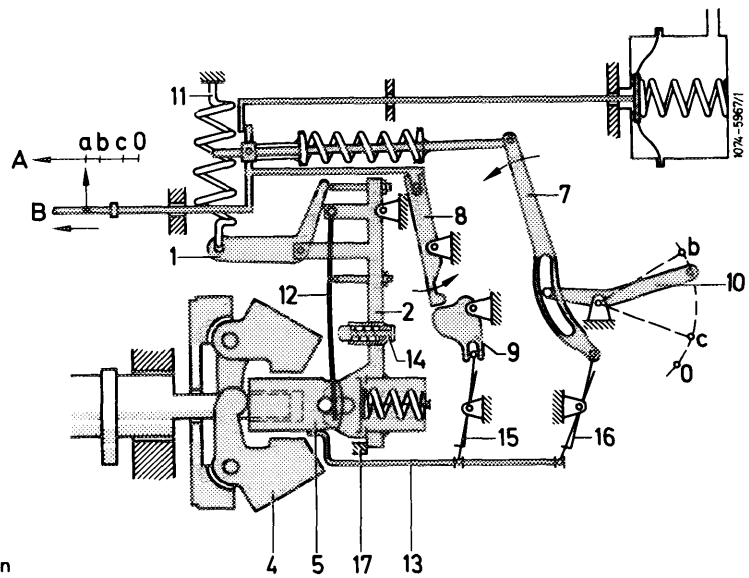
In rest position, the swivel lever (2) is pushed to the left agains stop (17) under influence of regulating spring (11) and bell crank (1). In addition, the fly-weights (4) are forced completely inward into their starting by means of the idle speed spring (12) via sliding sleeve (5).



1	Bell crank	13	Linkage
2	Swivel lever	15	Connecting lever
4	Flyweights	16	Connecting lever
5	Sliding sleeve	17	Stop
7	Slotted lever		
8	Finger	A	Control path
9	Cam	B	Control rod
10	Adjusting lever	a	Starting position
11	Regulating spring	b	Full load position
12	Idle speed spring	c	Idle speed position

When the accelerator pedal or the adjusting lever (10) are operated, the control rod (B) can be moved into starting position (a), since the excess fuel lock com-prising cam (9) and sensor finger (8) is eliminated.

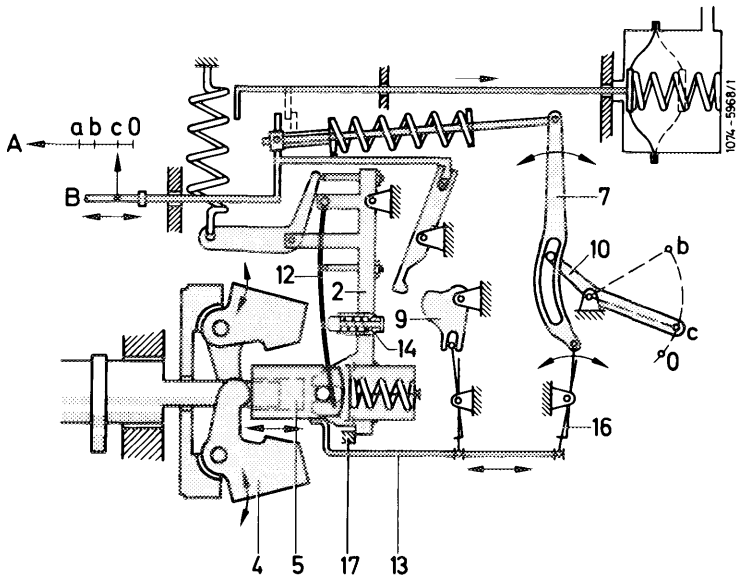
When the engine and thereby the camshaft of the injection pump are starting to rotate, the flyweights (4) will move away from each other. The sliding sleeve (5) will then be moved to the right together with linkage (13) against the spring pressure of the idle speed spring (12). The pin of the sliding sleeve is slidingly located in slot of swivel lever (2). This movement is transmitted to control rod by way of the connecting lever (16) and the slotted lever (7). Finger (8) will be swivelled out of cam (9) by way of the control rod.



1	Bell crank	13	Linkage
2	Swivel lever	15	Connecting lever
4	Flyweights	16	Connecting lever
5	Sliding sleeve	17	Stop
7	Slotted lever		
8	Finger	A	Control path
9	Cam	B	Control rod
10	Adjusting lever	a	Starting position
11	Regulating spring	b	Full load position
12	Idle speed spring	c	Idle speed position

As soon as the speed increases, the sliding sleeve (5) with linkage (13) and control rod (B) are each moving in the same direction, that is, a movement of the sliding sleeve to the right also makes the control rod move to the right. The injected fuel quantity is reduced, the engine speed will go down.

The adjusting lever (10) rests outside against resilient idle speed stop. (This may result in excess pressure against idle speed stop during manual shutoff.) In this position , the constant idle speed is regulated by the flyweights (4) together with the idle speed spring (12).



2	Swivel lever	14	Tickler
4	Flyweights	16	Connecting lever
5	Sliding sleeve	A	Control path
7	Slotted lever	B	Control rod
10	Adjusting lever	a	Starting position
12	Idle speed spring	b	Full load position
13	Linkage	c	Idle speed position

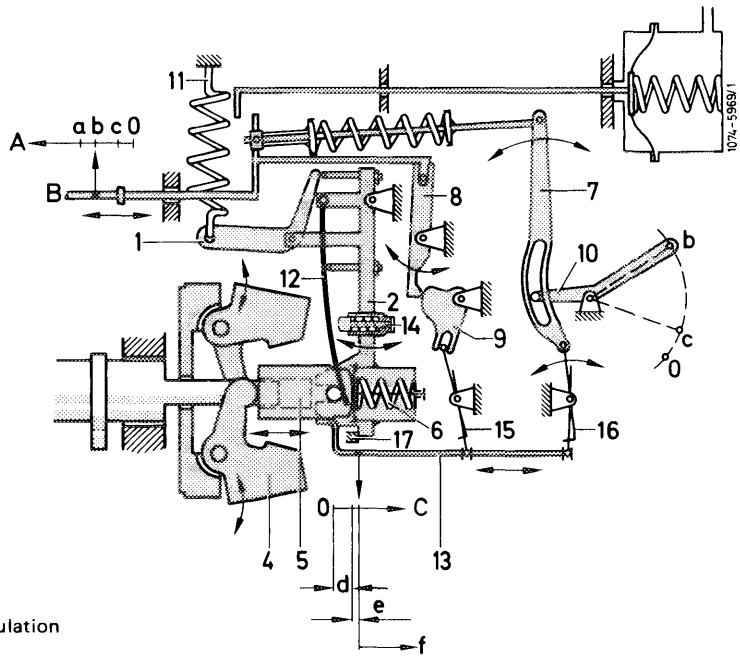
At dropping speed, the flyweights (4) are forced inwards by the spring force of the idle speed spring (12). The sliding sleeve (5) and thereby the linkage (13) will then move to the left. The linkage will automatically shift control rod (B) also to the left under influence of connecting lever (16) and slotted lever (7), which means increased quantity and thereby an increase in speed.

The flyweights are again moving away from each other The sliding sleeve and thereby the control rod are moved to the right (less fuel injected) until the force of the flyweights and the spring force of the idle speed spring (12) are in equilibrium. As a result, an almost constant speed can be maintained also when adding the air-conditioning system, power steering and when engaging a driving position.

To dampen the idle speed, the swivel lever (2) is provided with an auxiliary idle speed spring (tickler 14), which pushes against idle speed spring starting at a given speed and thereby stabilizes the idle speed.

Full load and breakaway speed

In partial load and full load range the control rod (B) of the injection pump is operated by means of accelerator pedal only, which is connected to adjusting lever (10) of governor by way of the throttle linkage.



1	Bell crank	17	Stop
2	Swivel lever	A	Control path
3	Flyweights	B	Control rod
5	Sliding sleeve	C	Sliding sleeve path
6	Compensating spring	a	Starting position
7	Slotted lever	b	Full load position
8	Finger	c	Idle speed position
9	Cam	d	Idle speed path
10	Adjusting lever	e	Compensating path
11	Regulating spring	f	Full load speed regulation
13	Linkage		

In full load position, the adjusting lever (10) rests outside against full load stop, that is, the control rod is at full load, which is the max. delivery quantity the engine can burn free of smoke.

The excess fuel lock comprising finger (8) and cam (9) serves to prevent that excess fuel is injected at full load and low speeds.

Regulation at full load and partial load begins at a given max. speed. The centrifugal force of the flyweights (4) is getting stronger than the pressure of the regulating speed (11) and swivel lever (2) will move from housing stop (17) to the right.

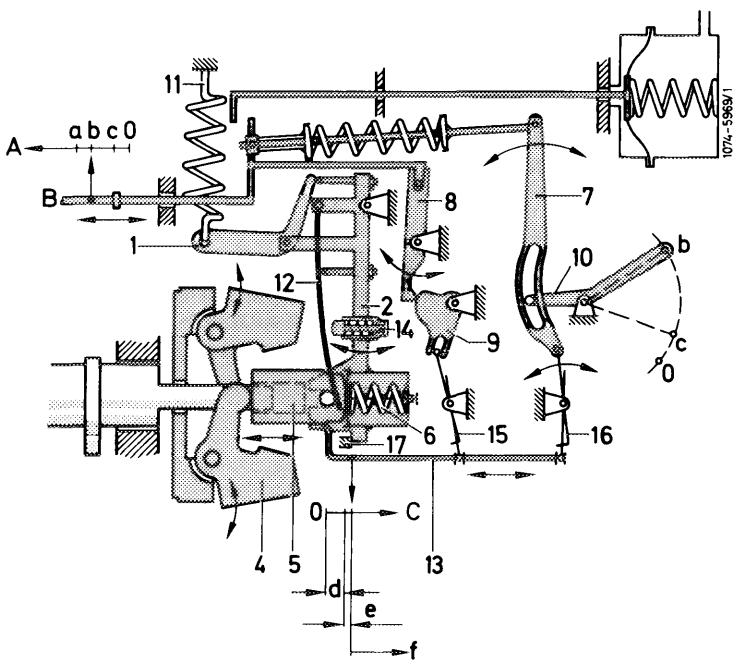
The resulting path of the sliding sleeve moves the control rod via the various transmission elements in direction of stop (0) until a given speed and injection quanty in accordance with the engine load is obtained.

If the engine load is reduced with the adjusting lever position unchanged, the speed will increase up to no load max. speed. The P-degree (proportional degree) can be determined from the difference in speed between breakaway and end of regulation (no load max. speed).

Position between idle and full load speed regulation.

Except for torque control, there is no additional regulation in this range.

Torque control serves the purpose of feeding the engine the proportionally correct amount of injected fuel for each operating point on full load curve.



2	Swivel lever	14	Tickler
4	Flyweights	16	Connecting lever
5	Sliding sleeve	A	Control path
7	Slotted lever	B	Control rod
10	Adjusting lever	a	Starting position
12	Idle speed spring	b	Full load position
13	Linkage	c	Idle speed position

Prior to control the governor is once again in the position shown in illustration. The flyweights have applied excess pressure to idle speed spring (12) and torque control spring (6) via sliding sleeve (5), so that the sliding sleeve (5) rests rigidly against swivel lever (2). When the load on engine is increased, the speed will drop; the torque control spring (6) will slide the torque control pin resting on sliding sleeve (5) in outward direction and the flyweights will come together. The path which can be travelled by the torque control spring is restricted by a stop on torque control pin. The movement of the sleeve will push the control rod forward for a given distance (torque control path) via linkage (13) and slotted lever (7), so that the quantity of the injected fuel and the torque will be increased. The operating range of the torque control is determined by the preload of the torque control spring in torque control capsule and its rigidity.

Absolutely measuring boost pressure stop (ALDA)

The ALDA equipment serves to adapt the injected fuel quantity to the prevailing boost pressure and the respective altitude. As a result, the combustion chambers will always be provided with the correct injected fuel quantity for the pertinent cylinder charge, so that the best possible efficiency during the varying operating conditions will be obtained. The ALDA capsule is connected to the boost air pipe by means of a pressure line.

Enrichment by means of boost pressure (charge-air pressure)

The ALDA equipment comprises 2 aneroid capsules (12), a compression spring (11), a connecting rod (10) and the adjustable guide lever (7). The connecting rod (10) is connected to the control rod (9) by means of the adjustable guide lever (7), lever (3) and slotted lever (4). The increasing boost pressure compresses the aneroid capsules (12) and, supported by compression spring (11), the connecting rod (10) is pulled in direction "a". As a result, the adjustable guide lever (7) will move within its adjusting range in direction "b" and will thereby push control rod (9) in direction "c" via coupling lever (3) and control lever (4). **The injected fuel quantity will be increased.**

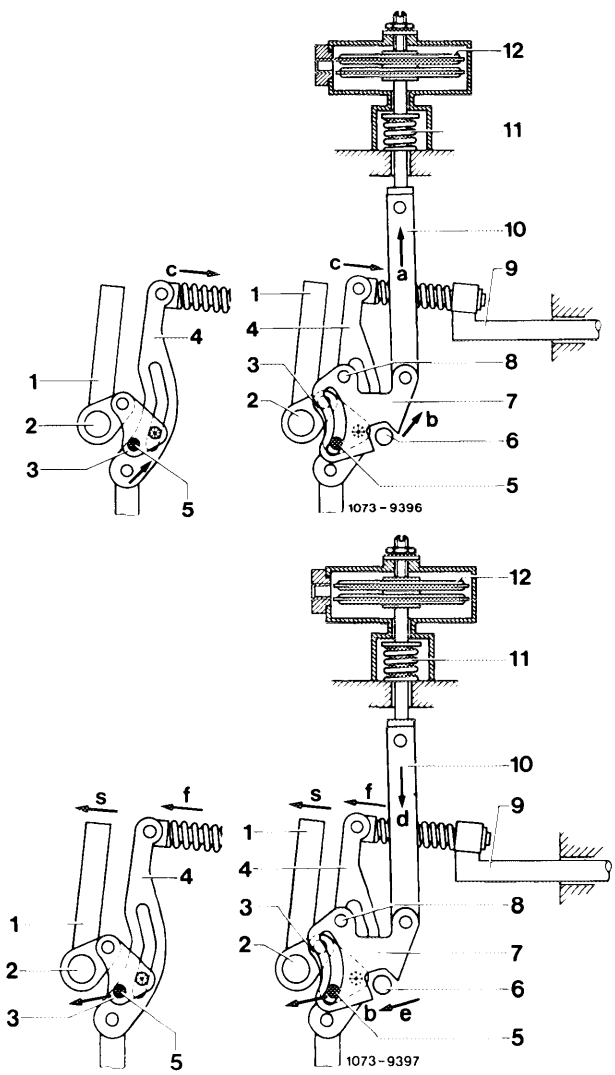
ALDA with control equipment

1 Adjusting lever
2 Adjusting lever shaft
3 Coupling lever
4 Control lever
5 Pin
6 Stop
7 Adjustable guide lever
8 Pivot (adjusting guide lever)
9 Control rod
10 Connecting rod
11 Compression spring
12 Aneroid capsules

Altitude compensation

During altitude operation, the aneroid capsules (12) will expand under influence of the reduced absolute pressure and will push connecting rod (10) in direction "d" against compression spring (11).

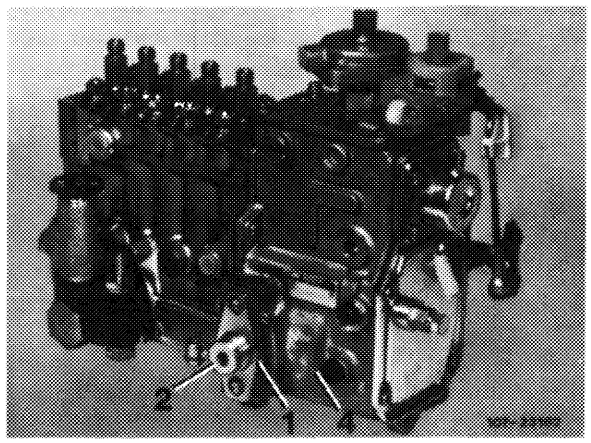
The ALDA adjustable guide lever (7) will automatically move in direction "e" and control rod (9) will consequently move over coupling lever (3) and control lever (4) in direction "f". **The injected fuel quantity will be reduced.**

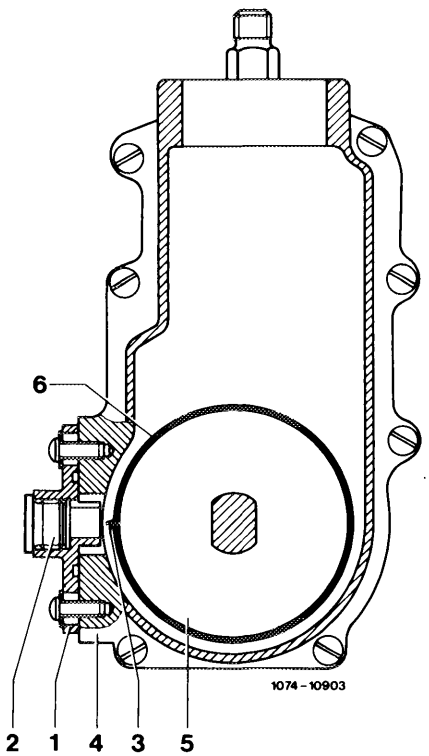


Reference impulse verification "RIV" for checking and adjusting injection timing (begin of delivery)

Instead of the static overflow method used up to now, injection timing (begin of delivery) can now be checked and adjusted with the engine running.

For this purpose, a flange (1) with closing plug (2) has been mounted outside on governor housing, and a lug (3) has been fitted to sheet metal bell (6).





1 Flange
2 Closing plug
3 Lug
4 Governor housing
5 Governor member
6 Sheet metal bell

Operation

Two signals are required to measure the association of the injection pump in relation to engine:

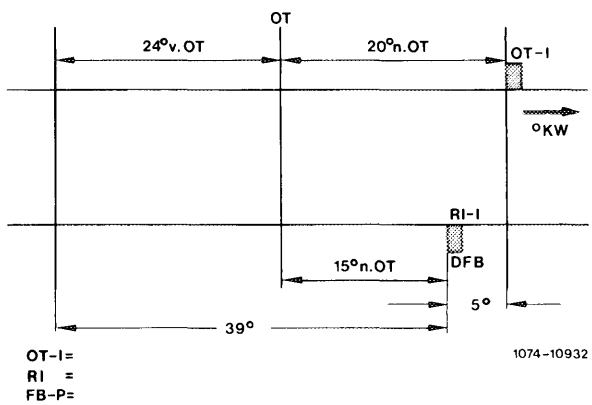
- TDC impulse from crankshaft.
- Regulating impulse from injection pump shaft.

Both impulses are supplied by inductance transmitters. To obtain a measuring signal, the transmitter pins must be moved past the inductance transmitters at a minimum speed (idle speed). A measuring instrument measures the chronological distance of the two pulses and changes the result into an angle value, which is then indicated.

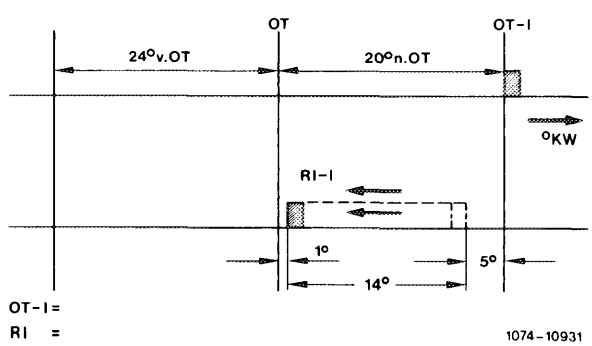
The highest measuring accuracy is attained, if the distance between the measuring impulses is relatively low.

The position of the TDC transmitter is similar to gasoline engine 20° after TDC.

The regulating impulse of the injection pump has been set to 15° after TDC.



OT-I TDC impulse
RI Regulating impulse
DFB Checking injection timing (begin of delivery)



RI Regulating impulse
OT-I TDC impulse

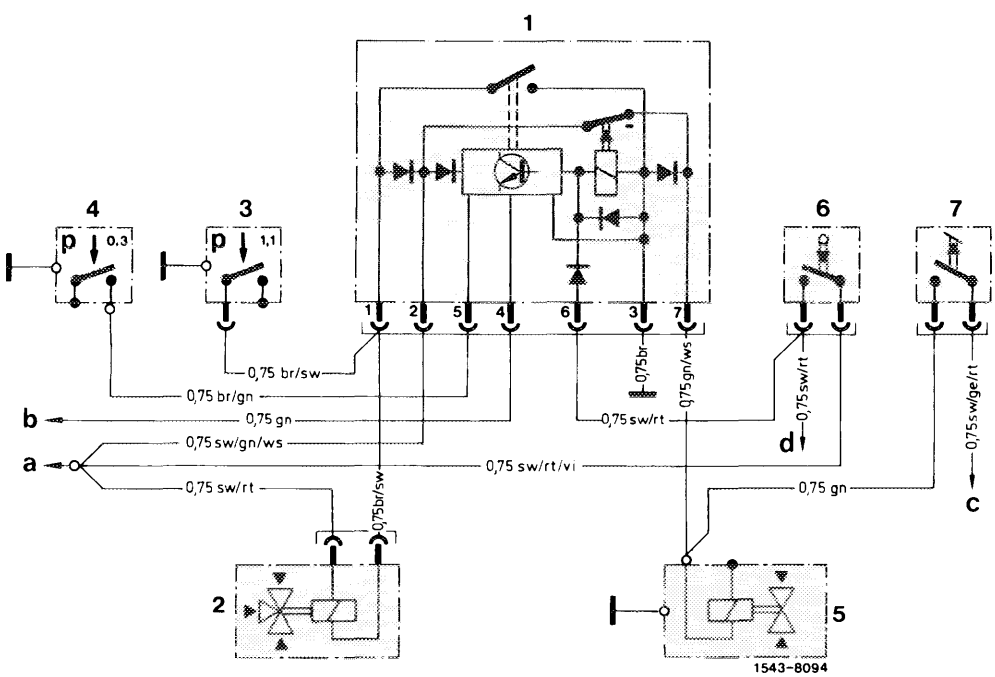
Injection timer

At increasing rpm the injection timer will set the regulating impulse in the direction of advance. The measuring value for injection timing (begin of delivery) is getting smaller and attains approx. 0°–1° at max. adjustment.

Engine-transmission overload protection

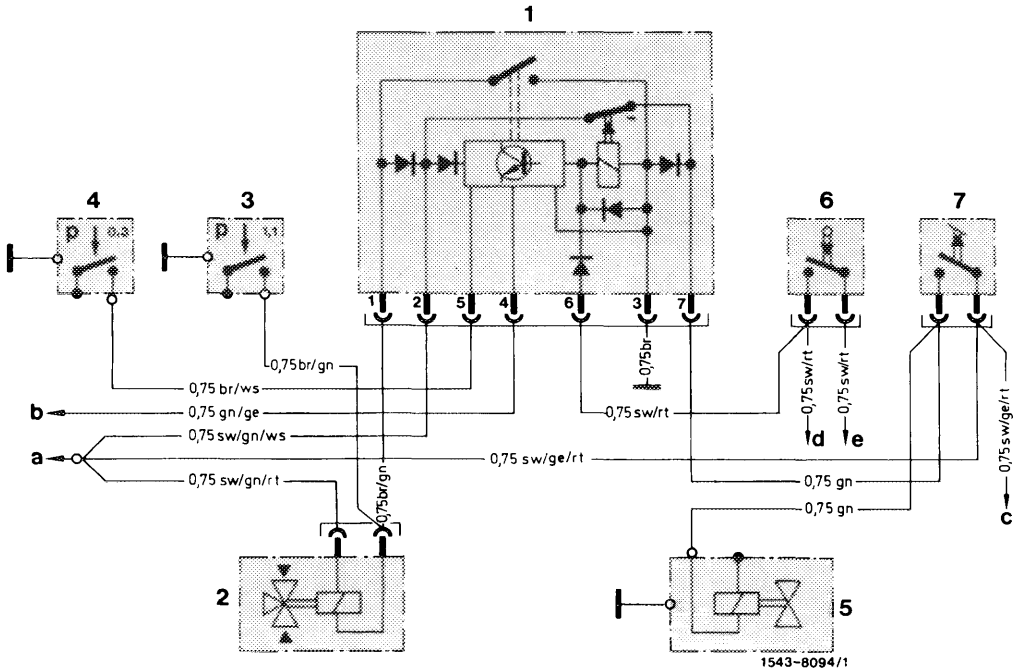
To prevent damage to engine and transmission in the event of faulty operation or during extreme situations the engine-transmission overload protection performs 3 functions:

1. Engine overload protection.
2. Transmission overload protection.
3. Shifting-down automatic transmission into 1st gear when moving off.



Circuit diagram engine-, transmission-overload switch – Model 116.120 (USA) model year 1978–1980

1 Switching unit overload protection
2 Changeover valve
3 Pressure switch boost air pipe
4 Pressure switch transmission
5 Solenoid valve automatic transmission
6 Stop lamp switch
7 Kickdown switch
a To fuse no. 4
b To revolution counter
c To clutch starter lockout switch
d To stop lamps



Circuit diagram engine-transmission overload switch — Model 123.193 standard version

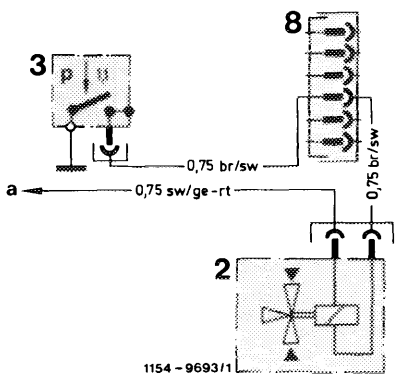
1 Switching unit overload protection
2 Changeover valve
3 Pressure switch boost air pipe
4 Pressure switch transmission
5 Solenoid valve automatic transmission
6 Stop lamp switch
7 Kickdown switch

a To fuse no. 4
b To revolution counter
c To clutch starter lockout switch
d To stop lamp switch

Engine overload protection

Model 123.193
Model 126.120 (USA) starting model year 1981

Starting model year 1981, installation of transmission 722.303 instead of 722.120 has made the transmission overload protection unnecessary. Only an engine overload protection will be installed.

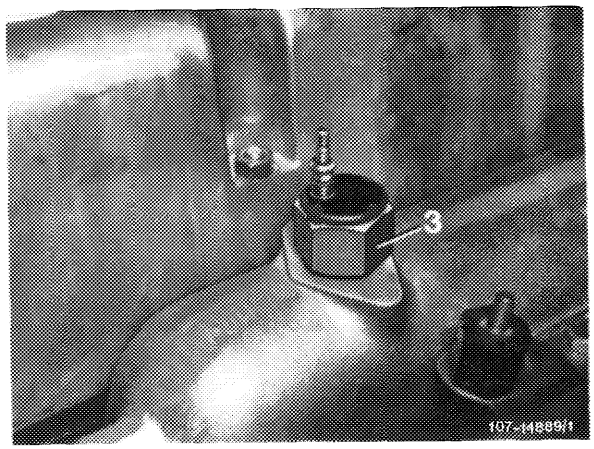


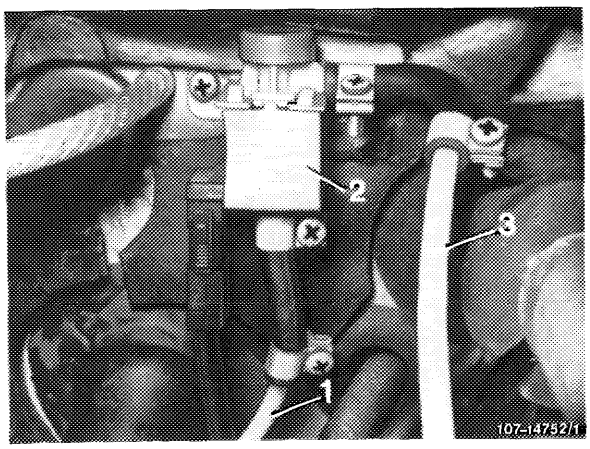
Circuit diagram engine overload protection

2 Changeover valve boost air pipe
3 Pressure switch boost air pipe
a To fuse no. 10 (terminal 15)

Engine overload protection

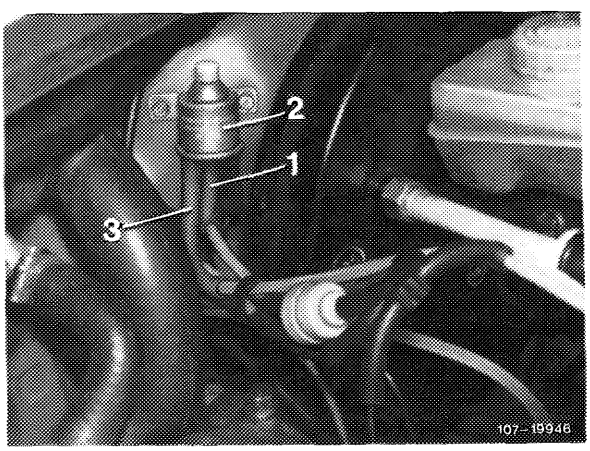
The boost air pipe is provided with a pressure switch (3) At a boost pressure above 1.1 ± 0,15 bar gauge pressure, the pressure switch will close and will connect minus (negative) to changeover valve (2), which is connected to plus (positive) via terminal 15. The changeover valve interrupts the connection boost air pipe to ALDA aneroid capsule on injection pump. The aneroid capsule is connected to atmosphere and the injection fuel quantity is thereby reduced. If the pressure drops to below 1.1 ± 0.15 bar gauge pressure, the pressure switch will again interrupt the minus (negative) connection and will connect the ALDA aneroid capsule again to boost air pipe.



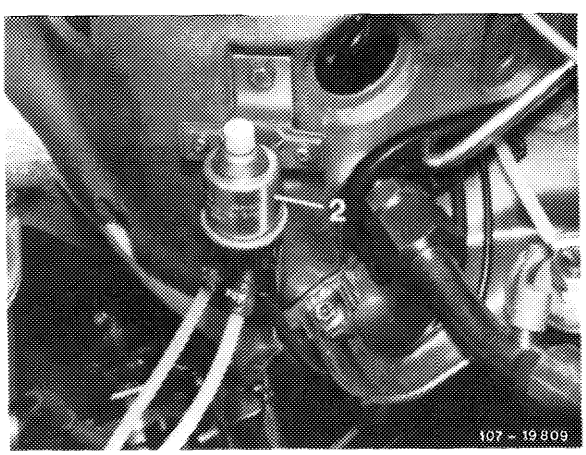


Model 116

1 Pressure line of boost air pipe
2 Changeover valve
3 Pressure line to ALDA capsule



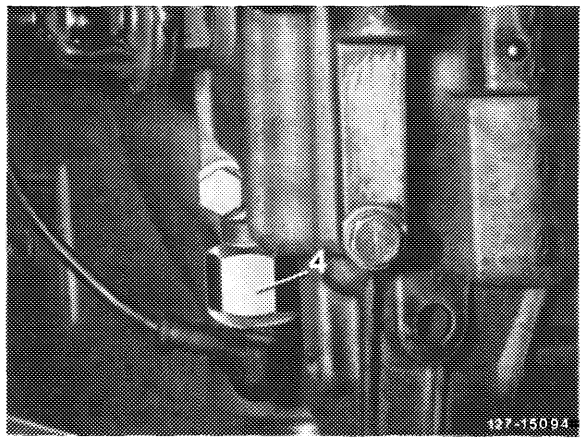
Model 123



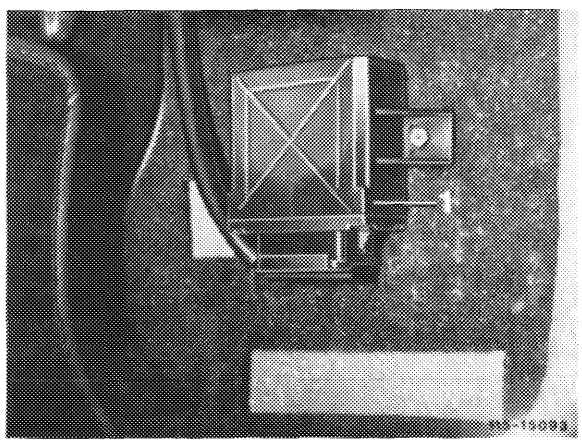
Model 126

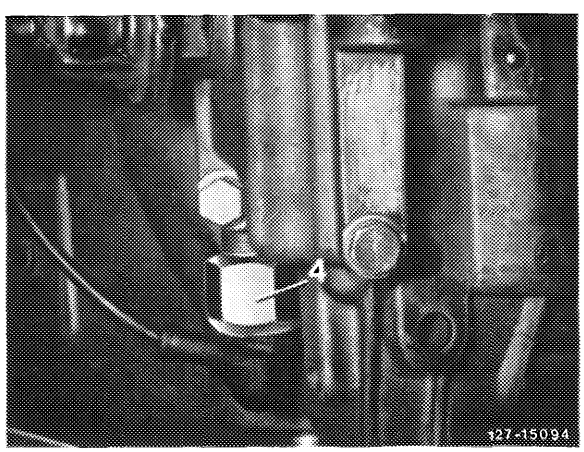
Transmission overload protection

If the pressure switch (4) is subject to a pressure below 0.3 bar gauge pressure (driving speed below approx. 8 km/h) and if the engine speed rises to above approx. 2000/min, e.g.when moving off on a high gradient with a fully loaded vehicle, the transmission may become overloaded by the high torque. A reduction of the injected fuell quantity on injection pump will prevent an engine speed increase obove approx. 2000/min.



The rpm switch in switching unit activates the changeover valve with minus (negative). Since terminal 15 provides a connection to plus (positive), the valve will switch and will provide the pressure line to ALDA capsule on injection pump with ambient pressure. This will reduce the injected fuel quantity, the engine speed will drop below 2000/min (by approx. 100/min). If engine speed drops below approx. 2000/min, the rpm switch in switching unit (1) will interrupt the minus (negative) connection at changeover valve. The valve opens the connection to boost air pipe and will close the connection of pressure line to the atmosphere. The reduction of the injected fuel quantity is cancelled and the engine speed will increase again. This regulating cycle will be repeated until the pressure at switch (4) has attained 0.3 bar gauge pressure. The pressure switch will then close and the overload protection is thereby disconnected.





Job no. of flat rates or standard texts and flat rates data 07–2053.

Testing and adjusting values (USA)

Standard version and

Model	Engine	Idle speed 1/min
116.1	617.95	700–800
123.1		
126.1		

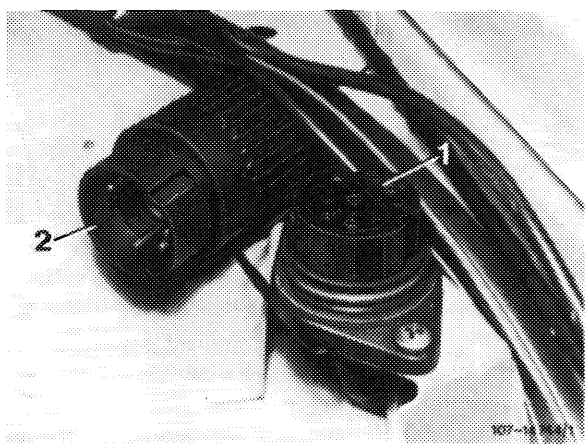
Conventional tester

Digital tester	e.g. Bosch, MOT 001.03

Note

Models 116 and 126 are provided with a revolution counter as standard equipment.

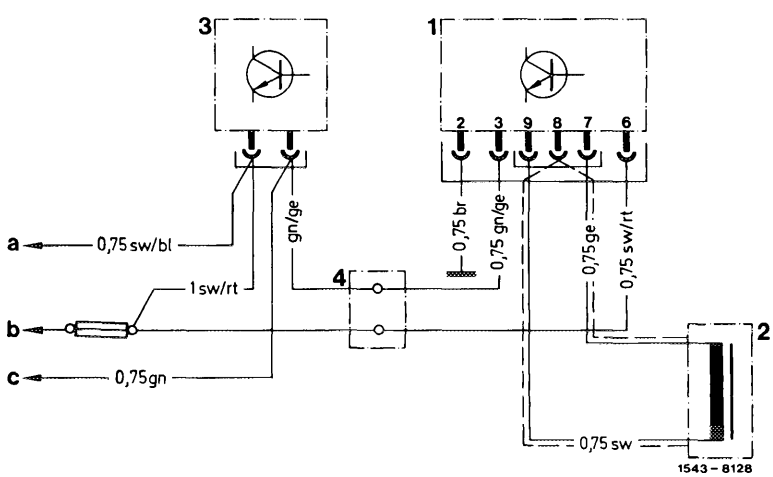
The revolution counter is activated via the transmitter adapter in the diagnostic socket. The adapter for the TDC transmitter clips into the cap on the diagnostic socket.



1 Diagnostic socket
2 TDC transmitter adapter

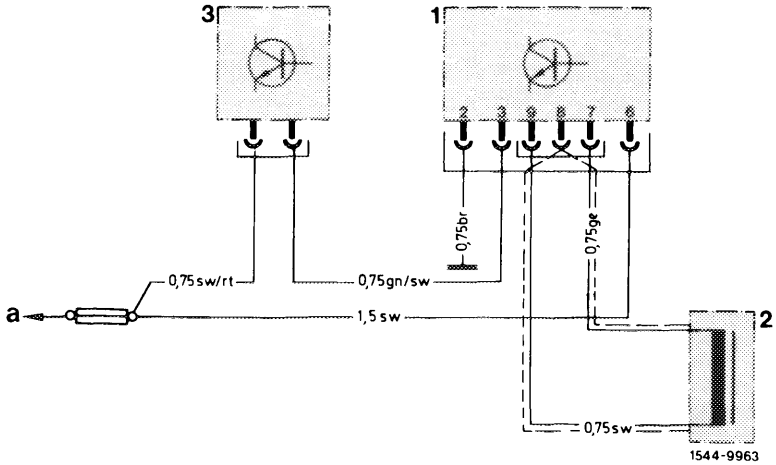
Do not adjust idle speed when engine is too hot, e.g. immediately following a fast drive or after measuring output on output dynamometer.

Model 116
Circuit diagram
Revolution counter



1 Adapter for TDC transmitter
2 TDC transmitter
3 Revolution counter
4 Cable connector
a to warning lamp, brake lining/pad wear indicator
b to terminal 15 (fuse No. 4)
c protection device

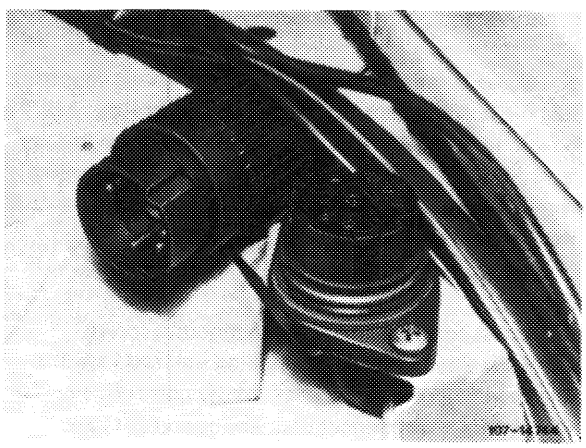
Models 123, 126
Circuit diagram
Revolution counter



1 Adapter for TDC transmitter
2 TDC transmitter
3 Revolution counter
4 Cable connector

a To terminal 15 (fuse no. 12)

Adjustment



1 Switch off air-conditioner or automatic climate control. Move selector lever to position "P".

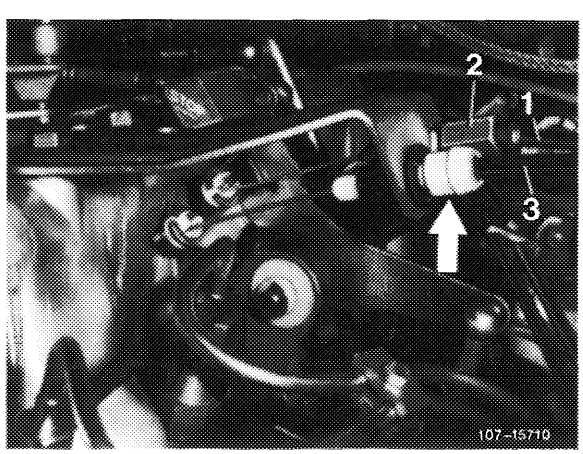
2 Connect digital tester to diagnostic socket.

3 Check control linkage for ease of movement and wear.

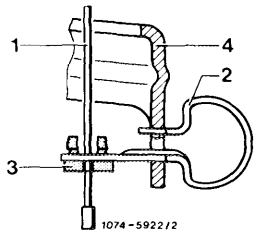
4 Run engine to 60–80 °C coolant temperature.

5 On model 116 up to model year 1979, turn idle speed adjuster completely to the right and check distance between nipple and clip on contour spring and adjust, if required. Nominal dimension = approx. 1.0 mm.

Attention:
Check whether the special form spring is fitted correctly. To do so, turn rotary knob back to left; free movement to point where idle speed rises again must not exceed approx. 1/2 turn. If necessary, adjust at screw (2).



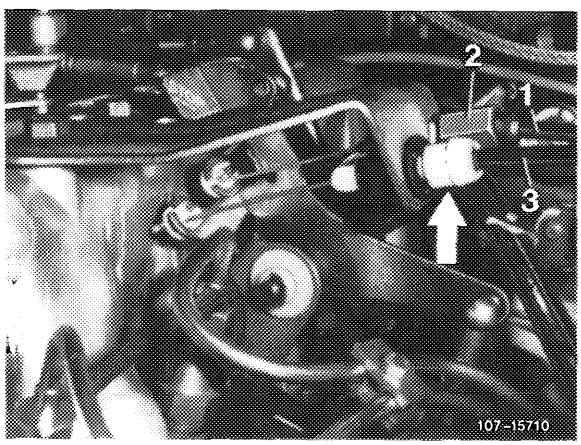
1 Bowden control cable for idle speed adjuster
2 Adjusting screw
3 Bowden wire for cruise control/tempomat



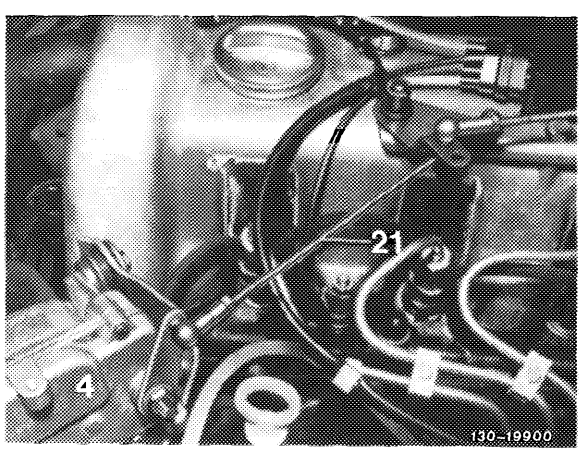
1 Control cable for idle speed correction
2 Special form spring
3 Nipple
4 Bell crank

6 Adjust tempomat (cruise control)

a) Adjust bowden wire for tempomat (cruise control). For his purpose, push shutoff lever up to stop, with bowden wire resting free of tension against regulating lever. Adjust bowden wire with adjusting nut (arrow), if required. Release shuttoff lever (idle speed position). In this position, bowden wire is subject to play.

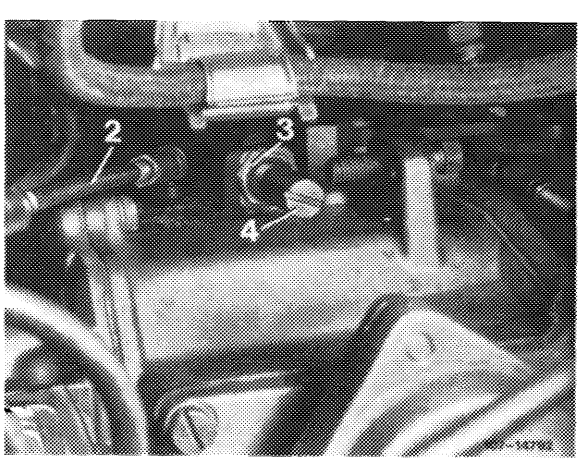


b) Adjust connecting rod for tempomat (cruise control). Check whether adjusting link rests against idle speed stop of tempomat (cruise control). For this purpose, disconnect connecting rod (21) and push lever of adjusting link (4) clockwise against idle speed stop. When attaching connecting rod (21) make sure that the lever of the adjusting link is pushed away from idle speed stop by approx. 1 mm. Adjust connecting rod, if required.



7 Detach connecting rod (2) from bell crank.

8 Check idle speed, loosen counter nut (3), if required, and adjust idle speed by means of idle speed adjusting screw (4) to 700–800/min.



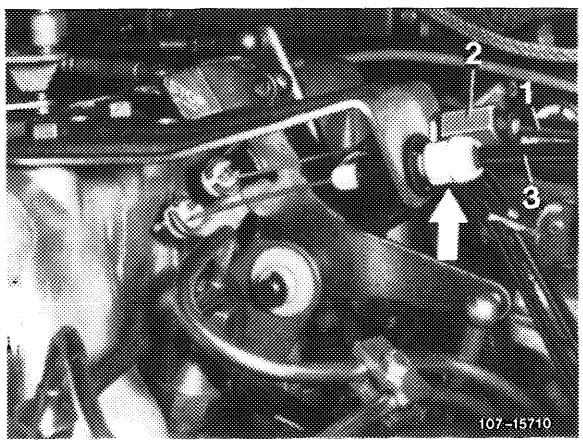
2 Connecting rod to bell crank
3 Lock-nut
4 Idle adjusting screw

9 Attach connecting rod so that it hangs freely. Adjust control linkage if necessary.

10 Move selector lever back to drive position, switch automatic air-conditioner on and turn power steering to full lock, making sure that engine runs smoothly. Adjust speed if necessary.

11 On Model 116 up to model year 1979, accelerate with accelerator pedal while simultaneously turning knob for idle speed adjuster to the left. Speed should now amount to 1000–1100/min. Adjust by means of adjusting screw (2), if required.

Attention:
The idle speed control range will be exceeded if a higher speed is set. The engine speed may then rise to maximum revolutions (at no-load).



07.1–105 Checking maximum speed at no-load

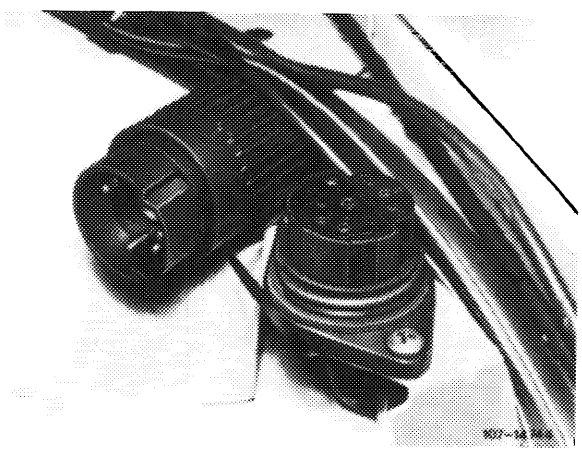
Test value

Maximum speed at no-load (end of control range)	4900–5200/min

Conventional tester

Digital tester	e.g. Bosch, MOT 001.03

Checking



1 Connect digital tester to diagnosis socket.

2 Run engine to 60–80 °C coolant temperature.

3 Slowly accelerate to full throttle at accelerator pedal and read revolution counter. Engine speed should attain 4900–5200/min.

4 If engine fails to reach specified speed, check whether pressure applied to vacuum control unit at injection pump is negative or not, disconnecting hose from control unit for this purpose. If engine still fails to reach specified speed, remove injection pump and adjust maximum speed at no-load on a Bosch injection pump test bench.

07.1–108 Checking injection timing (begin of delivery) with digital tester (RIV method)

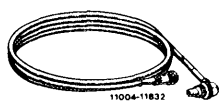
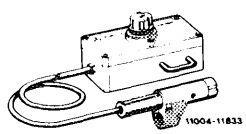
Job no. of flat rates or standard texts and flat rates data 07–8244.

Testing and adjusting value

RI-test value (indirect injection timing)	$-15^{\circ} \pm 1^{\circ}$ (after TDC)
RI-adjusting value (indirect injection timing)	-15° (after TDC)

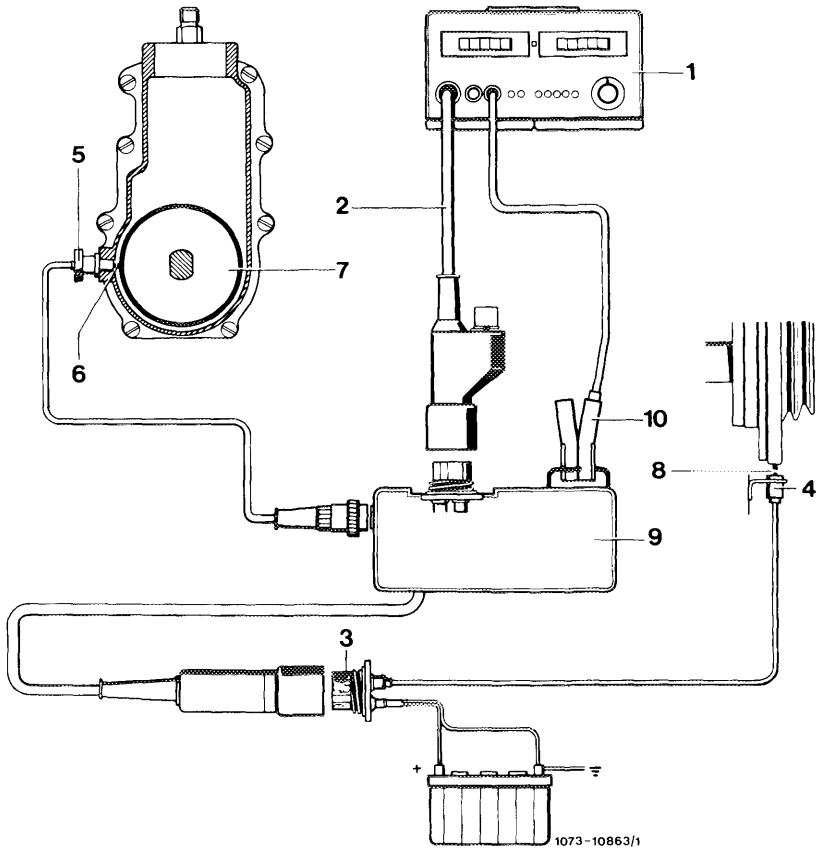
Tightening torque	Nm
Closing plug on regulator (measuring point)	30–35

Special tools

RI-transmitter		617 589 10 21 00
RI-adapter (for available digital testers)		617 589 09 21 00

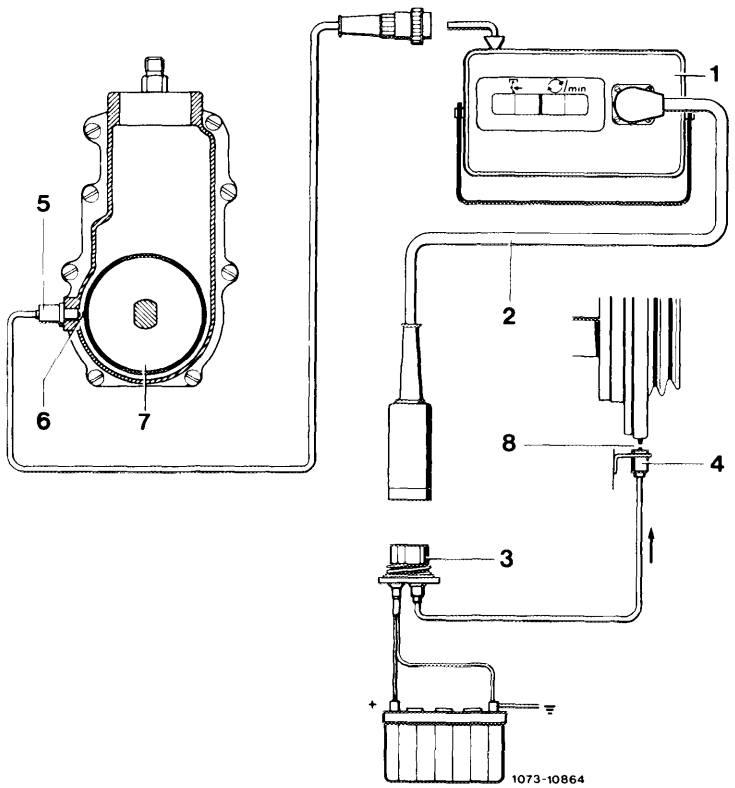
Conventional tester

Digital tester	e.g. Bosch, MOT 001.03



Connection diagram for available ignition-dwell angle testers, e.g. Bosch MOT 001.03, Hartmann & Braun EOMT 3

1 Tester
2 Test cable with plug
3 Diagnosis socket
4 TDC impulse transmitter
5 RI-transmitter
6 RI-transmitter pin
7 Regulator
8 TDC transmitter pin
9 Adapter
10 Trigger clamp



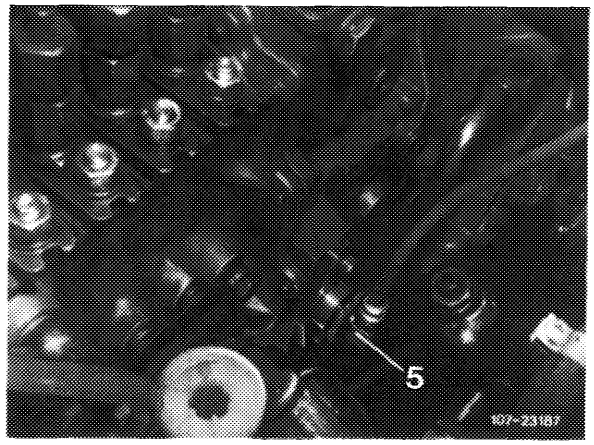
Wiring diagram with diesel tester, e.g. SUN DIT 9000, AVL diesel tester 875, Bosch EDT 019.00

1 Tester
2 Test cable with plug
3 Diagnosis socket
4 TDC impulse transmitter
5 RI-impulse transmitter
6 RI-transmitter pin
7 Regulator (injection pump)
8 TDC transmitter pin

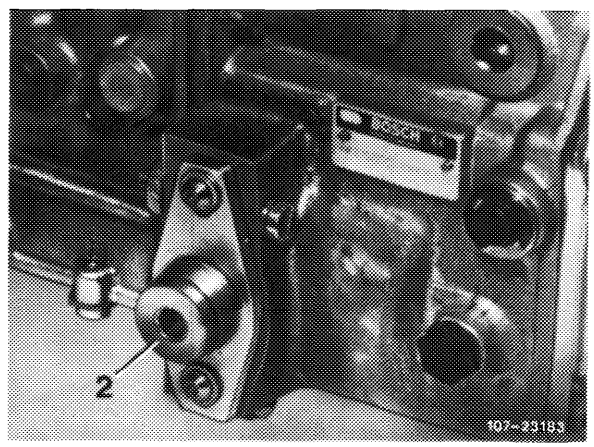
Testing

1 Connect tester according to wiring diagram.

2 Remove closing plug (2) on regulator housing, screw in RI-transmitter (5) and connect electrically with tester.



Attention!
When removing closing plug, approx. 0.2 l of engine oil will flow out. Collect oil.



3 Start engine. Read RI-value (indirect injection timing) and idle speed 700–800/min on tester.

RI-test value: $-15^\circ \pm 1^\circ$ (after TDC)

Note: If tester indicates values such as:
on Bosch MOT 001.03 -20° or $+147^\circ$ or -151
Hartmann & Braun $+67^\circ$ or -89°,
the injection pump is more than 5° too much in retard.

For adjustment refer to adjusting injection timing (begin of delivery) (07.1–114).

4 Stop engine.

5 Disconnect tester, remove RI-transmitter and screw in closing plug.

6 Run engine and check for leaks.

7 Check oil level and correct, if required.

07.1–109 Checking injection timing (begin of delivery) (high pressure method)

Job no. of flat rates or standard texts and flat rates data 07–8234.

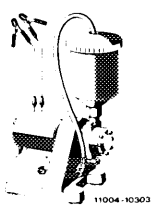
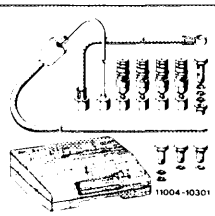
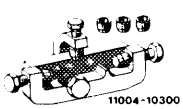
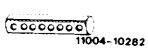
Test values

Injection timing (begin of delivery) before TDC in compression stroke	+24° +1°

Attention!
Push regulating lever of injection pump to full load while measuring and pull vacuum hose from vacuum control unit.

Tightening torque	Nm
Injection lines	25

Special tools

Box end wrench element, open 17 mm, 1/2" square for injection lines	 11004-6359	005 589 68 03 00
Pump unit, complete	 11004-10303	617 589 00 71 00
Connecting members with carrying case	 11004-10301	617 589 00 91 00
Quick lock	 11004-10302	617 589 02 91 00
Closing bracket	 11004-10300	617 589 03 91 00
Drive square 1/2", 80 mm long for rotating engine	 11004-10282	617 589 00 16 00

Conventional tool

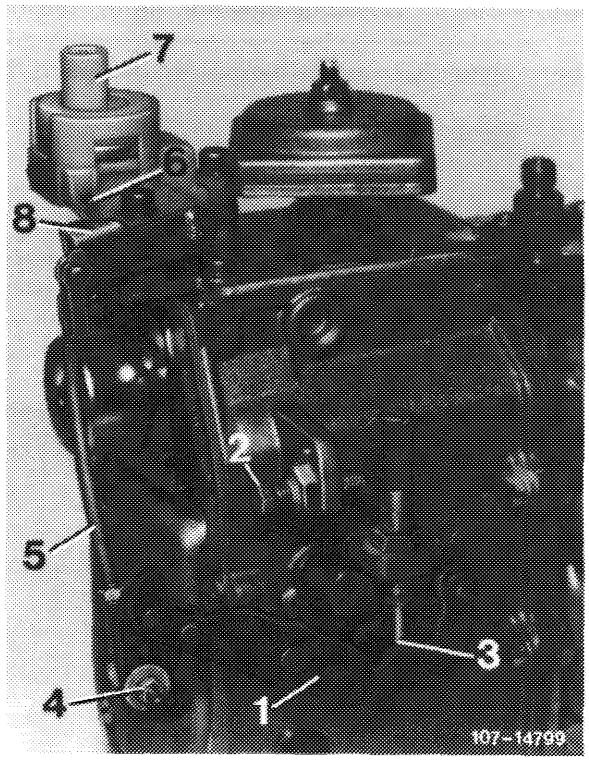
Torque wrench 1/2" square, 15–65 Nm

Checking

1 Clean injection lines in range of coupling nuts on injection pump as well as on fuel filter.

2 Set control rod of injection pump to **full load.** For this purpose, pull control lever (1) to full load stop (2).

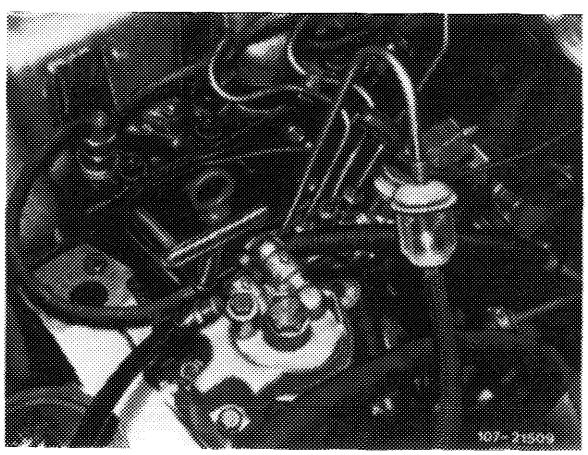
For this purpose, pull vacuum hose from vacuum control unit and lock regulating lever of injection pump to **full load.**



1 Regulating lever
2 Full throttle stop

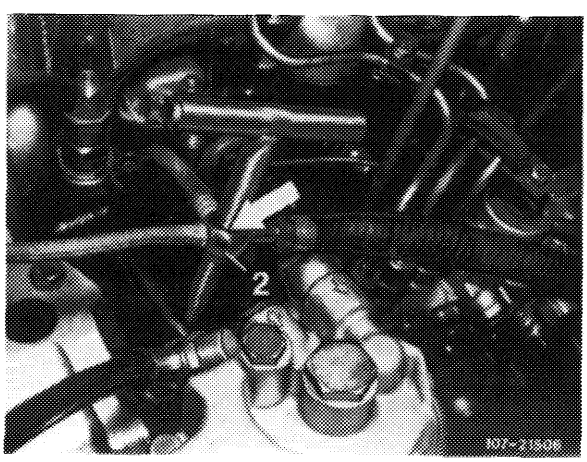
3 Unscrew injection line for cylinder 1.

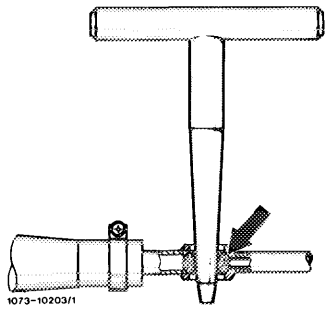
On injection pump, screw on test line with sight glass and install return line to fuel tank of pump unit.



4 Close fuel return line from injection pump to fuel filter.

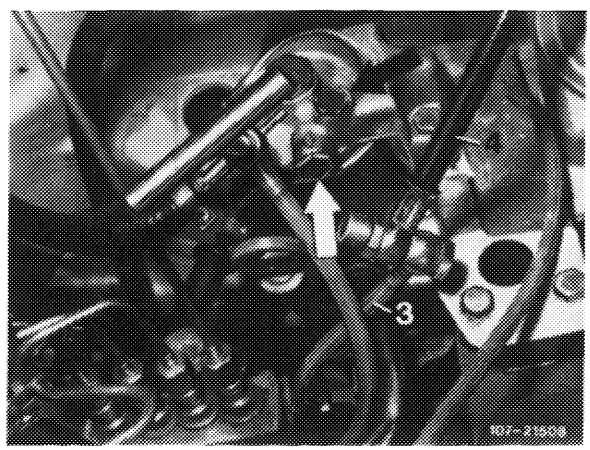
Insert O-ring into ring member (2) of return line and firmly push in quick lock.





Inserting quick lock into fuel return line

5 Connect supply line (3) for injection pump with connecting line (4) of pump unit by means of a double hollow screw. Close connecting holes on fuel filter with closing plugs (arrows).



6 Clamp connecting cable of pump unit to vehicle battery (red terminal positive, black terminal negative).

7 Rotate crankshaft in direction of rotation of engine up to approx. 35° before TDC in compression stroke of first cylinder. Engage pump unit.

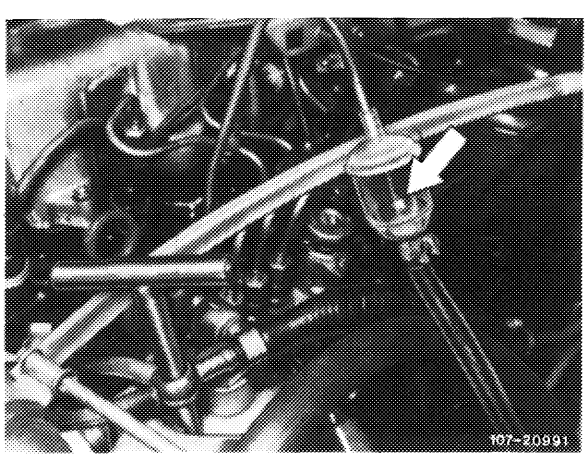
Attention!
Engage pump unit only up to measuring. In the event of a leaking injection nozzle, fuel may enter combustion chamber.

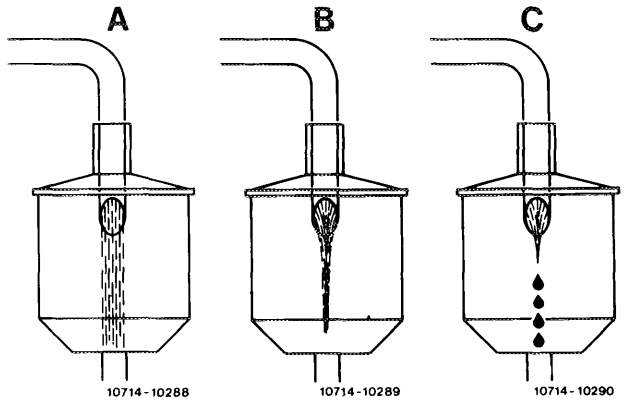
8 Slowly rotate crankshaft in direction of rotation of engine, while watching fuel jet in sight glass.

Delivery begins when the fuel jet changes over into a formation of droplets.

In this position, read begin of delivery on graduated scale on balancing disk.

Nominal value: 24° + 1°

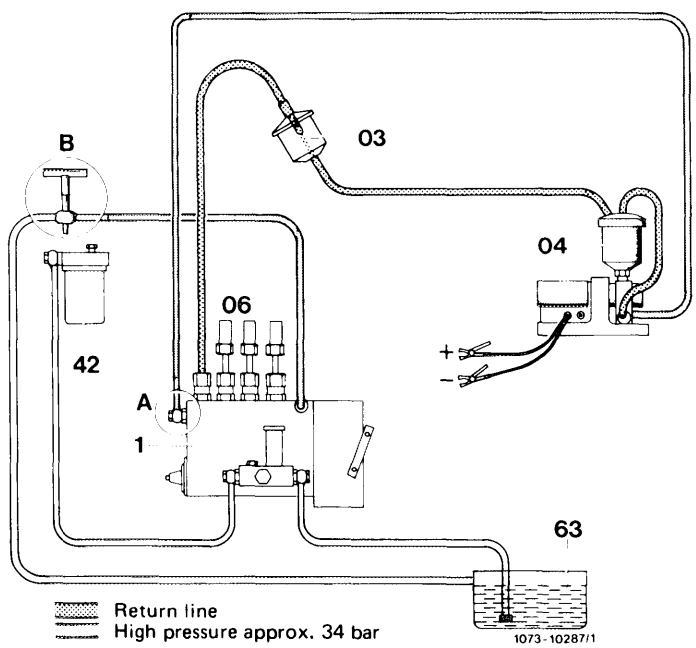




A **Full** fuel jet
B Fuel jet **constricted,** shortly before begin of delivery
C **Formation of droplets,** begin of delivery

9 Disconnect pump unit. Assemble injection system.

10 Ventilate injection system (07.1—140). Run engine and check all connections for leaks.



Connection diagram high pressure overflow method

1 Injection pump
2 Fuel filter
3 Sight glass
4 Pump unit
5 Fuel tank
A Hollow screw, fuel feed from pump unit
B Fuel return line with quick lock or closing bracket closed

07.1–110 Checking injection timing (begin of delivery) (flow pressure method)

Job no. of flat rates or standard texts and flat rates data 07–8228 or 8231.

Test value

Start of delivery before TDC in compression stroke	+24 ± 1°

Attention!
While conducting measurement, move injection pump control lever to full-load stop and disconnect vacuum hose from vacuum control unit.

Tightening torques	Nm
Pipe connection for delivery valves	40–50
Injection lines	25

Special tools

Box wrench socket open, 17 mm, 1/2" drive for injection lines	 11004-6359	000 589 68 03 00
Overflow pipe	 11004-6376	636 589 02 23 00

Conventional tool

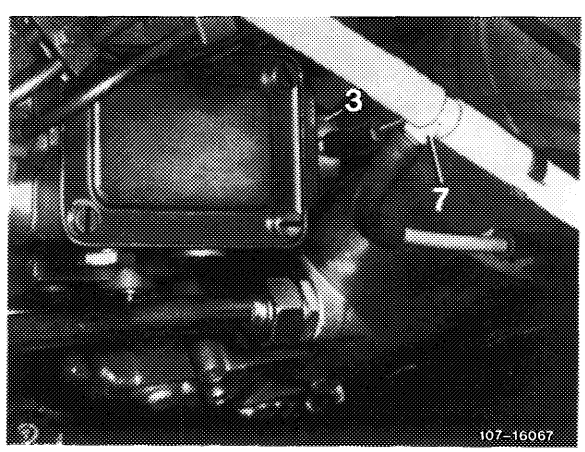
Torque wrench 1/2" drive, 15–65 Nm

Testing

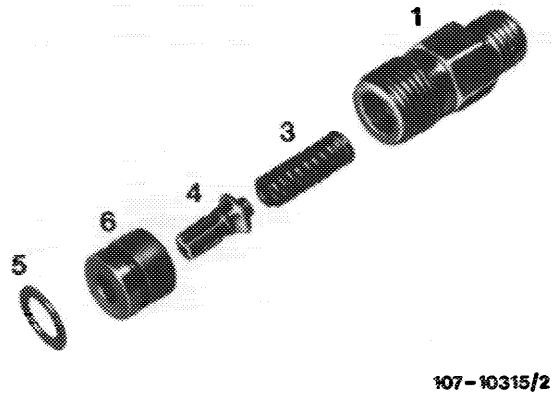
1 Clean injection pump at injection line cap nuts and pipe connections.

2 Pull vacuum line from vacuum control unit.

3 Unscrew injection line of No. 1 cylinder.



4 Unscrew pipe connection (1) of first injection pump element, removing compression spring (3) and delivery valve (4).

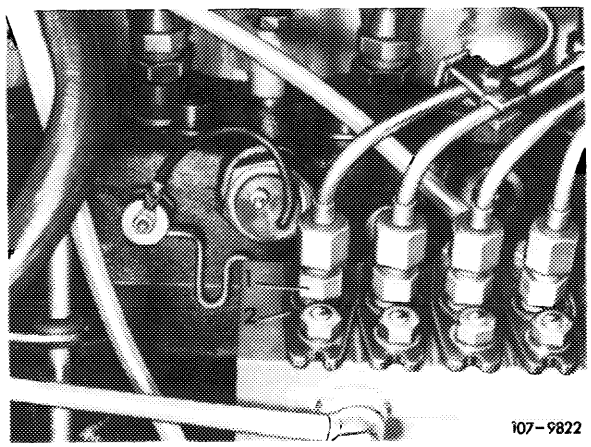


1 Pipe connection
3 Compression spring
4 Delivery valve
5 Copper sealing ring
6 Delivery valve carrier

107-10315/2

Attention:
Do not unscrew assembly (2) because injection pump will otherwise have to be re-adjusted on injection pump test rig.

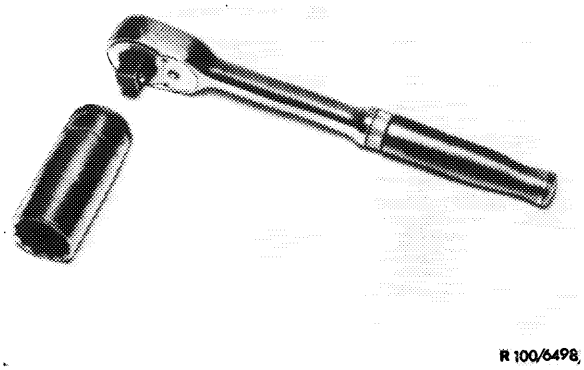
5 Screw pipe connection back in and attach overflow pipe.



1 Pipe connection
2 Element assembly

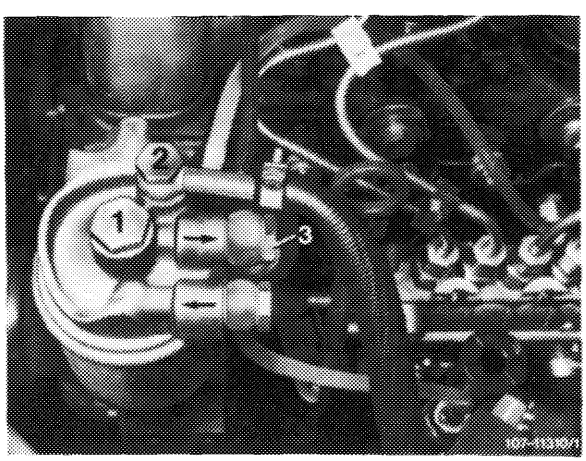
107-9822

6 Using wrench and socket, turn crankshaft in normal direction until crank angle is just short of start of delivery in compression stroke of first cylinder.

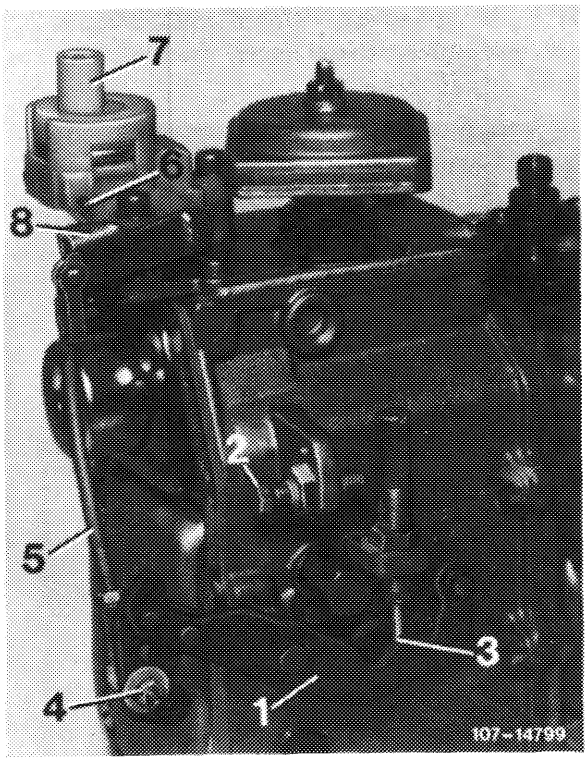


R 100/6498

7 Open union screw (2) at fuel filter and fill fuel filter using hand feed pump to make fuel run out of overflow pipe.



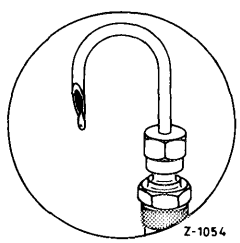
Attention:
While conducting measurement, move injection pump control lever to full load and detach vacuum hose from vacuum control unit.



1 Control lever
2 Full-load stop
3 Idle stop

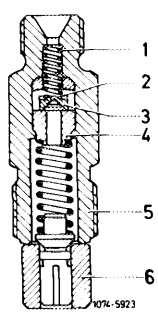
8 Turn crankshaft in direction of rotation until fuel at overflow pipe takes the shape of droplets. Droplet formation: one droplet per second.

Note: On pipe connections with relief throttles (2), no full fuel jet comes out of overflow pipe, but measuring accuracy is not influenced.



9 While maintaining this position, note start of delivery in degrees on balance disk. Adjust start of delivery if necessary (07.1–115).

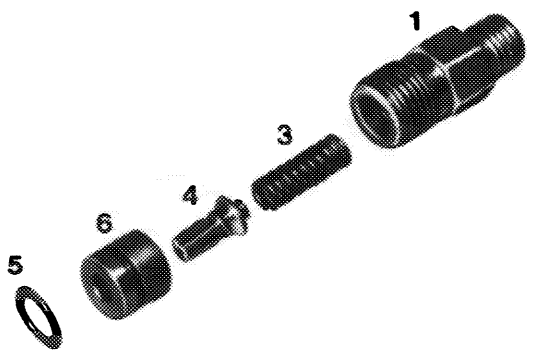
10 Unscrew overflow pipe and pipe connection.



11 Remove delivery valve holder (6), checking whether delivery valve (4) moves freely in holder (6).

12 Insert delivery valve holder (6) with annular groove pointing downward.

Attention:
The copper sealing ring (5) is located beneath the delivery valve holder and need not be exchanged.

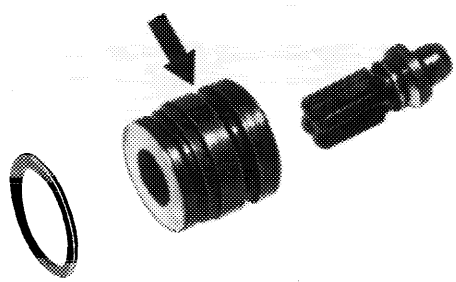


Up to Bosch production date "248" (August 1982)

1 Pipe connection
3 Compression spring
4 Delivery valve
5 Copper sealing ring
6 Delivery valve carrier

107-10315/2

Note: Starting Bosch production date "249" (September 1982) modified delivery valve carriers will be installed. On these carriers, the ring groove must be pointing upwards.



Starting Bosch production date "249" (September 1982)

Arrow = modified version with additional ring groove

107-25354

13 Slightly lubricate threads of pipe connection (1), screw-in and tighten to 40–50 Nm in **one step.**

14 Fit injection line and vent injection system (07.1–140).

15 Run engine and check all connections for leakage. Any pipe connection that is leaking has to be exchanged. In this case, remember to **exchange copper sealing ring beneath delivery valve holder** (07.1–210).

07.1–111 Checking injection timing (begin of delivery) (position indicator RIV method)

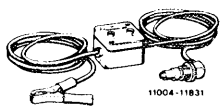
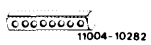
Job no. of flat rates or standard texts and flat rates data 07–8240.

Testing and adjusting value

RI-test value (indirect injection timing)	–15° ± 1.5° (after TDC)
RI-adjusting value (indirect injection timing)	–15° (after TDC)

Tightening torque	Nm
Closing plug on regulator (measuring point)	30–35

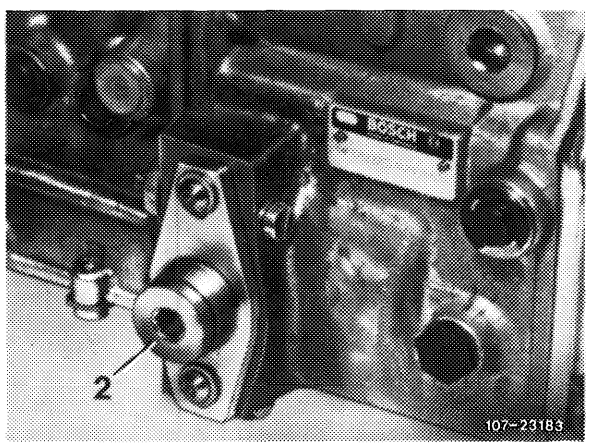
Special tools

Position indicator	 11004-11831	617 589 08 21 00
Drive square 1/2", 80 mm long for rotating engine	 11004-10282	617 589 00 16 00

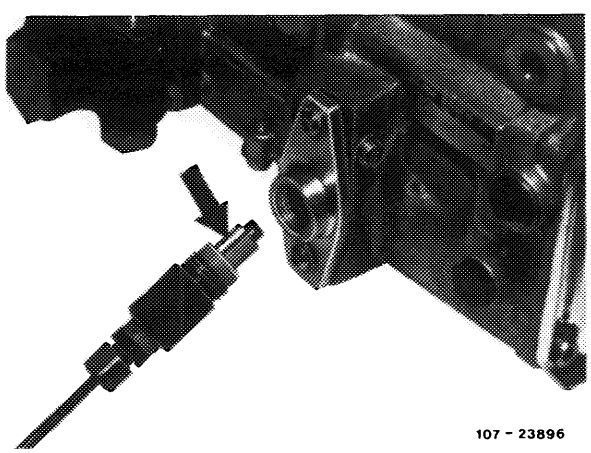
Checking

1 Remove closing plug (2).

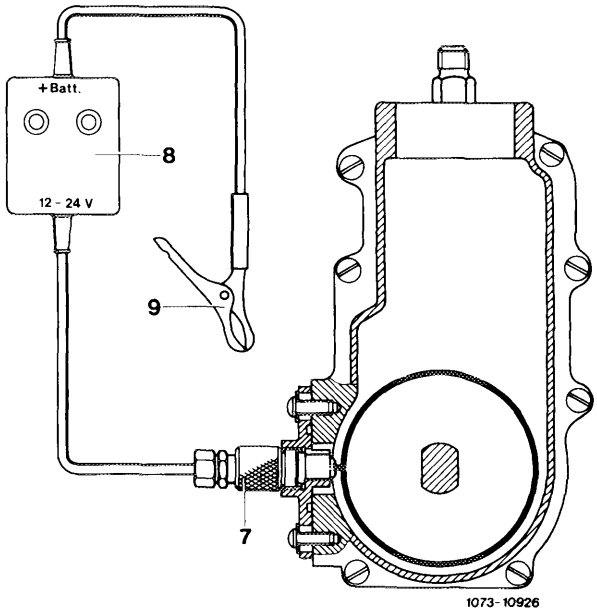
Attention!
When removing closing plug approx. 0.2 l engine oil will flow out. Collect oil.



2 Slip position transmitter into regulator housing. Make sure that the guide pin of position indicator (arrow) is pointing upward. Tighten coupling nut manually.



3 Connect indicating unit according to wiring diagram.

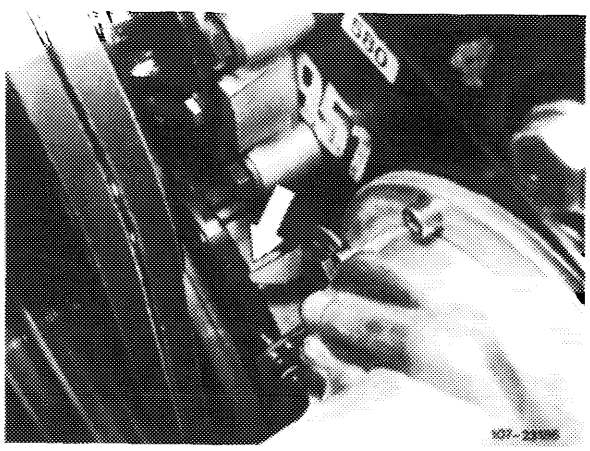


7 Position indicator
8 Indicating unit
9 Battery terminal (battery +)

4 Rotate engine manually (in direction of rotation only) until lamp "A" lights up. Carefully continue rotating engine until **both lamps** are lighting up ("A and B"). In this position, read begin of delivery on graduated scale.

RI-value: -15° after TDC

If only lamp "B" lights up, repeat checkup.



5 Remove position indicator, screw in closing plug.

6 Perform leak test with engine running. Check engine oil level or correct, if required.

07.1–114 Adjusting injection timing (begin of delivery) with digital tester (RIV method) – following checkup

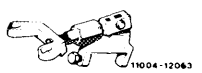
Job no. of flat rates or standard texts and flat rates data 07–8300.

Testing and adjusting value

RI-adjusting value (indirect injection timing)	–15° after TDC

Tightening torque	Nm
Closing plug on regulator (measuring point)	30–35

Special tool

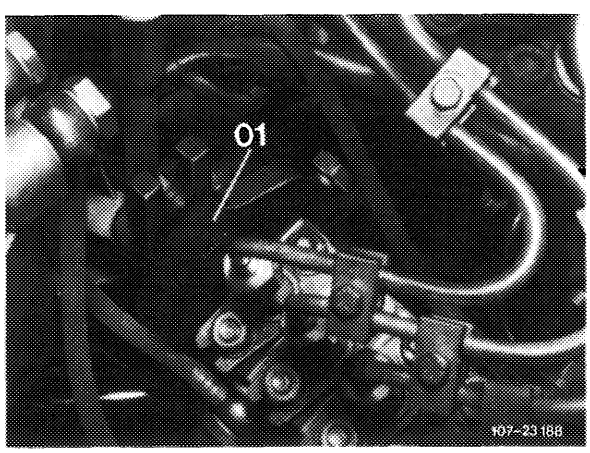
Adjusting device		617 589 07 21 00

Note

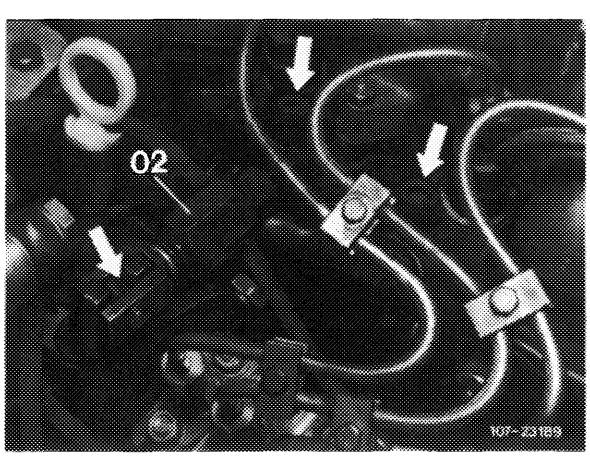
Prior to adjustment, check ignition timing (07.1–108).

Adjusting

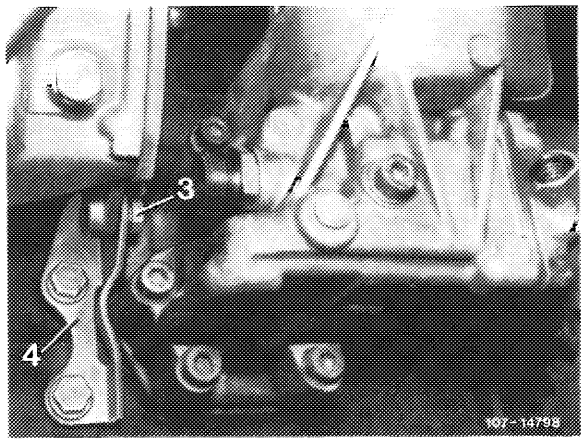
1 Mount holding bracket (01) on injection pump housing.



2 Place adjusting device (02) on cylinder head screws and holding fork (arrows).



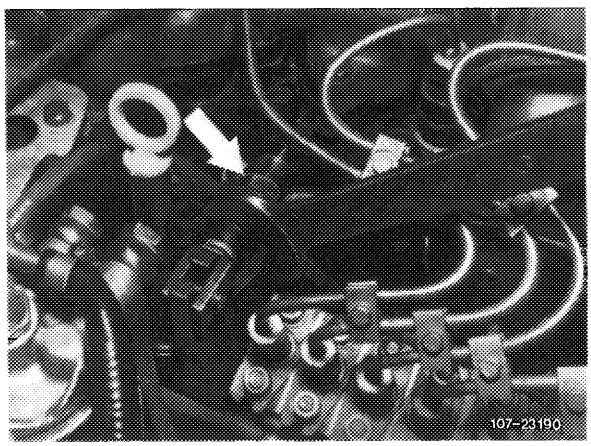
3 Loosen nuts on injection pump flange as well as screws (3) on supporting bracket (4).



3 Screw
4 Supporting bracket

4 Adjust begin of delivery at idle speed by turning hex. head screw (arrow).

RI-value: -15° after TDC.



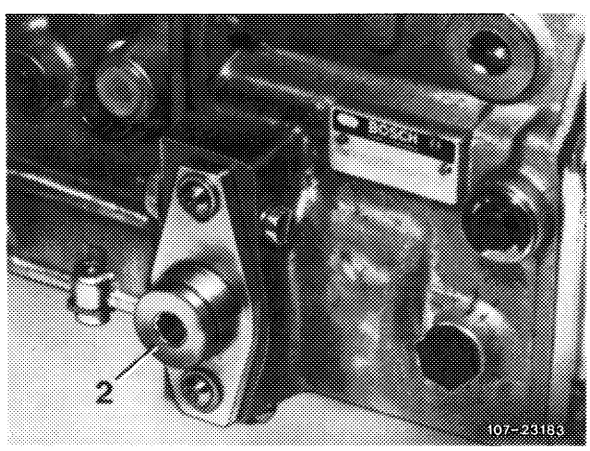
Swivelling direction of injection pump

Toward engine = delivery begins earlier
Away from engine = delivery begins later

5 Tighten nuts and screw for injection pump. Check preset value.

6 Stop engine.

7 Disconnect tester and RI-transmitter. Screw in closing plug (2) and tighten to 30–35 Nm.



8 Run engine and check for leaks.

9 Check oil level and correct, if required.

07.1–115 Adjusting injection timing (begin of delivery) (high pressure method) – following checkup

Job no. of flat rates or standard texts and flat rates data 07–8300.

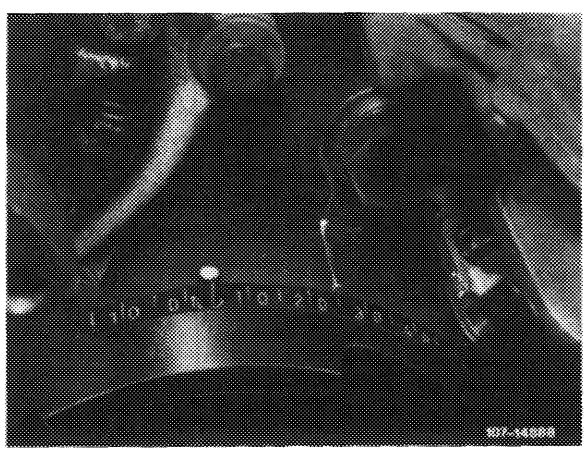
Special tool

Socket element 13 mm, 3/8" square		000 589 21 07 22

Preparation for checkup

Prior to adjustment, check begin of delivery (07.1–109 or 07.1–110).

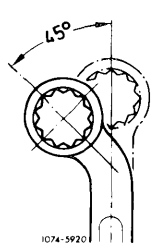
A. Preparing for adjustment



1 Set crankshaft in direction of rotation to 24° + 1° before TDC in compression stroke of first cylinder.

2 Loosen fastening nuts on injection pump flange and nut or screw on supporting bracket.

For loosening and tightening of fastening nuts or screws on supporting bracket, use self-bent box end wrench 13 mm.

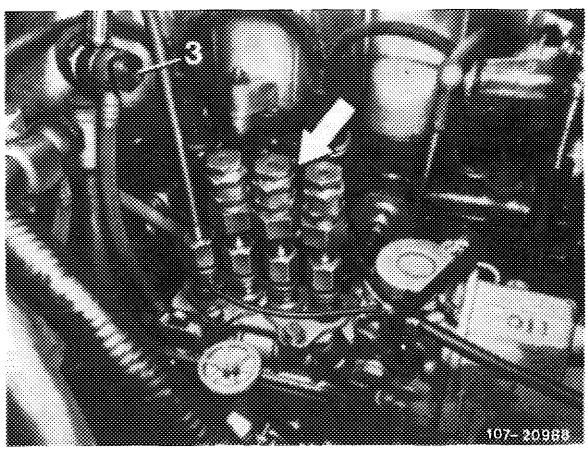


B. Adjustment (high pressure method)

1 Unscrew all injection lines.

2 Screw pressure limiting valves (arrow) on pipe connections of injection pump.

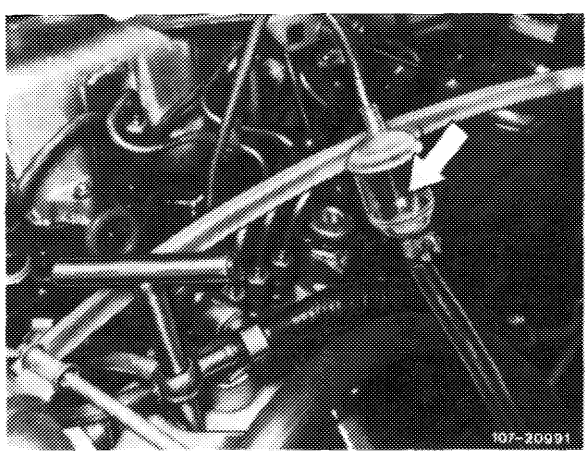
The pressure limiting valves are required to protect the injection pump, e.g. when cranking with starter.



3 Switch on pump unit.

4 Swivel injection pump while watching fuel jet.
Begin of delivery is attained, when the fuel jet changes into a formation of droplets (arrow).

Nominal value: 24° + 1° before TDC.



Swivel direction of injection pump

Toward engine = advances begin of delivery
Away from engine = retards begin of delivery

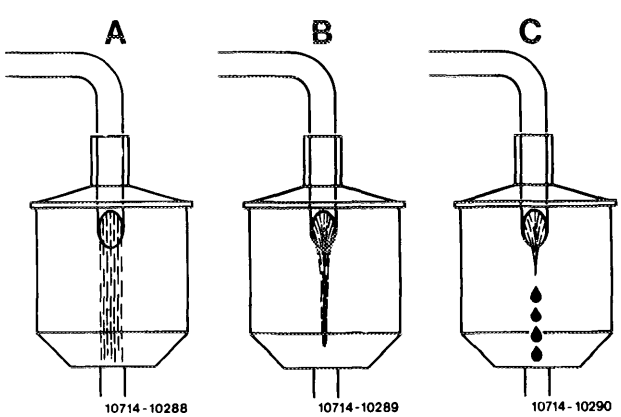
Note: If possibilities for adjustment are insufficient, the injection pump must be changed over.

5 Check begin of delivery once again.

6 Shut off pump unit.

7 Assemble injection system.

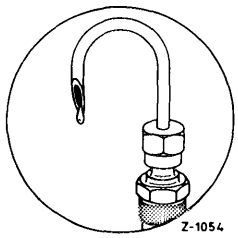
8 Vent injection system (07.1–140). Run engine and check all connections for leaks.



A Fuel jet **full**
B Fuel jet **constricted** prior to begin of delivery
C **Formation of droplets** begin of delivery

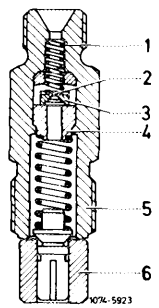
C. Adjustment (low pressure method)

1 Swivel injection pump until fuel changes to droplets at overflow pipe. Formation of droplets: One droplet per second.



Attention!
While measuring, push regulating lever of injection pump to full load and pull vacuum hose from vacuum control unit.

Note: On pipe connections with relief orifice (2), no full fuel jet will come out of overflow pipe. However, measuring accuracy will not be impaired.



Pipe connection MW-injection pump

Swivelling direction

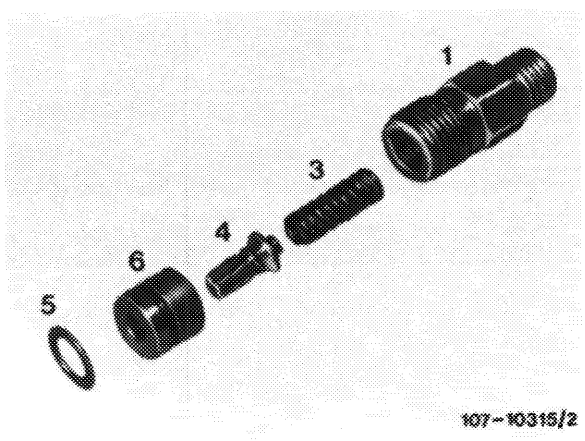
toward engine = advances begin of delivery,
away from engine = retards begin of delivery.

Note: Injection pump will have to be relocated if adjustment is inadequate (07.1–205).

2 Attach injection pump and recheck begin of delivery.
Install damper, adjust (07.1–200).

3 Attach injection pump.

4 Unscrew overflow pipe and pipe connection.



1 Pipe connection
3 Compression spring
4 Delivery valve
5 Copper sealing ring
6 Delivery valve holder

5 Fit pipe connection.

Remove delivery valve holder (6), checking whether delivery valve (4) moves freely in holder (6).

Insert delivery valve holder (6) with annular groove pointing downward.

Attention!
Starting with Bosch production date "249" (September 1982) the annular groove should point upwards.

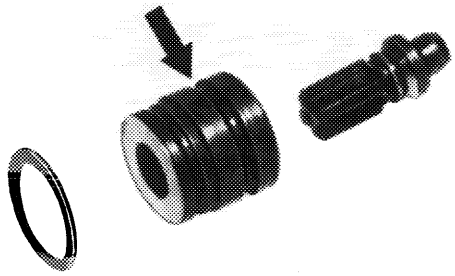
The copper sealing ring is located beneath the delivery valve holder and need not be exchanged.

Smear thread of pipe connection (1) with oil, insert connection and torque to 40–50 Nm in **one step.**

6 Fit injection lines and vent injection system (07.1–140).

7 Check throttle linkage and adjust, if required (30–300).

8 Run engine and check all connections for leakage. Any pipe connection that is leaking has to be exchanged. In this case **exchange copper sealing ring beneath delivery valve holder** (07.1–210).



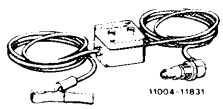
107-25354

07.1–116 Adjusting injection timing (begin of delivery) (position indicator RIV method) – following checkup

Job no. of flat rates or standard texts and flat rates data 07–8300.

Testing and adjusting value	
RI-adjusting value (indirect injection timing)	–15° (after TDC)

Tightening torque	Nm
Closing plug on regulator (measuring point)	30–35

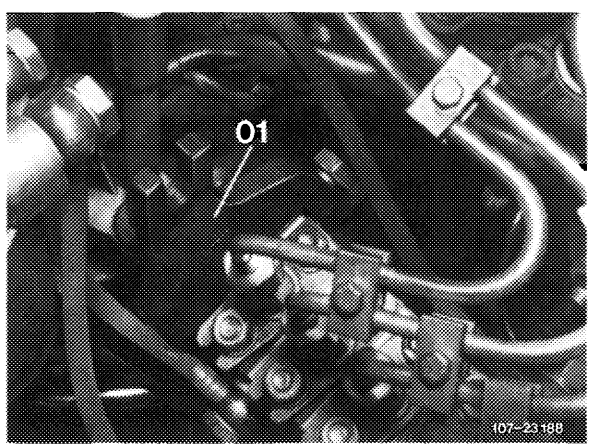
Position indicator		617 589 08 21 00

Note

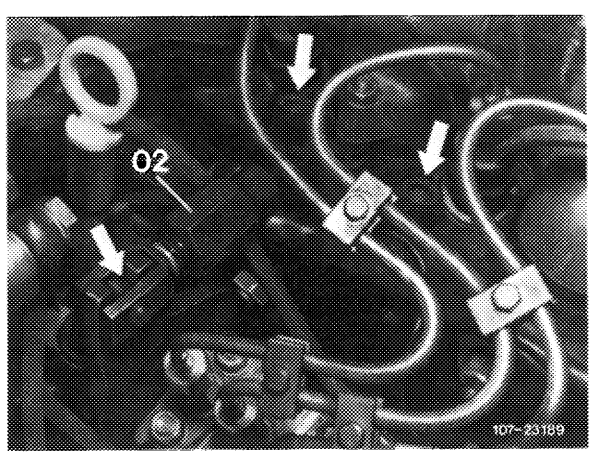
Check begin of delivery prior to adjustment (07.1–111).

Adjusting

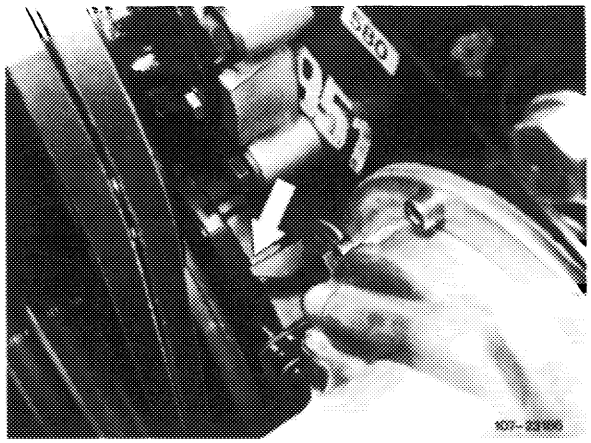
1 Mount holding bracket (01) on injection pump housing.



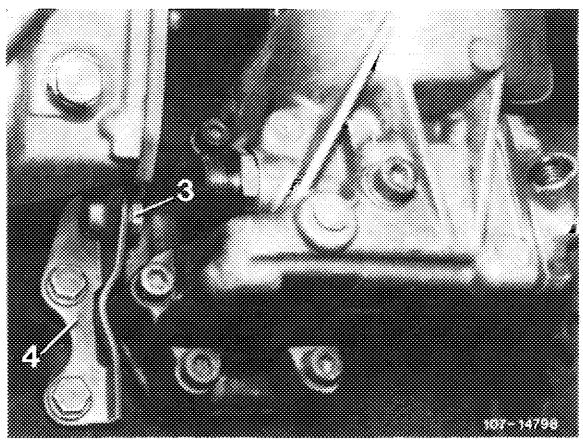
2 Place adjusting device (02) on cylinder head screws and holding fork (arrows).



3 Rotat crankshaft once in direction of rotation and set to −15° after TDC.

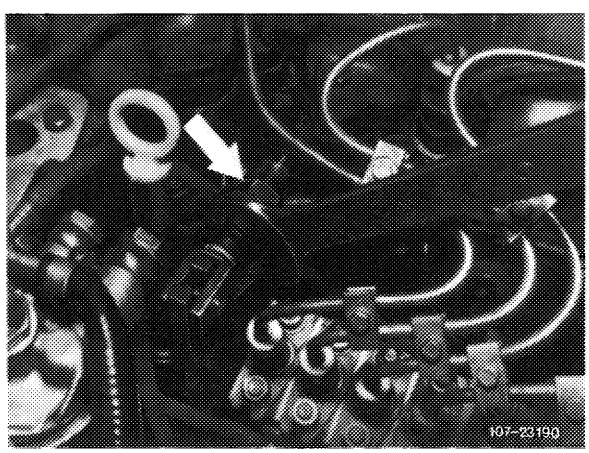


4 Loosen nuts on injection pump flange as well as screws (3) on supporting bracket (4).



3 Screw
4 Supporting bracket

5 Adjust begin of delivery by turning hex. head screw (arrow) (−15° after TDC).



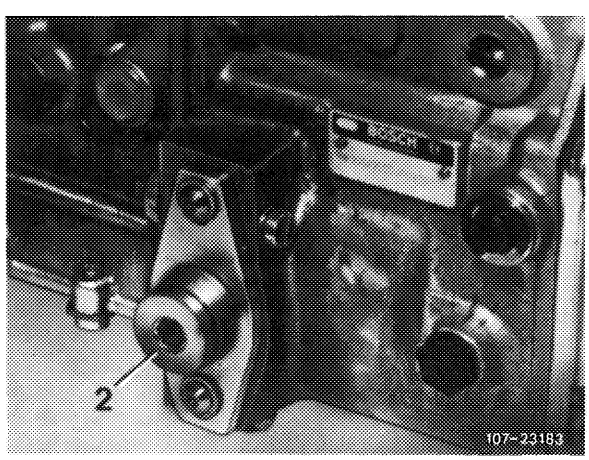
Swivelling direction of injection pump

Toward engine = advances begin of delivery
Away from engine = retards begin of delivery

6 Tighten nuts and screw for injection pump and check preset value.

7 Run engine and check for leaks.

8 Check oil level and correct, if required.



07.1–135 Checking injection nozzles

Job no. of flat rates or standard texts and flat rates data 07–6712.

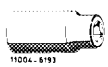
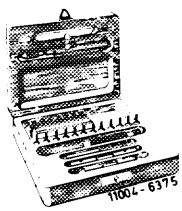
Test values injection nozzles

Bosch designation	Injection pressure in bar positive [1] for new injection nozzles	for used injection nozzles, min.
DNO SD 2400 DNO SD 240[2]) DNO SD 240/[3])	135–143	120

[1]) The difference between any two injection nozzles within one engine must not exceed 5 bar positive.
[2]) Starting production code no. 928 or 041.
[3]) Starting November 1981 with center bore 0.20 mm dia. (formerly 0.15 mm dia.)

Tightening torques	Nm
Injection nozzles, upper and lower parts	70–80

Special tools

Socket 27 mm, 1/2" drive		001 589 65 09 00
Cleaner		000 589 00 68 00

Conventional tools

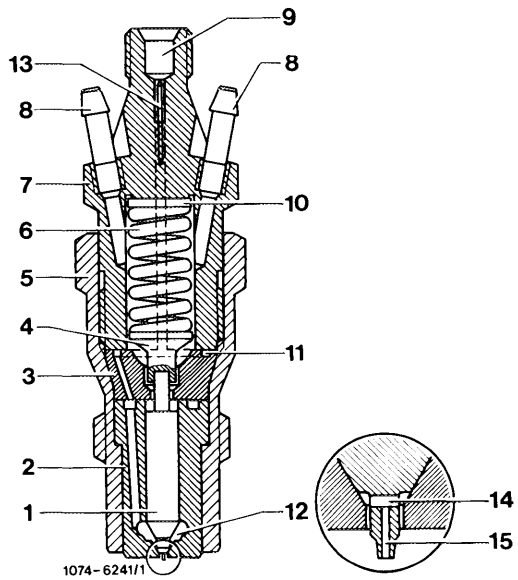
Torque wrench 1/2" drive, 40–130 Nm	
Tester EFEP 60 H	e.g. Bosch, D–7000 Stuttgart Order No. 0 681 200 502
Cleaning needles 0.13 mm dia.	e.g. Bosch, D–7000 Stuttgart Order No. KDEP 2900/3
Cleaning needles 0.18 mm dia.	e.g. Bosch, D–7000 Stuttgart Order No. KDEP 2900/5

Note

For testing always use clean testing oil or filtered diesel fuel. **Be sure never to hold your hand in the jet from an injection nozzle.** For the jet would penetrate your skin, destroy the tissue beneath, enter your bloodstream and possibly give you blood poisoning.

Attention:
Be sure to close the pressure gage tap for checking jet and rattling noise because pressure gage may otherwise be damaged by excessive increase in pressure.

The engine is equipped with a center hole pintle nozzle which is distinguished from the standard pintle by a cross hole and a center hole (14 and 15) in the thrust pin. Moreover, a maintenance-free edge filter (13) is pressed into upper part (7) of the injection nozzle holder.

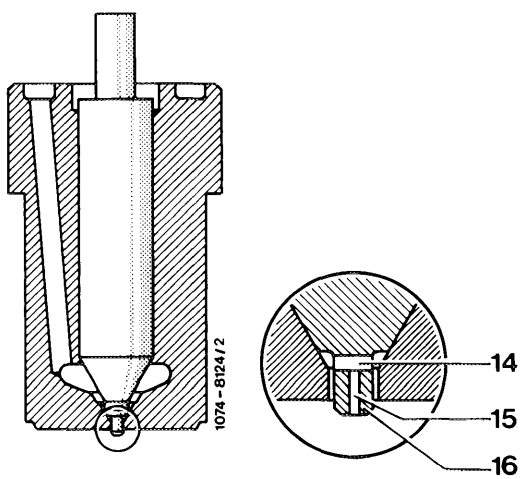


1 Needle valve
2 Nozzle body
3 Nozzle holder insert
4 Thrust pin
5 Injection nozzle holder, lower part
6 Compression spring
7 Injection nozzle holder, upper part
8 Leak-off connection
9 Fuel inlet
10 Steel shim
11 Annular groove and inlet ports
12 Pressure chamber in nozzle body
13 Edge filter
14 Cross hole
15 Center hole

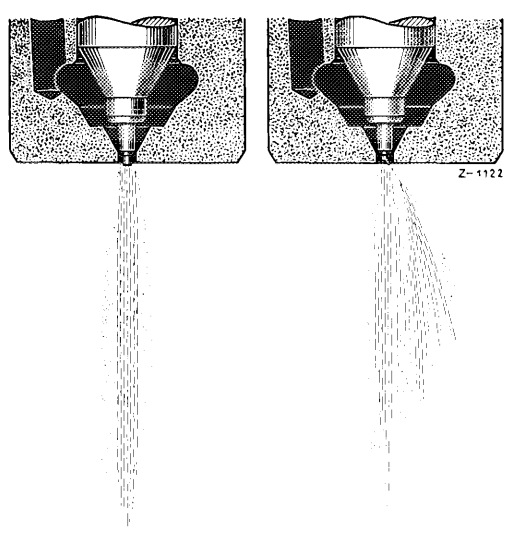
Checking

1 Prior to checking: Check center hole (47) with cleaning needle of 0.18 mm dia. for passage. On nozzles with 0.15 mm ID, check pintle with cleaning needle 0.13 mm dia. for passage.

2 Thoroughly pump injection nozzle 5 times on tester. Then check **buzzing,** actuating hand lever slowly for this purpose (at least 1 stroke per second).



3 **Check jet:** At short, fast partial strokes (at least 2 strokes per second) the jet must be rather closed and break well.

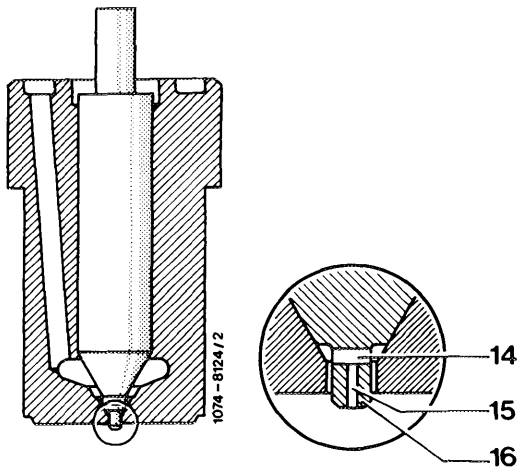


A Jet pattern closed and well atomized
B Jet pattern torn up, too wide and spreading

4 Establish **initial jet** by moving hand lever slowly down (4–6 s/stroke).

A vertical cord-like jet must come out of center hole (15).

Note: On new nozzles, the initial jet is very difficult to produce, for this reason check center hole with cleaning needle 0.18 mm dia. for passage.

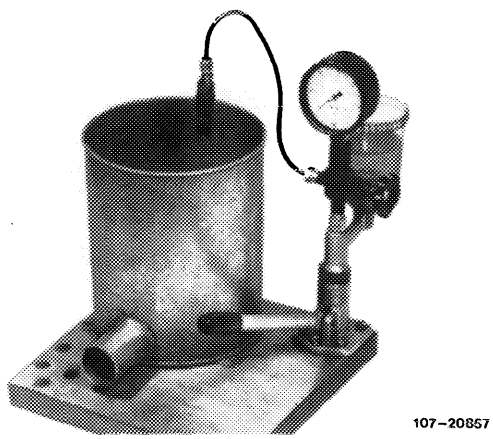


5 **Checking ejection pressure:**

Nominal value: 135–143 bar with new nozzle, at least 120 bar with used nozzle.

At slow downward movement of hand lever (approx. 1 stroke per second) read ejection pressure on pressure gauge.

Shutoff valve must be open for checking.



07.1–137 Disassembly, cleaning, assembly and adjustment of injection nozzles

Job no. of flat rates or standard texts and flat rates data 07-6750 or 6752.

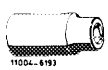
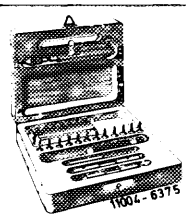
Testing data, injection nozzles

Bosch designation	Injection pressure in bar positive [1] for new injection nozzles	for old injection nozzles, min.
DNO SD 240[2] DNO SD 2400 DNO SD 240/[3]	135–143	120

[1] The difference between any two injection nozzles within one engine must not exceed 5 bar positive.
[2] Starting production code no. 928 or 041.
[3] Starting November 1981 with center hole 0.20 mm dia. (formerly 0.15 mm dia.)

Tightening torques	Nm
Injection nozzles, upper and lower parts	70–80

Special tools

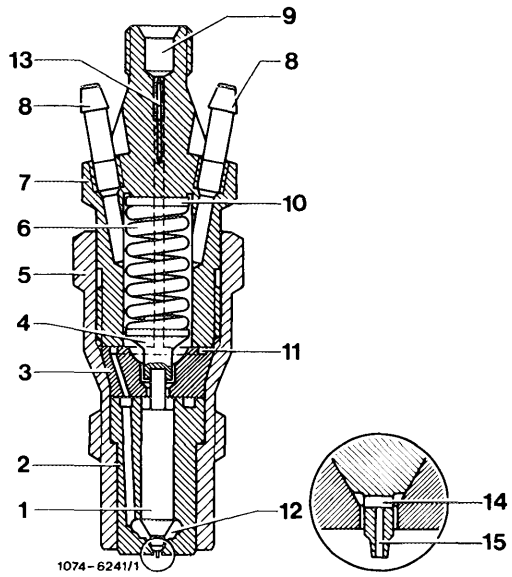
Socket 27 mm, 1/2" drive		001 589 65 09 00
Cleaner		000 589 00 68 00

Conventional tools

Torque wrench 1/2" drive, 40–130 Nm	
Tester EFEP 60 H	e.g. Bosch, D–7000 Stuttgart, Order No. 0 681 200 502
Cleaning needles 0.13 mm dia.	e.g. Bosch, D–7000 Stuttgart, Order No. KDEP 2900/3
Cleaning needles 0.18 mm dia.	e.g. Bosch, D–7000 Stuttgart Order No. KDEP 2900/5

Note

The engine is equipped with a center hole pintle nozzle which is distinguished from the standard pintle by a cross hole and a center hole (14 and 15) in the thrust pin. Moreover, a maintenance-free edge filter (13) is pressed into upper part (7) of the injection nozzle holder.

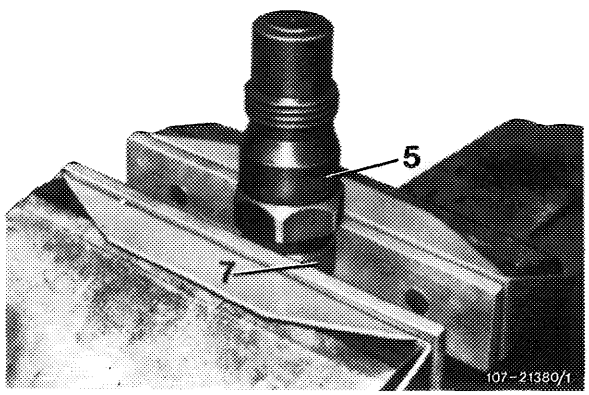


1 Needle valve
2 Nozzle body
3 Nozzle holder insert
4 Thrust pin
5 Injection nozzle holder, lower part
6 Compression spring
7 Injection nozzle holder, upper part
8 Leak-off connection
9 Fuel inlet
10 Steel shim
11 Annular groove and inlet ports
12 Pressure chamber in nozzle body
13 Edge filter
14 Cross hole
15 Center hole

Disassembly

1 Clamp upper part (7) of injection holder in vise so that leak-off connections cannot be damaged.

2 Using socket, release and unscrew lower part (5) of injection nozzle holder.



5 Injection nozzle holder, lower part
7 Injection nozzle holder, upper part

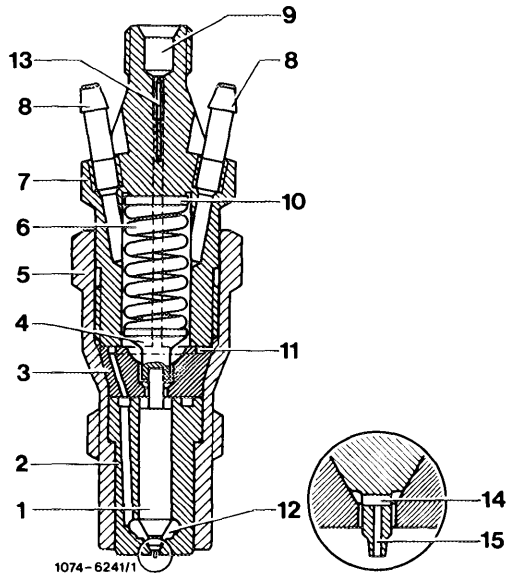
3 Remove steel shim (10), compression spring (6), thrust pin (4), nozzle holder insert (3) and nozzle body (2) together with needle valve (1).

Attention:
When disassembling nozzle, be sure to keep nozzle body, needle valve and all other parts in correct order.

Cleaning

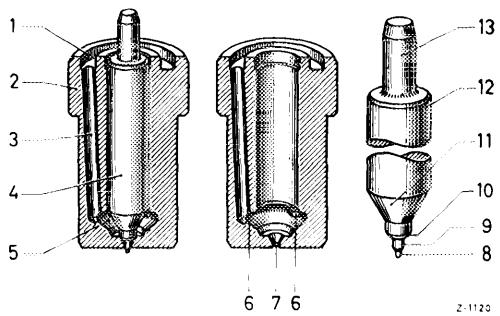
4 Using brass brush, remove carbon deposits from end face of nozzle body (2), chiefly around nozzle orifice.

Using surface plate, check nozzle holder insert (3) and nozzle body (2) for truth at both ends.



1 Needle valve
2 Nozzle body
3 Nozzle holder insert
4 Thrust pin
5 Injection nozzle holder, lower part
6 Compression spring
7 Injection nozzle holder, upper part
8 Leak-off connection
9 Fuel inlet
10 Steel shim
11 Annular groove and inlet ports
12 Pressure chamber in nozzle body
13 Edge filter
14 Cross hole
15 Center hole

5 Clean pressure chamber (5) in nozzle body using annular groove scraper.



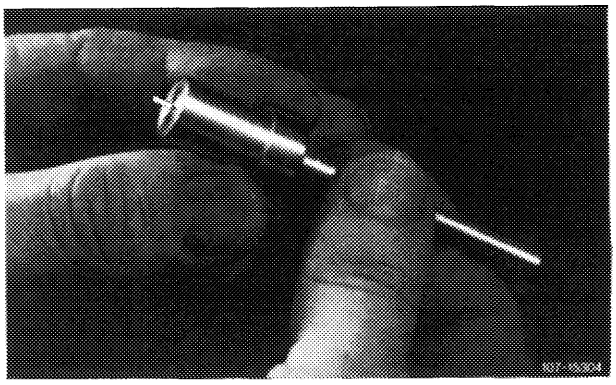
1 Annular groove
2 Nozzle body
3 Inlet port
4 Needle valve
5 Pressure chamber
6 Orifice of inlet ports in pressure chamber
7 Nozzle orifice
8 Injection pin
9 Throttle pin
10 Needle seat
11 Thrust shoulder
12 Needle stem
13 Thrust pin

6 Clean nozzle needle seat in nozzle body with cleaning cutter. This job should be given special care, since usability of a nozzle depends to a high degree on a good nozzle needle seat.

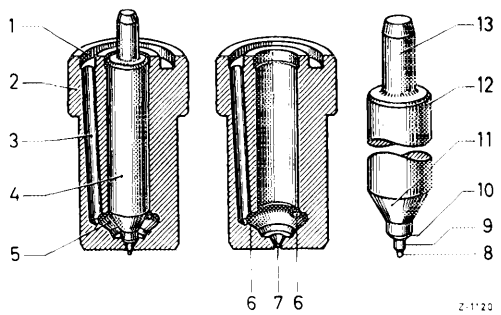
Do not apply excessive pressure with cleaning cutter.

Clean center hole (15 in fig. item 4) with cleaning needle (0.13 mm dia. or 0.18 mm dia.).

7 Clean injection hole in nozzle orifice, using injection hole cleaner. As can be seen in the illustration, work **from inside to outside** and not vice versa (so that injection hole cleaner is guided correctly and not twisted).



8 Clean nozzle needle with brass brush.

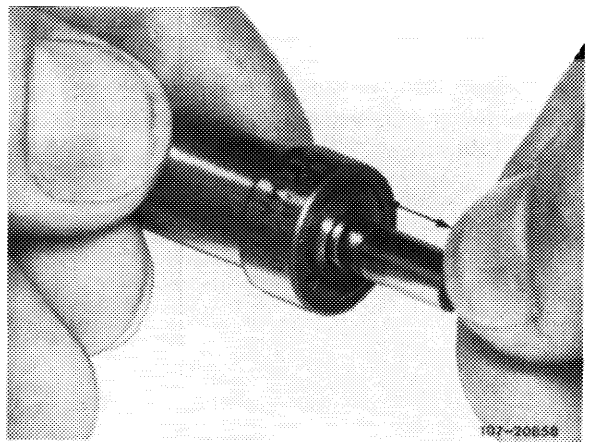


1 Annular groove
2 Nozzle body
3 Inlet port
4 Needle valve
5 Pressure chamber
6 Orifice of inlet ports in pressure chamber
7 Nozzle orifice
8 Injection pin
9 Throttle pin
10 Needle valve seat
11 Pressure shoulder
12 Needle stem
13 Thrust pin

Checking the needle valve

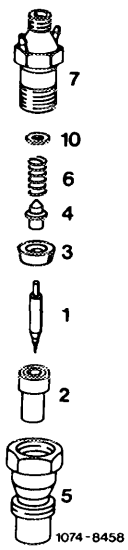
9 Subject to sight-check. Used nozzles are to be sight-checked after cleaning. Check needle valve for indented or rough seat, and also for worn or damaged injection pins. Exchange any nozzle that is damaged.

10 Carry out test for freedom of movement. To do so, immerse needle valve and nozzle body in filtered diesel fuel, inserting needle valve into nozzle body. Hold nozzle body vertically and draw needle valve out by about one third. It must be able to slide back into its seat under its own weight. Exchange injection nozzle if necessary.

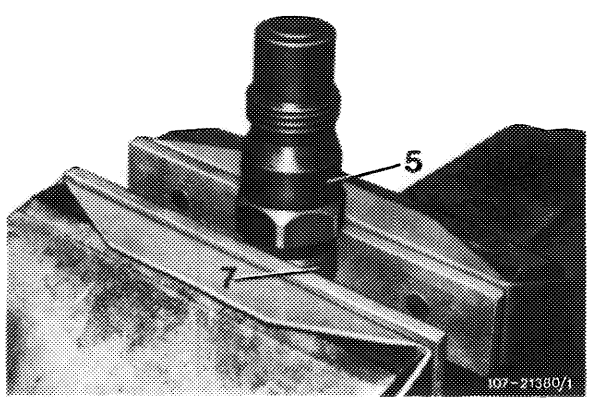


Assembly

11 Introduce all parts into lower part (5) of injection nozzle in reverse order and screw on upper part (7). Be sure to fit thrust pin (4) on needle valve (1) at end showing hole.

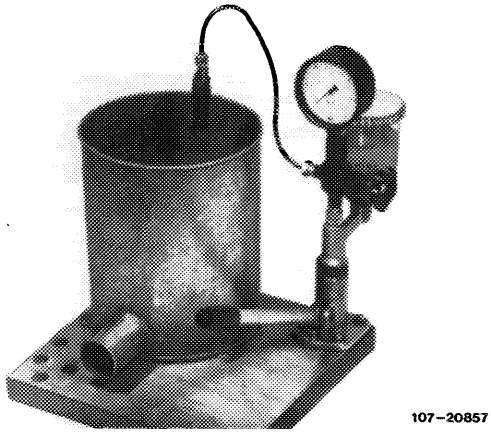


12 Clamp upper part (7) of injection nozzle in vise and torque lower part (5) to 70–80 Nm.



Checking

13 Check injection nozzles for satisfactory jet, rattling sound, injection pressure and leakage (07.1–135).

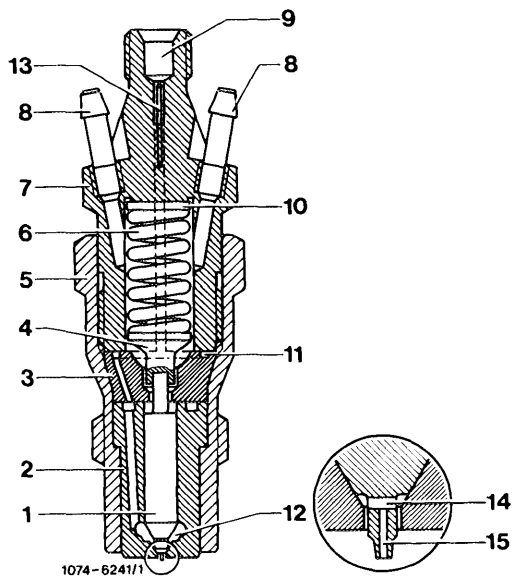


Adjustment

14 In order to obtain correct injection pressure setting, it may be necessary to insert or remove steel shims (10) between compression spring (6) and upper part (7) of injection nozzle.

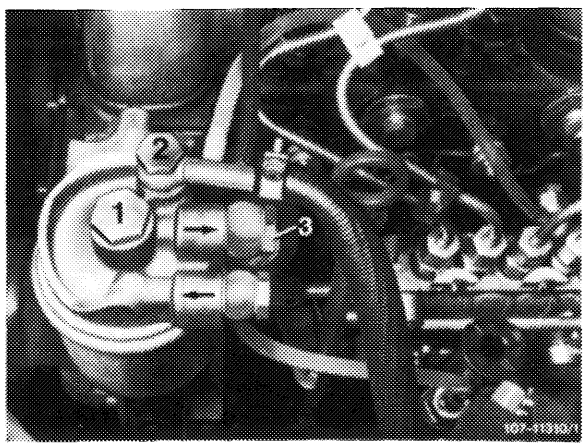
Inserting = higher injection pressure
Removing = lower injection pressure

These shims are available in thicknesses of 1.0 to 1.8 mm, in steps of 0.05 to 0.05 mm. Increasing the preloading by 0.05 mm increases the injection pressure by about 3.0 bar positive.

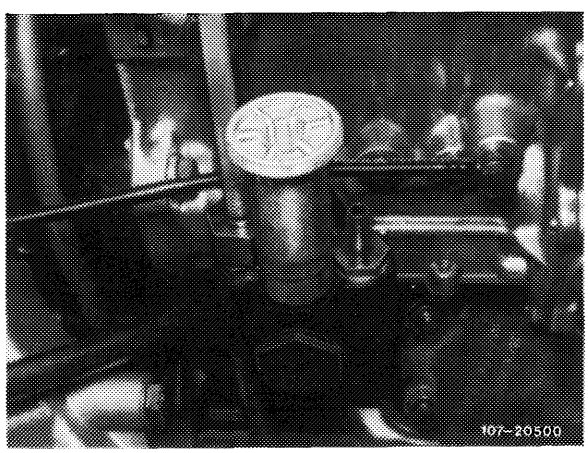


Venting fuel filter

1 Release union screw (3) at fuel filter.



2 Release knob on hand feed pump and operate this pump until clear fuel (containing no air bubbles) emerges from union screw. Now tighten union screw again.



Venting injection pump

3 Operate hand pump until bypass valve at injection pump opens (audible rattling sound).

4 Retighten knob on hand feed pump.

Note: This forces the pump piston against a sealing ring and seals the hand pump off from atmosphere. If knob is released during operation, hand feed pump will leak, allowing air to enter fuel system.

5 Run engine and check whether all connections are tight.

07.1–145 Checking fuel pump and bypass valve

Job no. of flat rates or standard texts and flat rates data 07–8800 or 5700.

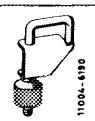
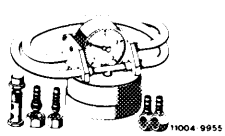
Test values

Bosch designation		FP/K 22 MW 8, MW 22
Vacuum	Measuring point	prior to fuel pump inlet
	at idle speed bar vacuum	0.1
Delivery pressure	Measuring point	between fuel pump and main fuel filter
	at idle speed bar gauge pressure	0.6– 0.8
	at 3000/min bar gauge pressure	min. 0.8
Delivery end pressure	at idle speed bar gauge pressure	min. 1.1
	at 3000/min bar gauge pressure	min. 1.3

Fuel bypass valve

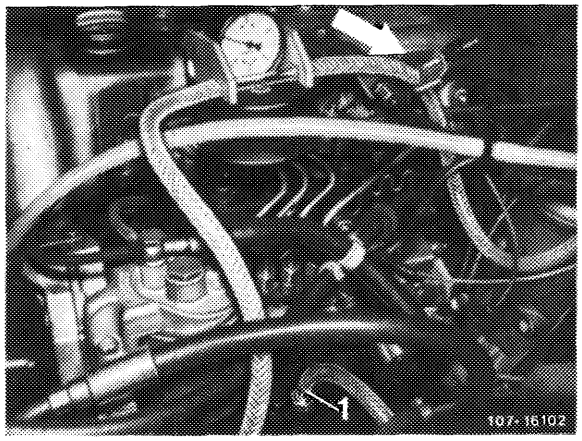
	Opening pressure in bar gauge pressure
at idle speed	0.6–0.8
at 3000/min	min. 1.3

Special tools

Clip for fuel hose		000 589 40 37 00
Tester for fuel pump		617 589 04 21 00

Measuring negative pressure

1 Connect tester to fuel inlet (1) on fuel pump. For this purpose, remove fuel feed line. Vent injection system (07.1–140).



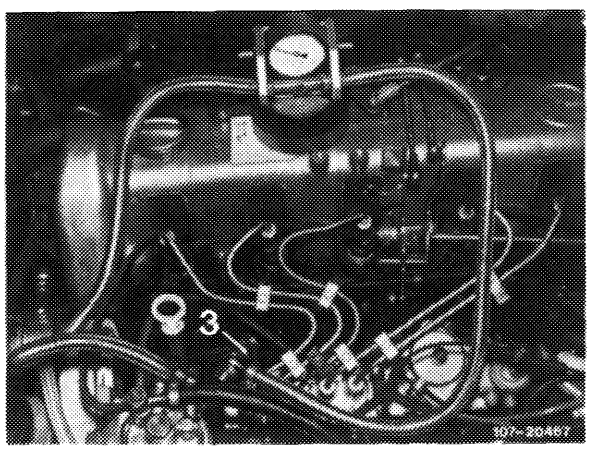
Measure vacuum pressure at idle speed. To do so, use clip to nip hose (arrow) at tester downstream of pressure gage.

If system fails to reach value of 0.1 bar vacuum, exchange suction and delivery valves or fuel pump (07.1–240).

Checking fuel feed pressure

2 Unscrew fuel line (3) on fuel main filter.

3 Connect tester. For this purpose, connect fuel line to hose line for tester with a double hollow screw and closing nut. Connect other hose line of tester to fuel filter.



4 Vent injection system (07.1–140).

5 Warm up engine.

6 Measure fuel feed pressure at idle speed and 3000/min.

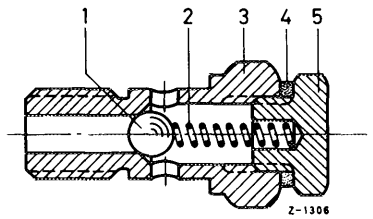
0.6–0.8 bar gauge pressure at idle speed.

Min. 0.8 bar gauge pressure at 3000/min.

7 What to do in case feed pressure is inadequate:

a) Check bypass valve, removing, disassembling and cleaning for this purpose.

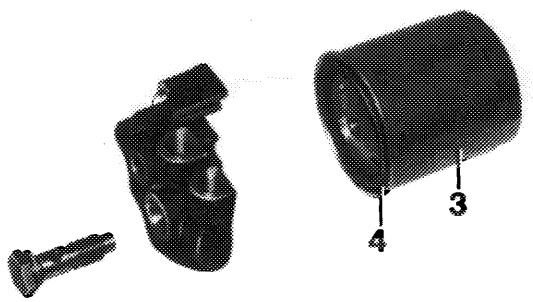
Increase preloading of compression spring (2), lengthening spring to 26–27 mm.



1 Ball
2 Compression spring
3 Body
4 Sealing ring
5 Screw plug

b) Check fuel filter for clogging. If necessary, **fit new filter element with body (3) and sealing ring (4).**

c) Exchange suction and delivery valves or fuel pump (07.1–235).



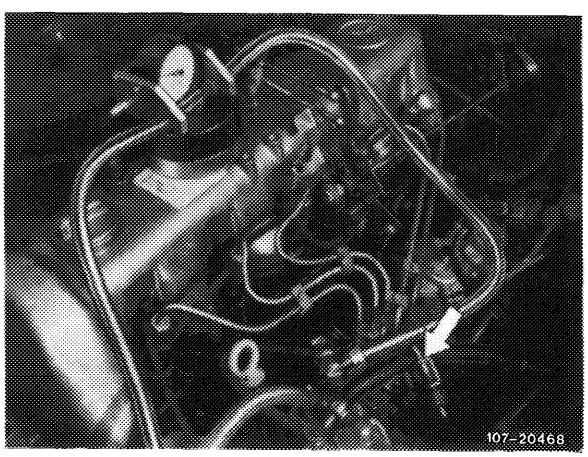
Checking final fuel feed pressure

8 Using clip (arrow), nip fuel return hose.

9 Measure final fuel feed pressure at idle speed and 3000/min.

Min. 1.1 bar gauge pressure at idle speed.

Min. 1.3 bar gauge pressure at 3000/min.



10 If final feed pressure is inadequate, exchange suction and delivery valves or fuel pump (07.1–235).

07.1–150 Checking vacuum shutoff for leaks

Job no. of flat rates or standard texts and flat rates data 07–8222 or 8225.

A. Without Tester

Note concerning diaphragm vacuum pump

Installed:
Model 116 up to model year 1979.
Model 116 starting model year 1980, 123 and 126 are provided with piston vacuum pumps.

If engine oil appears in vacuum lines or brake booster, you may find that the diaphragm in the vacuum control unit or the one in the vacuum pump is defective.

The appearance of engine oil necessitates the replacement of the vacuum control unit and also of the vacuum lines carrying oil. The vacuum pump will have to be repaired and the brake booster exchanged if they show oil at the vacuum line connection.

Leakage through the vacuum pump diaphragm or through the vacuum control unit at the injection pump will allow engine oil to reach the combustion chambers through the suction pipe, causing a higher combustion temperature which may damage the precombustion chambers.

If the full length of the vacuum lines is a dark black it may be assumed that engine oil has entered the combustion chamber. In this case you are advised to check all the precombustion chambers.

Precombustion chambers which are cracked at the bottom or have burnt (scaly) ball pin surfaces, have to be exchanged because engine damage due to breaking precombustion chamber parts will otherwise have to be taken into account.

Checking

1 Run engine.

2 Disconnect vacuum line (brown) at Tee piece (7) and check whether pressure is negative or not.

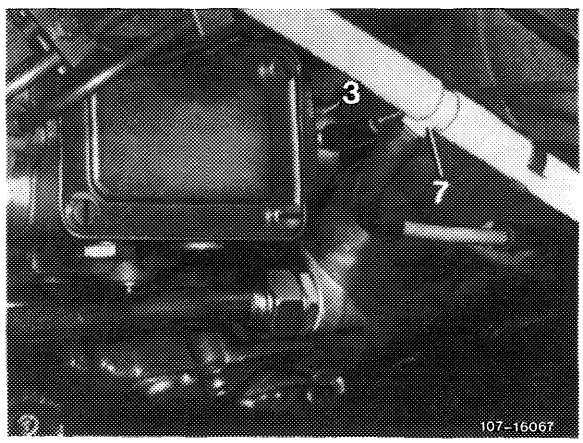
a) Should this not be the case, unscrew vacuum line with Tee piece at vacuum pump and brake booster.

Check throttle in Tee piece for obstructions, blowing out with compressed air if necessary.

Note: On vehicles with diaphragm vacuum pump. If throttle is oiled up, diaphragm in vacuum pump may be defective. Throttle is defective, if engine oil shows up at connection of vacuum line (pump end). Reconditioning of vaccuum pump is described in repair instructions brakes model 115 and 123 (42–620).

b) If pressure at Tee piece is negative, connect vacuum control unit (3) straight to Tee piece (7) via a hose.

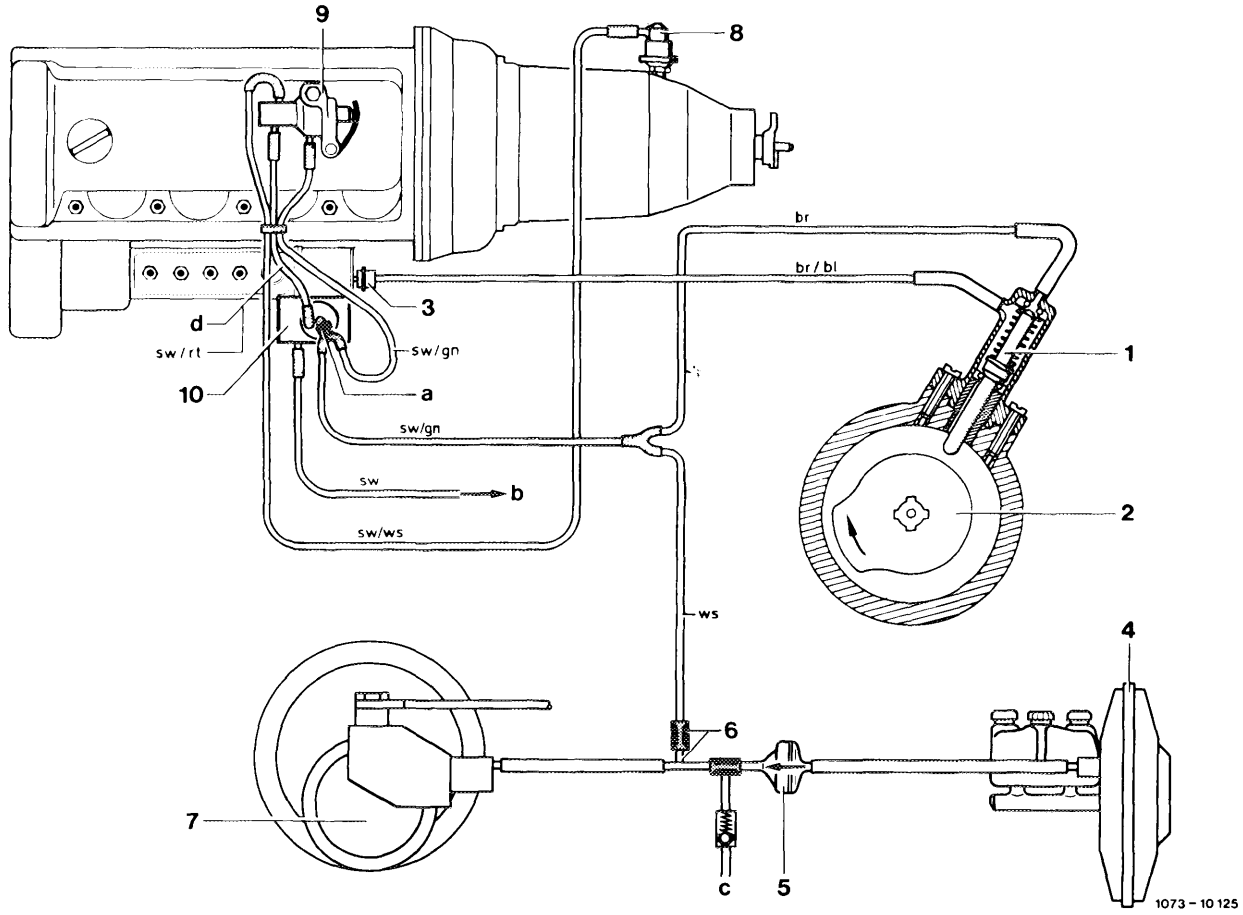
The vacuum from vacuum pump (8) now acts direct on the diaphragm in vacuum control unit (3) and draws the injection pump control rod to the stop position.
Exchange the vacuum control unit if engine does not stop immediately (07.1–220).



Immediate stoppage of engine means that vacuum control unit is in good working order. In this case, trouble may be due to sticking of valve (1) in steering lock. Exchange valve with reference to repair instructions for steering system models 115 and 123 (46–640).

Attention:
Do not cross vacuum lines when reconnecting.

3 Run engine. Check vacuum control unit and valve in steering lock for satisfactory operation, and examine injection pump for leakage.



1 Valve
2 Cam plate
3 Vacuum control unit
4 Brake booster
5 Check valve
6 T-piece with integratied throttle
7 Vacuum pump
8 Vacuum control unit transmission
9 Change-over valve
10 Vacuum control valve

a Suction line
b Vent line
c Central lock
d Control line

br = brown
br/bl = brown/blue
sw/rt = black/red
sw/gn = black/green
sw = black
sw/ws = black/white

B. With tester

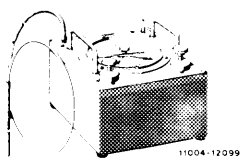
Data

Permissible system leakage	6 mbar/min at 400 mbar negative pressure
Permissible leakage at component parts	5 mbar/min at 300 mbar negative pressure
Mating length at connections	12 ± 2 mm

Color coding of vacuum lines for diesel engine key starting system

Vacuum line	Color code
Suction line from distributor to valve for key starting system (100)	brown
Control line from key starting system valve to vacuum control unit of injection pump (101)	brown/blue

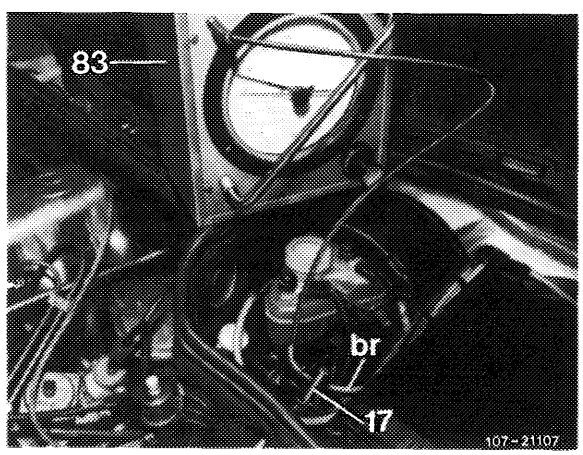
Special tool

Tester for vacuum and gauge pressure		201 589 13 21 00

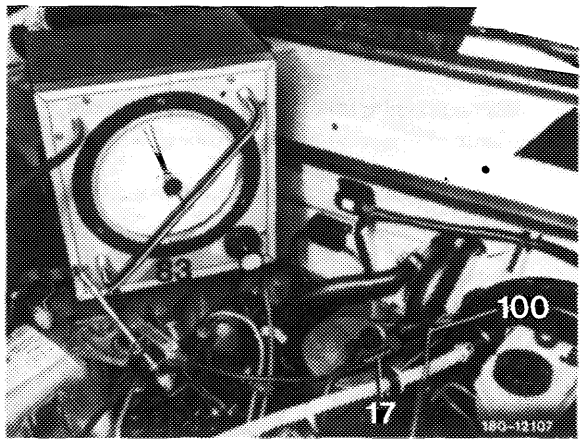
Checking

1 Turn ignition key in steering lock to position "2".

2 Pull brown line (br) out of connection (17) and connect tester (83) to brown line (br).



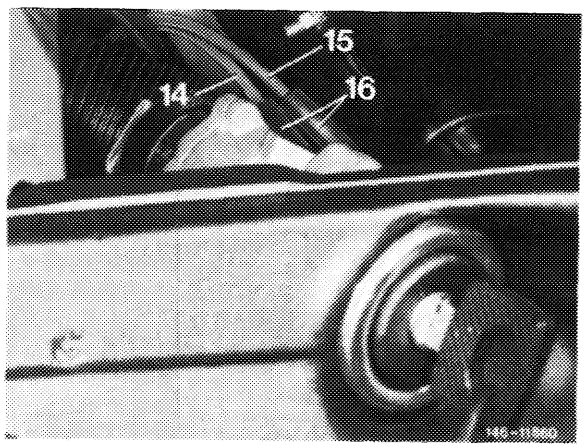
3 Evacuate tester (83).



4 Rising pressure on gage means that key starting system valve at steering lock is subject to leakage.

5 Exchange key starting system valve at steering lock (46–640).

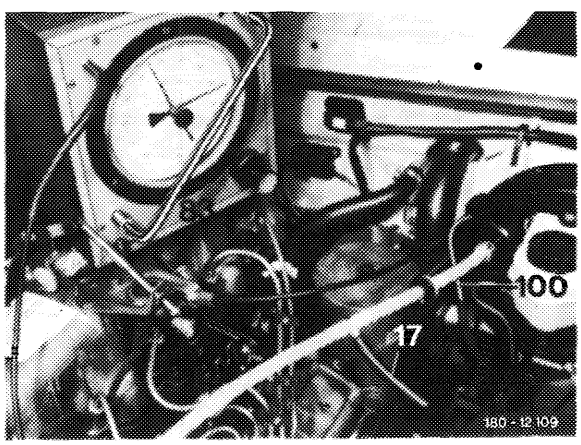
Attention:
Prior to exchanging key starting system valve and vacuum control unit of injection pump, check hose lines and connectors.



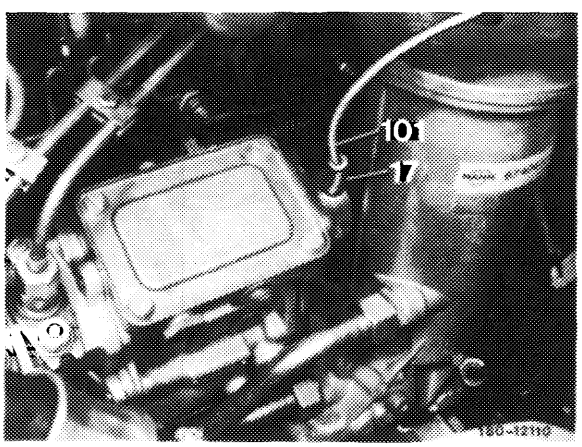
6 Turn ignition key in steering lock back to position "1" or "0".

7 Evacuate system using tester (83).

8 Rising pressure on gage may imply that vacuum control unit or valve is subject to leakage.



9 Disconnect control line (101) with connector (17) from vacuum control unit of injection pump.

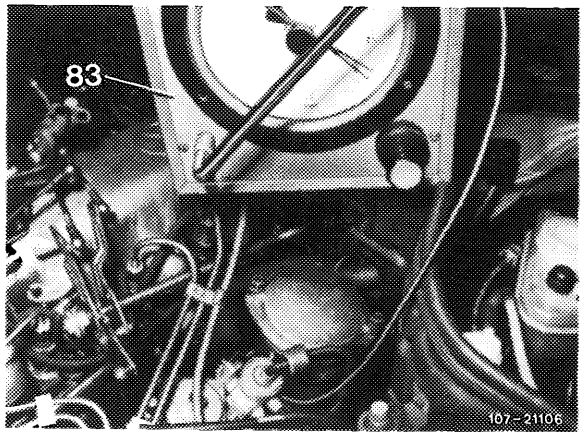


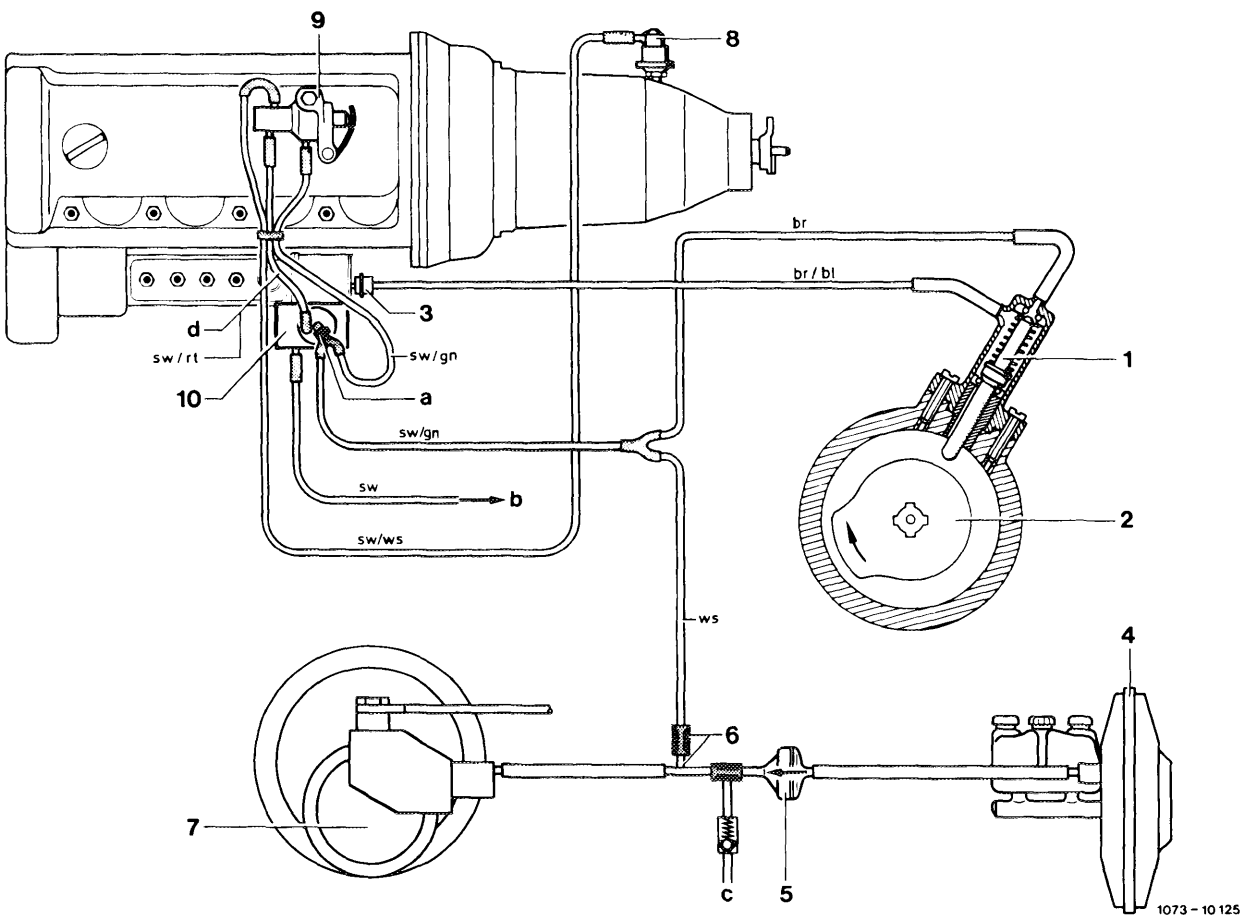
10 Connect tester (83) to vacuum control unit and evacuate.

11 Rising pressure on gage means that vacuum control unit of injection pump is subject to leakage.

12 Exchange vacuum control unit of injection pump (07.1–220).

13 Constant pressure on gage means that vacuum control unit of injection pump is in order and that key starting valve is subject to leakage. Exchange key starting system valve (46–640).





1 Valve
2 Cam
3 Vacuum control unit
4 Brake booster
5 Check valve
6 T-fitting with installed throttle (orifice)
7 Vacuum pump
8 Vacuum control unit for transmission
9 Changeover valve
10 Vacuum control valve

a Suction line
b Positive vent line
c Central lock
d Control line

br =brown
br/bl = brown/blue
sw/rt = black/red
sw/gn = black/green
sw = black
sw/ws = black/white

07.1–200 Removal and installation of injection pump

Job no. of flat rates or standard texts and flat rates data 8410 or 8411, 8430, 8431.

Survey model – engine – injection pump

Model	Engine	Injection pump Bosch designation	Regulator Bosch designation	Delivery pump Bosch designation	Test values[1] 1B-sheet Edition
Standard version up to 1980					
123.193	617.952	PES 5 MW 55/320 RS 16	RW 375/2200 MW 28–1	FP/K 22 MW 22	3.0 g 5th edition
Standard version starting 1981					
123.193	617.952	PES 5 MW 55/320 RS 16	RW 375/2200 MW 28–3[3])	FP/K 22 MW 8	3.0 g 1st edition
(USA) **1978/1979**		Identification: Green type rating plate			
116.120	617.950	PES 5 MW 55/320 RS 16	RW 375/2200 MW 22	FP/K 22 MW 8	3.0 g 4th edition
(USA) **1980**					
116.120	617.950	PES 5 MW 55/320 RS 16	RW 375/2200 MW 22 RW 375/2200 MW 28[2])	FP/K 22 MW 22	3.0 g 4th edition
(USA) **1981**					
123.193	617.952	PES 5 MW 55/320 RS 16	RW 375/2200 MW 28–1	FP/K 22 MW 22	3.0 g 5th edition
126.120	617.951				
(USA) **starting model year 1982**					
123.133 123.153 123.193	617.952	PES 5 MW 55/320 RS 16	RW 375/2200 MW 28–3[3])	FP/K 22 MW 22	3.0 m 1st edition
126.120	617.951				

(USA) starting model year 1984 California

123.133 123.153 617.952 123.193	PES 5 MW 55/320 RS 16–1	RW 375/2200 MW 28–3[3])	FP/K 22 MW 22	3.0 m 1st edition
126.120 617.951				

[1] Accurate checkup and adjustment of injection pump is possible on an injection pump test bench only. For workshops, where such a test bench is installed, test sheets for the different pumps are available.
[2] Entering production starting February 1980.
[3] Reference impulse verification (RIV), dynamic injection timing (begin of delivery) test possible.

Tightening torques	Nm
Pipe connection for delivery valves	40–50
Injection lines	25

Special tools

Socket 13 mm, 3/8" drive		000 589 21 07 22
Box wrench socket open, 17 mm, 1/2" drive for injection lines		000 589 68 03 00
Overflow pipe		636 589 02 23 00

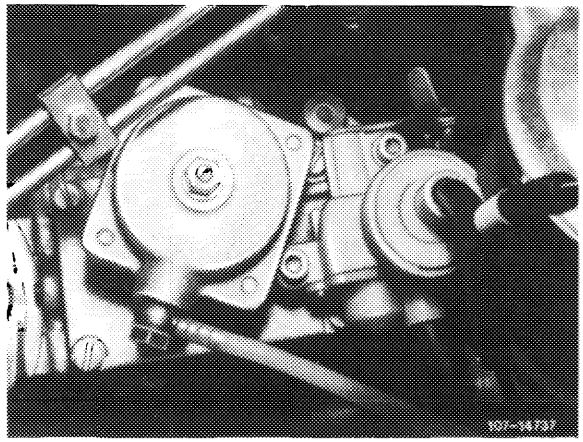
Conventional tool

Torque wrench 1/2" drive, 15–65 Nm

Removal

1 Detach vacuum line at vacuum control unit and at vacuum control valve for automatic transmission.

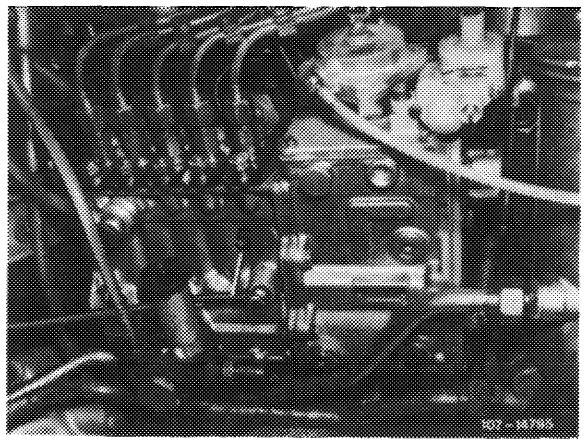
2 Unscrew delivery line at aneroid compensator.



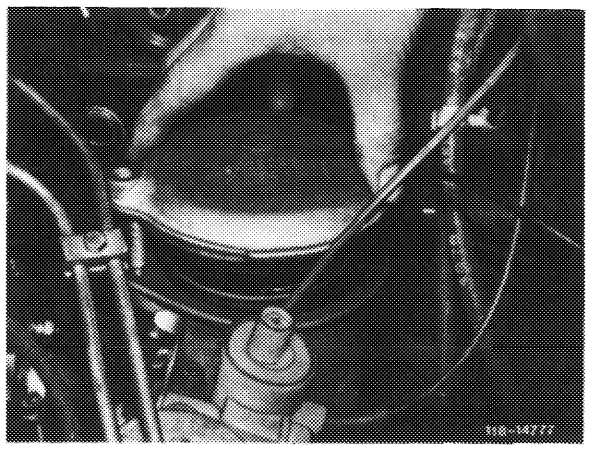
3 Disconnect electric cable at temperature sensor, detach control rod, unscrew injection lines and fuel lines at injection pump. Clip caps onto connections for injection lines and fuel hoses at injection pump.

4 Unscrew lubricating oil line (5).

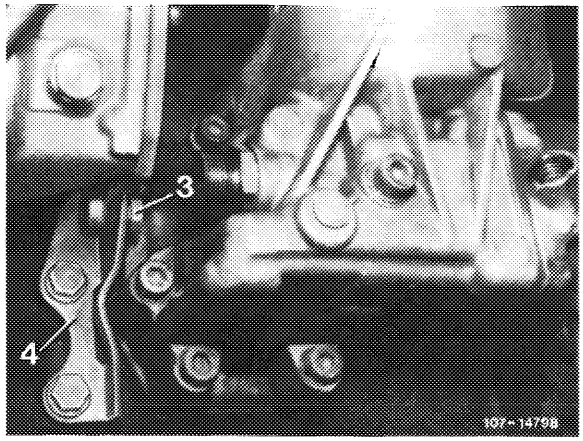
Attention:
Prior to removal of lubricating oil line (5), clean connecting points.



5 Unscrew and remove upper part of oil filter so that engine oil can return to oil pan.



6 Unscrew hex-head bolts at supporting holder (4) as well as 3 nuts holding injection pump. Release feastening bolt (3) to provide adjustment within oblong hole.

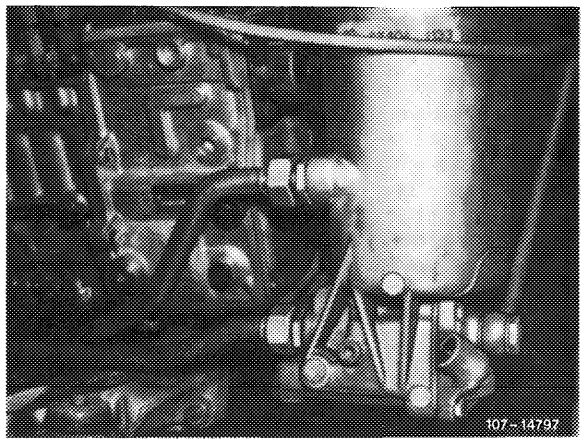


7 Unscrew all engine oil lines at oil filter body, releasing clamps for this purpose.

8 Unscrew and remove oil filter body from crankcase (18–110).

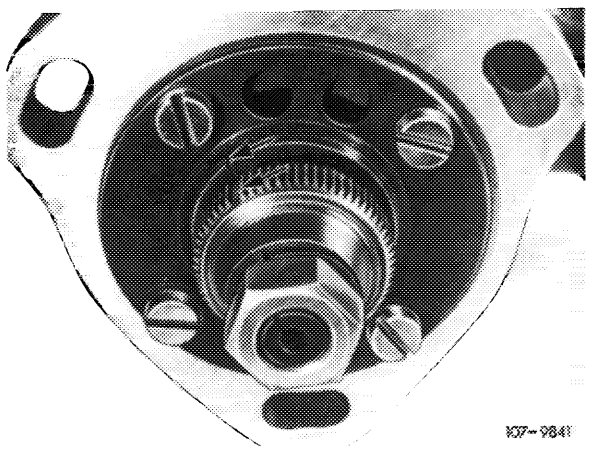
Attention:
When removing gasket, make sure that no remains drop into oil passages.

9 Withdraw injection pump from crankcase. Detach coupling sleeve from injection pump driver or from drive shaft.



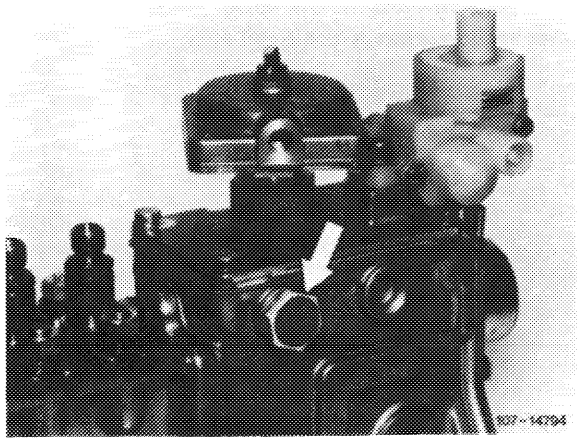
Note: If driver is to be exchanged, lock driver with serrated wrench and release hexagon nut. Then remove driver from injection pump shaft using puller. Clean axle stub and driver, making sure that both cones are absolutely clean and dry.

When fitting a new driver, note Woodruff key and marks (arrows).



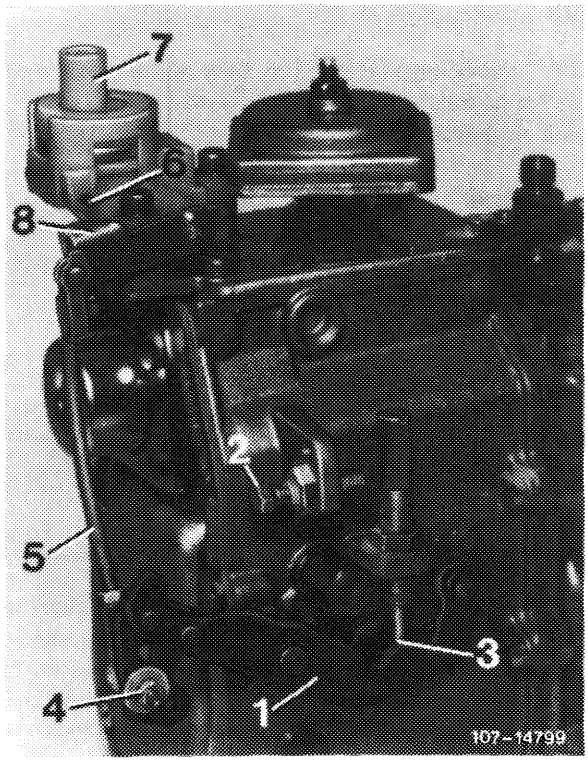
Installation

Attention:
Prior to installing a replacement injection pump, remove screw plug (arrow) and fill with 0.4 l engine oil (first filling).



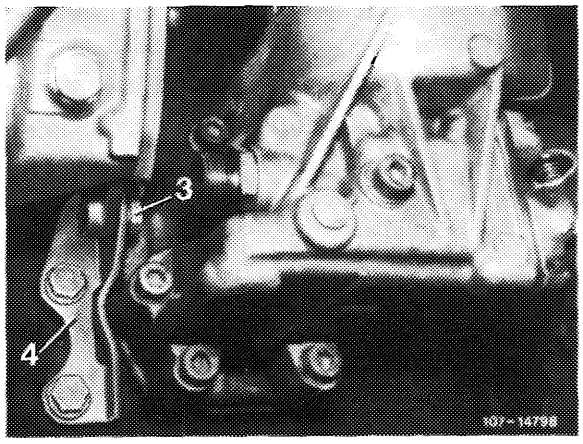
10 Check whether connecting rod (5) is correctly set, moving control lever (1) to full-load stop (2) for this purpose. Operating lever (8) must have approx. 0.5 mm clearance from full-load stop (6).

If necessary, adjust connecting rod (5) at adjustable knuckle (4).

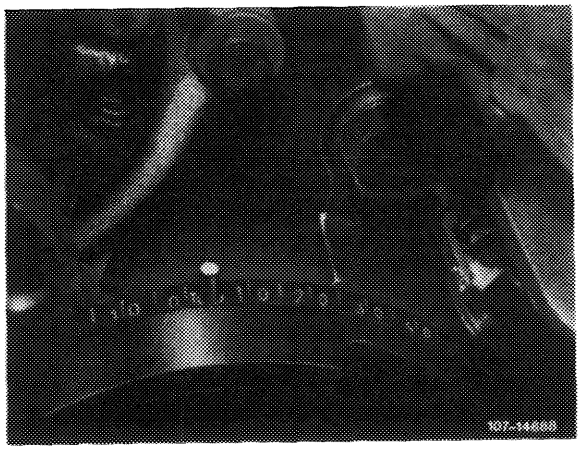


1 Control lever
2 Full-load stop
3 Idle speed stop
4 Adjustable knuckle
5 Connecting rod
6 Full-load stop at vacuum control valve
7 Vacuum control valve
8 Operating lever for vacuum control valve

11 Detach supporting holder (4) from removed injection pump and bolt to injection pump for installation. Do not tighten fastening bolt (3) because adjustment within oblong hole is still necessary.



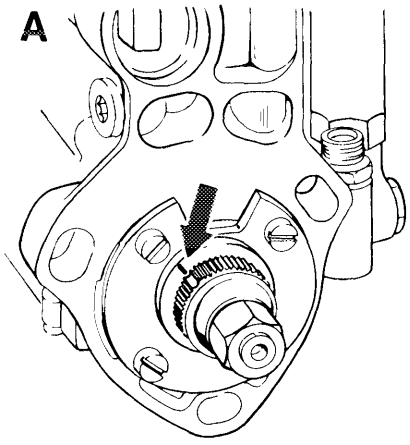
12 Move crankshaft to start of delivery in compression stroke.



13 Fit new gasket.

14 Move injection pump to mark, turning injection pump camshaft until mark on camshaft agrees with line on flange (arrow).

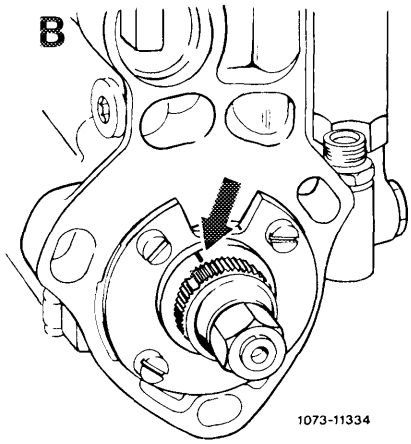
Attention!
On Bosch production code number "251" (November 1982) the mark for begin of delivery may be applied to the wrong spot on bearing cap.



Mark on bearing cap correct
(approx. center of bearing cap screw)

Note

When installing an injection pump with wrong mark on bearing cap, the pinion should be positioned in such a manner that the recess is 3 teeth to the left on the mark of the bearing cap. In this position the injection pump is at begin of delivery (basic position). The engine should be at 24° before TDC, as usual.



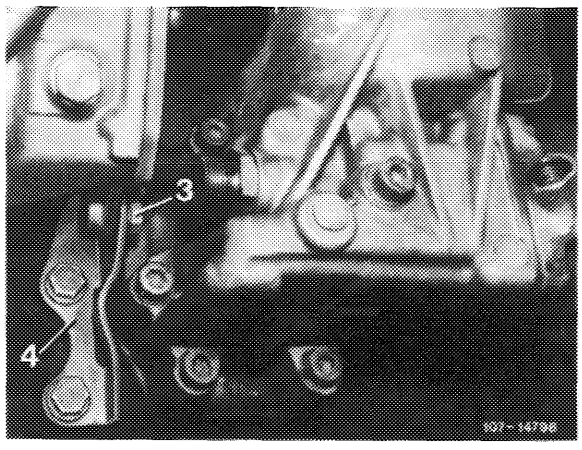
Marking on bearing cap wrong
(approx. lefthand edge recess of oil overflow)

15 Slip coupling sleeve onto driver and insert injection pump. Fit washers and slightly tighten fastening nuts of injection pump.

16 Check and adjust start of delivery (07.1–110 and 115).

17 Tighten injection pump fastening nuts and attach supporting holder (4) to crankcase. Now tighten fastening bolt (3) in oblong hole of supporting holder. Supporting holder is to be fastened with shims as per part No. 116 990 14 40 and hex-head bolts M 8 x 16.

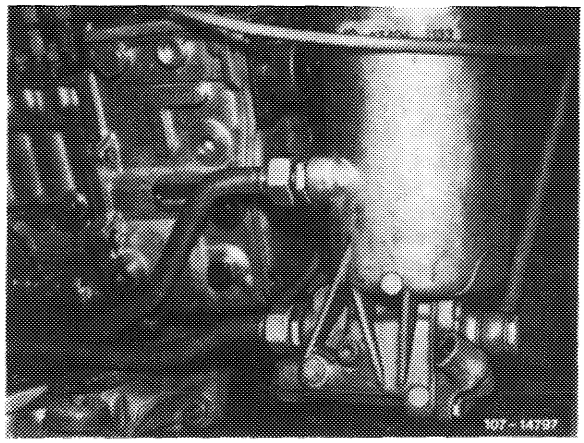
18 Reconnect lubricating oil line to injection pump.



19 Fit oil filter and oil filter cover with new seal.

20 Connect all oil lines to oil filter.

21 Attach temperature sensor cable, connect charge air line and vacuum lines to injection pump, and fit all fuel lines.



22 Vent injection system with hand delivery pump (07.1–140).

23 Check throttle linkage and adjust, if required (30–300).

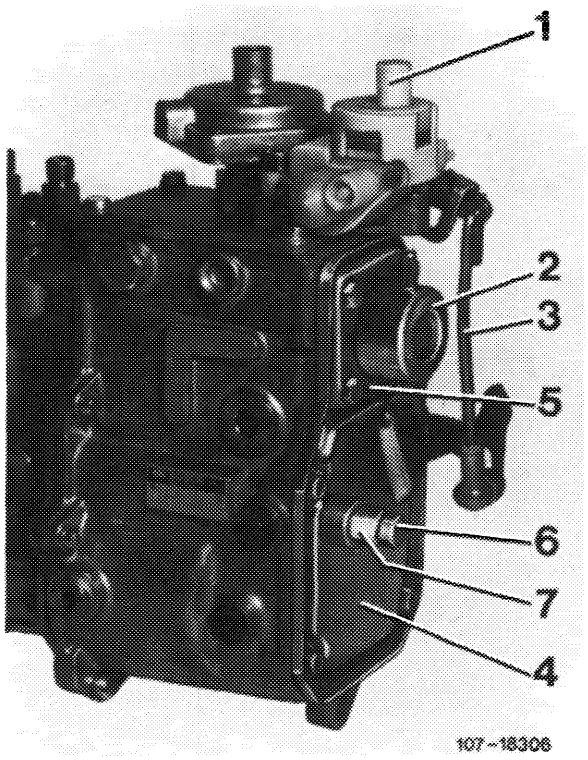
24 Run engine to operating temperature and check all connections for leaks.

25 Check idle speed and adjust, if required (07.1 - 100).

26 Adjust damper for regulator. If a damper (6) is installed on regulator of injection pump, adjust at idle against transverse vibrations of engine.

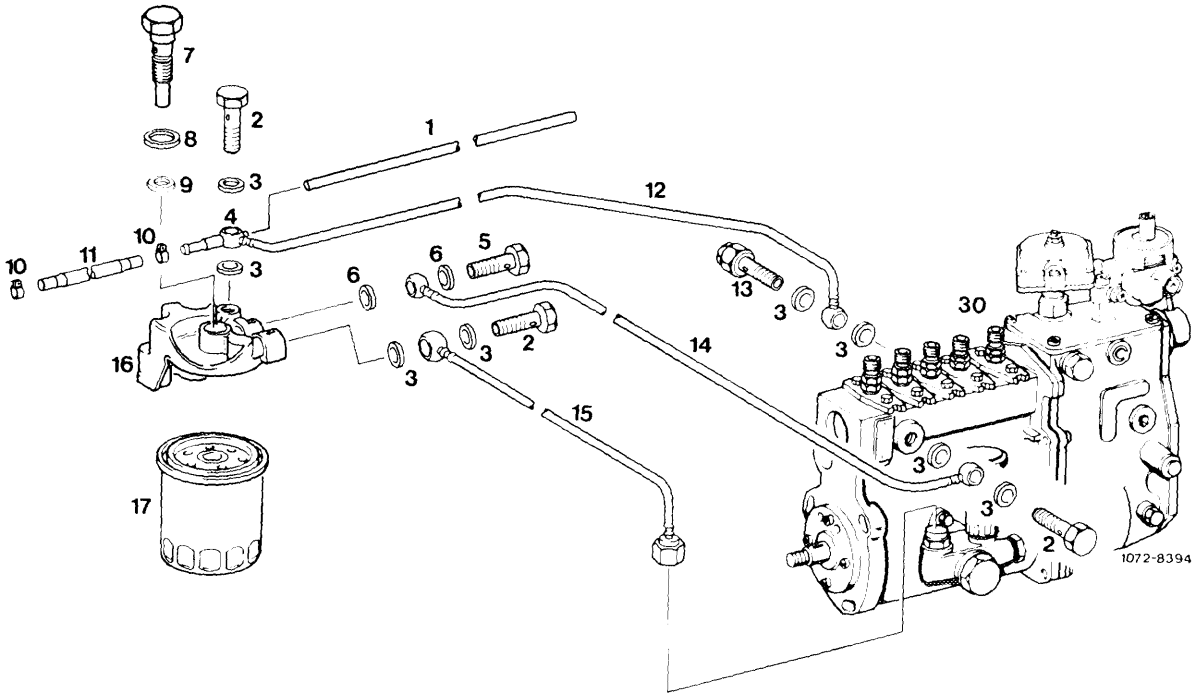
For this purpose, loosen counter nut (7).

Adjust damper (6) at idle speed, screwing damper in until transverse engine vibrations have been remedied. Then tighten counter nut (7) to 20–25 Nm.



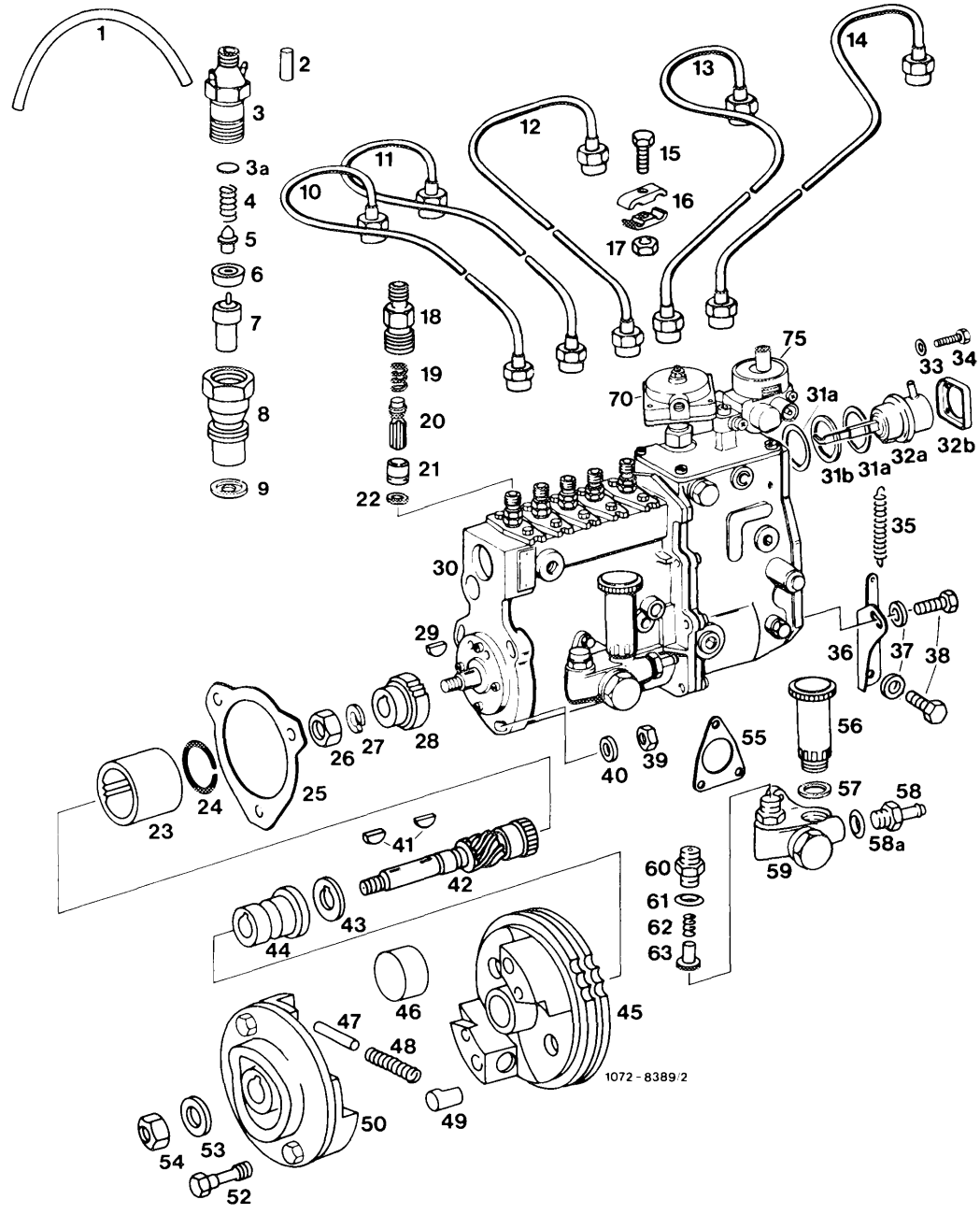
6 Damper
7 Counter nut

Fuel filter



1 Leak-off hose from injection nozzle
2 Union screw
3 Sealing ring
4 Banjo connector
5 Union screw
6 Sealing ring
7 Union screw
8 Sealing ring
9 O-ring
10 Hose clamp
11 Expansion hose
12 Return line from bypass valve
13 Bypass valve
14 Fuel line
15 Fuel line
16 Upper part of fuel filter
17 Fuel filter
30 Injection pump

Mixture Control

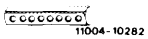


1	Leak-off hose	23	Seal	44	Socket
2	Stopper	24	Snap ring	45	Segment for injection timing device
3	Injection nozzle, upper part	25	Gasket	46	Centrifugal weight
3a	Steel shim	26	Nut	47	Pin
4	Compression spring	27	Lock washer	48	Compression spring
5	Thrust pin	28	Drive pinion	49	Pin
6	Nozzle holder insert	29	Woodruff key	50	Segmental flange
7	Nozzle body	30	Injection pump	52	Waisted bolt
8	Injection nozzle, lower part	31a	Gasket	53	Washer
9	Nozzle plate	31b	Steel washer	54	Nut
10	Injection line	32a	Vacuum control unit	55	Gasket
11	Injection line	32b	Flange	56	Hand-operated fuel feed pump
12	Injection line	33	Washer	57	Rubber sealing ring
13	Injection line	34	Bolt	58	Socket
14	Injection line	35	Return spring	58a	Sealing ring
15	Bolt	36	Holder	59	Fuel feed pump
16	Pipe holder	37	Washer	60	Screwed union
17	Nut	38	Bolt	61	Sealing ring
18	Pipe connection	39	Nut	62	Compression spring
19	Compression spring	40	Washer	63	Delivery and suction valve
20	Delivery valve	41	Woodruff key	64	Aneroid compensator
21	Delivery valve holder	42	Idler gear shaft	75	Vacuum control valve
22	Copper sealing ring	43	Thrust ring		

Adjusting value

Set engine to **–15° after TDC** of 1st cylinder

Special tools

Locking screw	 11004-11773	601 589 05 21 00
Driving square 1/2", 80 mm for rotating engine	 11004-10282	617 589 00 16 00

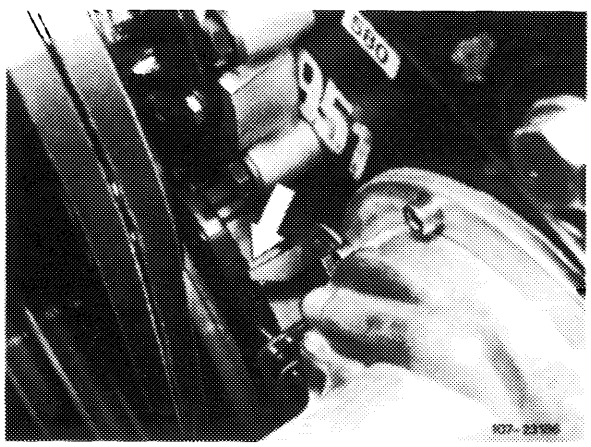
Note

Remove engine pump (07.1–200).

Installation

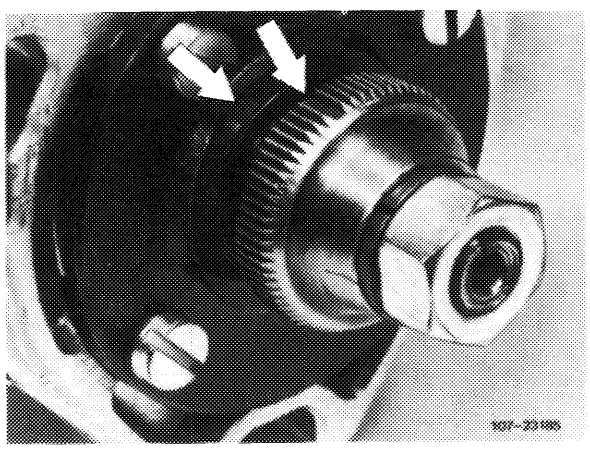
1 Rotate engine in direction of rotation once and set to –15° after TDC of 1st cylinder.

Note: Clearances must be compensated.



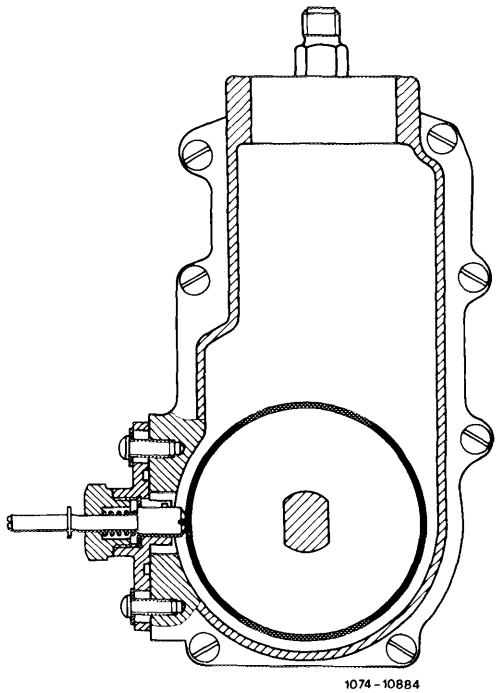
2 Mount new gasket.

3 Lock injection pump. For this purpose, rotate pump shaft until **4th tooth** on driver after tooth gap is in alignment with mark (arrows).



4 Slip in locking screw until there is a noticeable lock, turn camshaft slightly, if required.

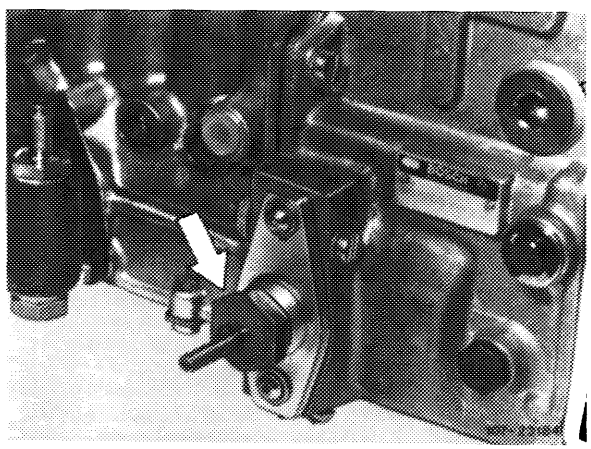
Tighten coupling nut manually.



5 Slip coupling sleeve on driver.

6 Install injection pump, tighten.

7 Remove locking screw (arrow). Additional jobs (07.1–200 starting item 16).



07.1–210 Replacement of pipe connection, delivery valve or copper sealing ring on injection pump

Job no. of flat rates or standard texts and flat rates data 07–8627.

Tightening torques	Nm
Pipe connection for delivery valve	40–50
Injection line	25

Special tools

Box wrench socket open, 17 mm 1/2" drive for injection lines	 11004-6359	000 589 68 03 00

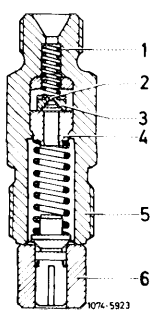
Conventional tool

Torque wrench 1/2" drive, 15–65 Nm

Note

To reduce hydrocarbons in exhaust gases, relief throttles are installed in pipe connections of injection pump.

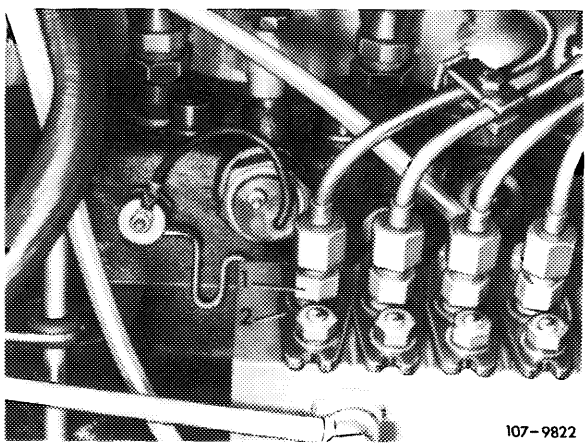
Relief throttle (2) is a poppet valve (3) with an orifice of 0.6 mm dia. opening in direction of injection nozzle. Valve seat (4) is riveted into pipe connection.



1 Compression spring
2 Relief throttle
3 Peppet valve
4 Valve seat
5 Pipe connection
6 Delivery valve holder with valve

The relief throttle allows fuel to pass through freely in the direction of the injection nozzle. The pressure wave travelling toward the injection pump from the injection nozzle is caused by the secondary pumping action of the needle valve as it closes; this is attenuated by the relief throttle and prevented from returning to the injection nozzle where it would otherwise cause secondary injection. This in turn would increase the hydrocarbon content of the exhaust gases.

Removal



1 Clean injection pump at injection line cap nuts and at pipe connections.

2 Unscrew injection lines and pipe connection.

Attention:
Do not release assembly (2) because basic injection pump adjustment will otherwise have to be corrected on injection pump test bed.

3 Remove compression spring, copper sealing ring and delivery valve with holder.

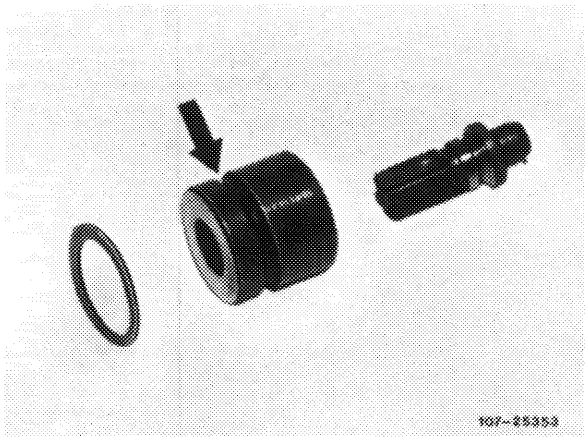
4 Flush out injection pump suction chamber, using hand-operated feed pump. Remove foreign matter if necessary.

Installation

5 Clean delivery valve and holder, checking for damage and freedom of movement.

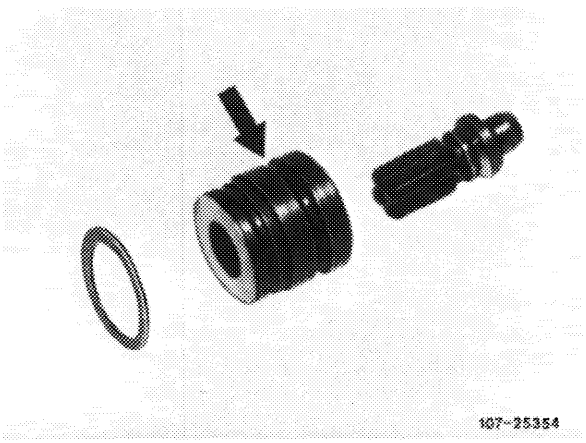
6 Position new copper sealing ring (5) **beneath** delivery valve holder (6).

On 1st version, the annular groove (arrow) must point in downward direction toward pump element.

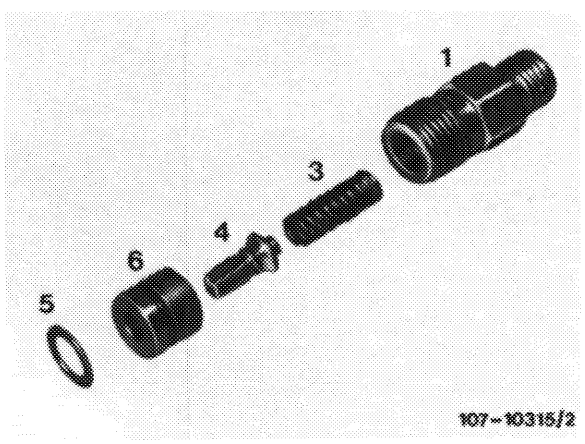


1st version

On 2nd version, the annular groove (arrow) must point toward delivery valve.



2nd version



1 Pipe connection
3 Compression spring
4 Delivery valve
5 Copper sealing ring
6 Delivery valve holder

7 Smear thread of pipe connection (1) with oil, insert and torque to 40–50 Nm in **one step.**

8 Connect injection lines and vent injection system (07.1–140).

9 Run engine, checking for leakage and smooth idling.

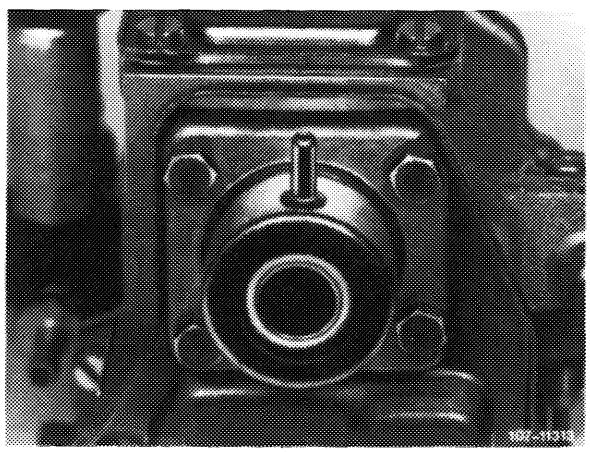
07.1–220 Replacement of vacuum control unit at injection pump

Job no. of flat rates or standard texts and flat rates data 07–8621.

Removal

1 Unscrew vacuum control valve on injection pump.

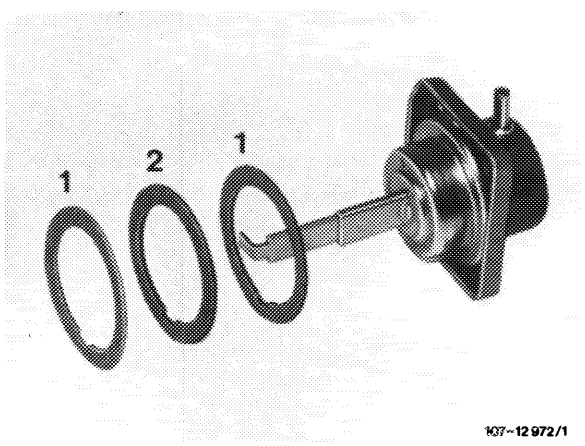
2 Remove vacuum control unit after loosening 4 fastening screws.



Installation

3 Bolt vacuum control unit to governor cover, using 2 new gaskets (1).

Make sure that connecting rod of vacuum control unit latches onto control rod.



1 Gasket
2 Steel ring

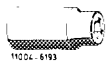
107-12972/1

07.1–230 Removal and installation of injection nozzles

Job no. of flat rates or standard texts and flat rates data 07–6810 or 6830.

Tightening torques	Nm
Injection nozzles	70–80
Injection lines	25

Special tools

Box wrench socket open, 17 mm, 1/2" drive for injection lines	 11004-6359	000 589 68 03 00
Socket for injection nozzle 27 mm, 1/2" drive	 11004-6193	001 589 65 09 00

Conventional tools

Torque wrench 1/2" drive, 40–130 Nm

Torque wrench 1/2" drive, 15–65 Nm

Removal

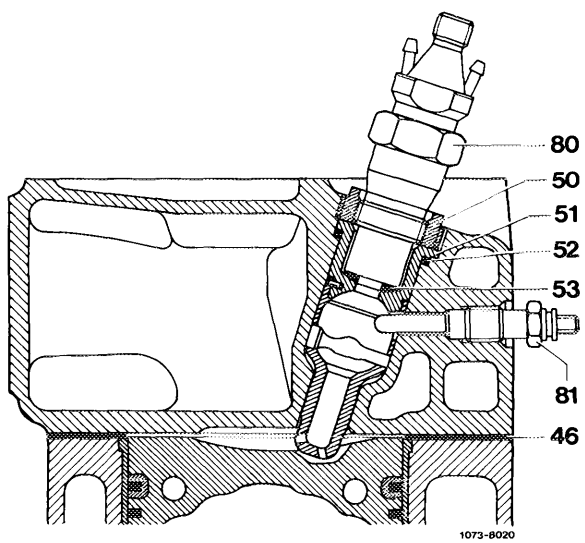
1 Unscrew injection lines.

2 Detach leak-off fuel hoses and plug of 5th injection nozzle.

3 Unscrew injection nozzles using socket. If precombustion chamber collar comes undone, tighten all collars (05–117).

4 Withdraw nozzle plate (53).

5 Sight-check precombustion chamber. Direct flashlight into chamber and examine whether ball pin is in satisfactory condition.



46 Cylinder head gasket
50 Collar
51 Precombustion chamber
52 Sealing ring
53 Nozzle plate
80 Injection nozzle
81 Pin-type glow plug

Installation

6 Install in reverse order, using new nozzle plates. Note tightening torques.

07.1–235 Removal and installation of fuel pump

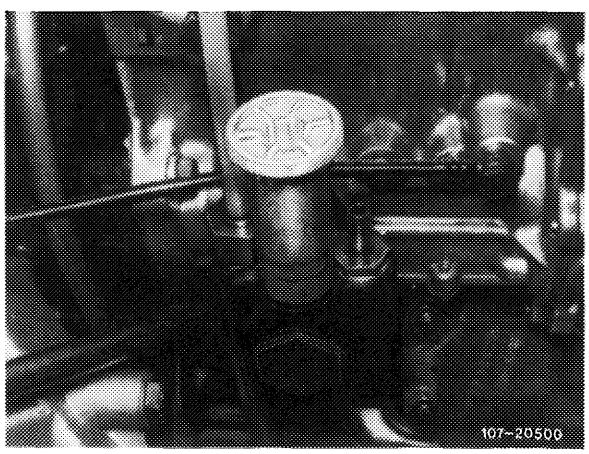
Job no. of flat rates or standard texts and flat rates data 07–5710.

Removal

1 Unscrew all fuel connections.

2 Release two fastening nuts and remove fuel pump.

3 Clean fuel pump, exchanging suction and delivery valves or fuel pump.



Installation

4 Fit fuel pump using new gasket.

5 Attach fuel connections and vent injection system (07.1–140).

6 Check fuel pump (07.1–145).

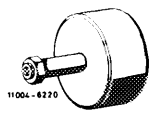
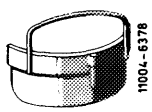
07.1–240 Removal and installation of injection timing device

Job no. of flat rates or standard texts and flat rates data 07–8014.

Testing data	
End play of intermediate sprocket shaft	0.05–0.12

Tightening torques	Nm
Hex-head bolt for injection timing device	40
Tightening bolt for camshaft sprocket	80

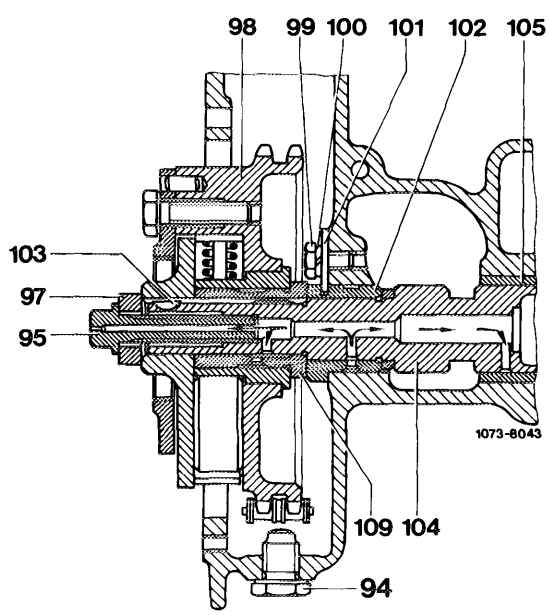
Special tools

Impact extractor for guide rail pins (basic unit)	 11004-6220	116 589 20 33 00
Stud M 6, 50 mm long	 11004-6368	116 589 01 34 00
Stud M 6, 150 mm long	 11004-6216	116 589 02 34 00
Supporting plate	 11004-6378	616 589 02 40 00

Note

The injection timing device is attached to the intermediate sprocket shaft (104) by a hex-head bolt (95).

Vacuum pump lubrication is provided via the intermediate sprocket shaft (104) and the hollow hex-head bolt (95). The adjustment range of the injection timing device amounts to 8° up to model year 1979, starting model year 1980 7.5°.



94 Retaining screw
95 Hex-head bolt M 10 x 45
97 Washer
98 Injection timing device
99 Bolt M 6 x 12
100 Lock washer B 6
101 Lock washer
102 Bearing bush
103 Woodruff key
104 Intermediate sprocket shaft
105 Bearing bush, rear
109 Bearing bush, injection timing device

Removal

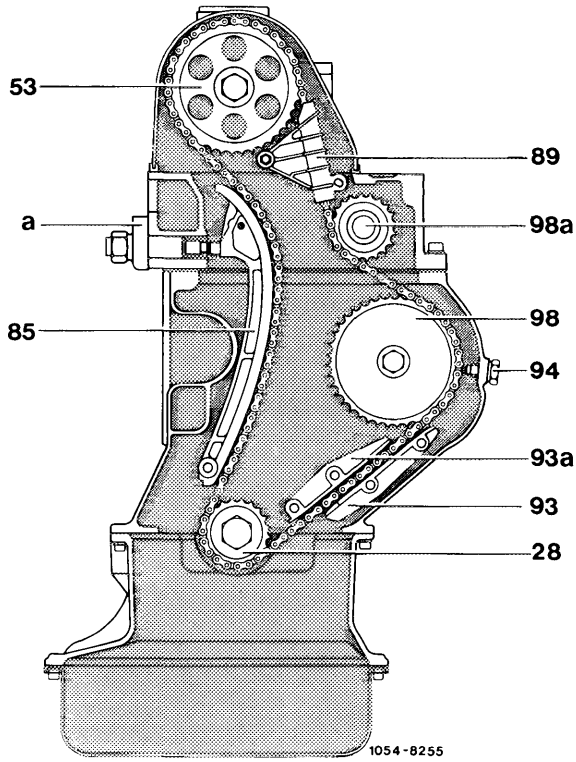
1 Remove radiator.

2 Unscrew suction and pressure line of diaphragm vacuum pump or suction line of piston vacuum pump and vacuum pump from cylinder crankcase.

3 Unscrew fastening nut of injection timing device.

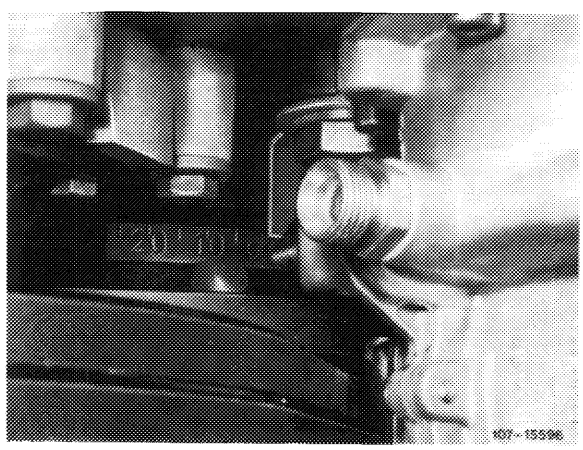
4 Remove cylinder head cover.

5 Unscrew bolt holding camshaft sprocket (53).

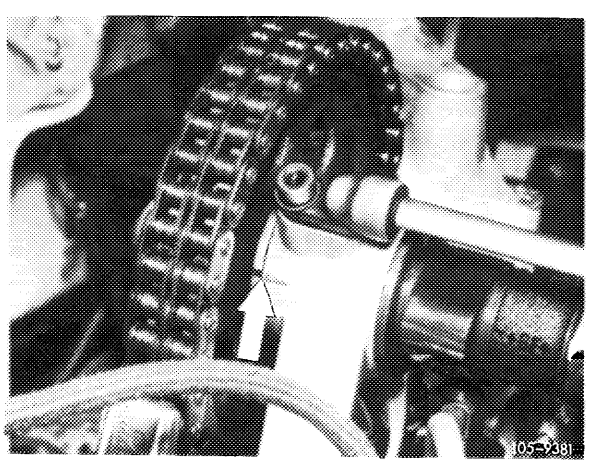


53 Camshaft sprocket
89 Guide rail
94 Retaining screw
93 Guide rail
93a Guide rail

6 Turn crankshaft in normal direction to TDC mark.



For correct camshaft alignment, position mark on shim adjacent to that on 1st camshaft bearing (arrow).



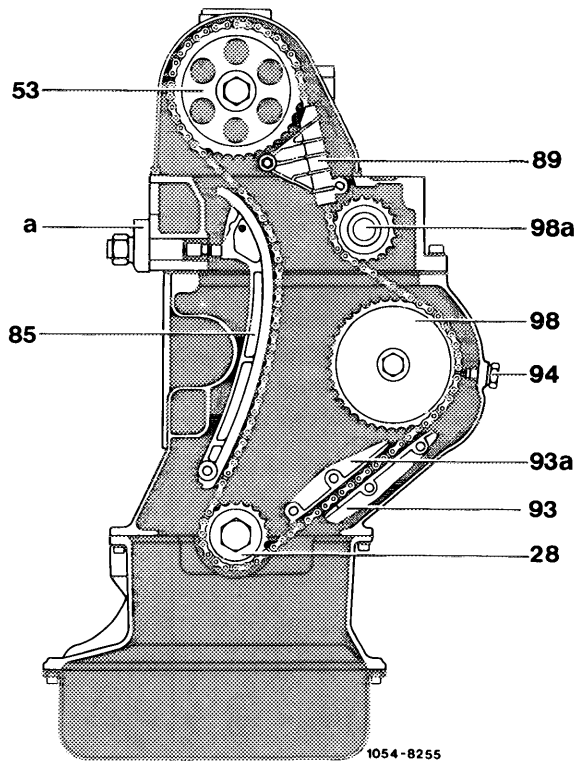
7 Using ink or paint, mark meshing point of chain on injection timing device, and position of injection timing device relative to crankcase.

8 Remove chain tensioner (05–310).

9 Unscrew hex-head bolts, withdraw bearing pin and then remove guide rail (89).

10 Detach camshaft sprocket, noting shim between camshaft and camshaft sprocket. Leave chain on sprocket and deposit together in chain box.

11 Unscrew chain drive retaining screw (94) and withdraw upper pin of guide rail (93) using puller.

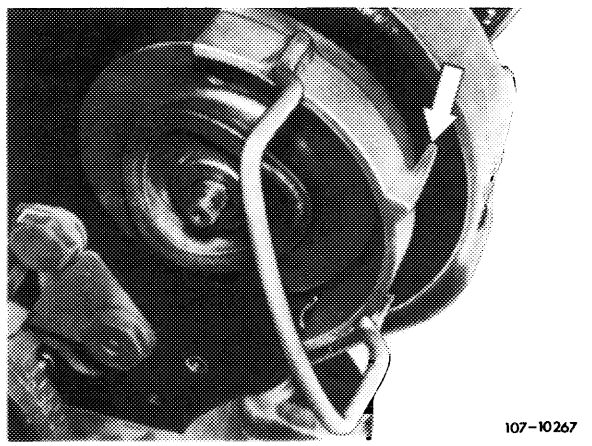


53 Camshaft sprocket
89 Guide rail
93 Guide rail
93a Guide rail
94 Retaining screw

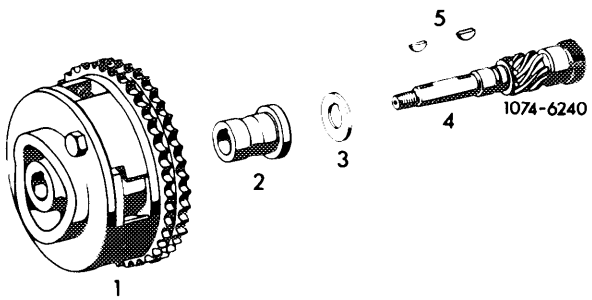
12 Lift chain out of injection timing device, sliding support plate between injection timing device and chain for this purpose. For better fixing, introduce guide pin (arrow) into tapped hole.

13 Remove or push off injection timing device.

Attention:
After removing injection timing device, be sure not to turn crankshaft or camshaft.



14 Remove injection timing device bush (2) and thrust ring (3) from intermediate sprocket shaft.



1 Injection timing device
2 Bush
3 Thrust ring
4 Intermediate sprocket shaft
5 Woodruff keys

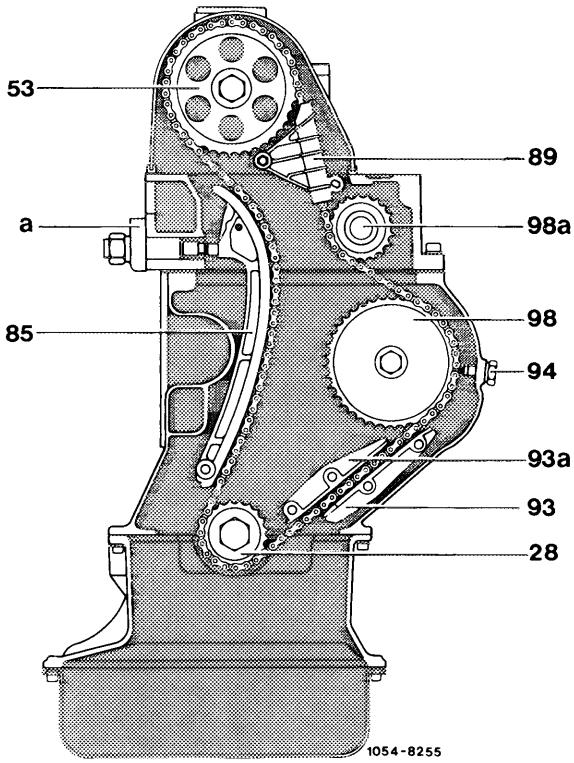
15 Check guide rails (93 and 93a) (sight-check), exchanging if necessary.

Installation

16 Oil thrust ring (3) and bush (2), slipping onto intermediate sprocket shaft. Make sure that both Woodruff keys (5) are correctly seated (illustration, No. 14).

Note: If injection timing device needs exchanging, position the old one on the new one in such a way that the keyways of the one agree with those of the other. The paint mark on the old injection timing device must now be transferred to the new one.

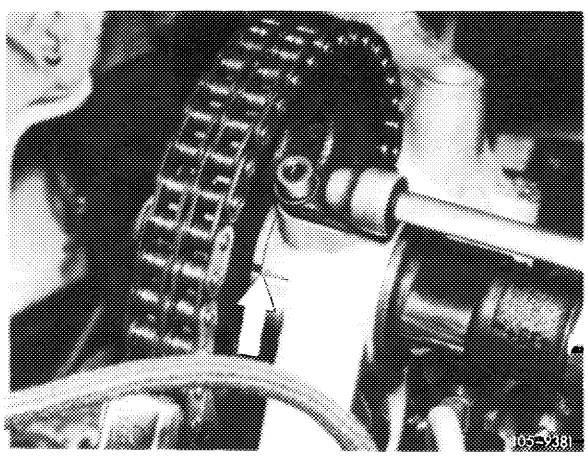
17 Slip injection timing device onto intermediate sprocket shaft.



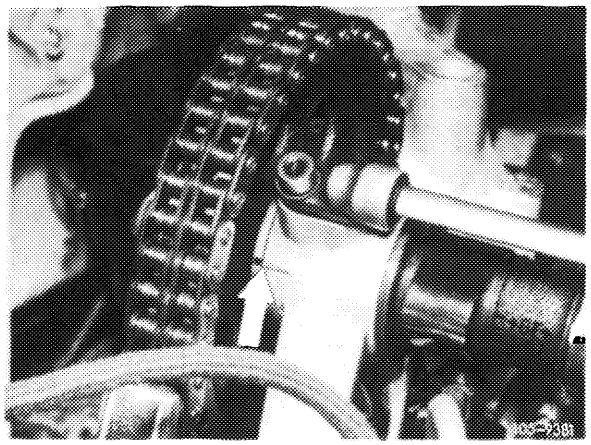
93 Guide rail
93a Guide rail

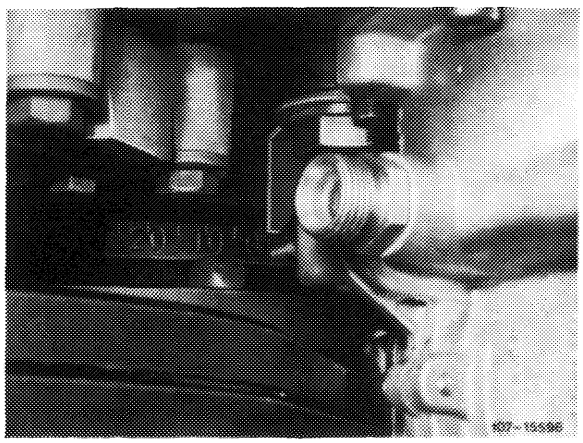
18 Draw chain upward and lift camshaft sprocket with chain, making sure that mark on injection timing device agrees with that on crankcase. If necessary, turn injection timing device until the two marks agree again. Then withdraw supporting plate. If marks are offset, insert supporting plate again and relocate chain on sprocket to make marks agree.

19 Slip camshaft sprocket and chain onto camshaft, making sure that mark in shim agrees with mark in first camshaft bearing.



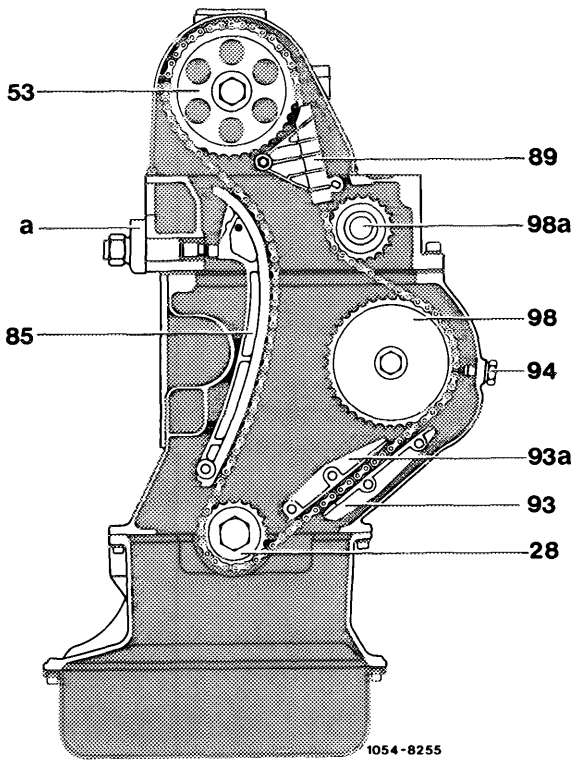
Check once again whether all marks are aligned in same way as before removal and whether TDC position of balance disk is correct.





20 Install chain tensioner (05–310).

21 Introduce bearing pin of guide rail (93a) into crankcase, coating pin end with sealant. While driving into position, make sure that wire retainer of guide rail engages notch in bearing pin.



22 Insert and tighten retaining screw (94) with new sealing ring.

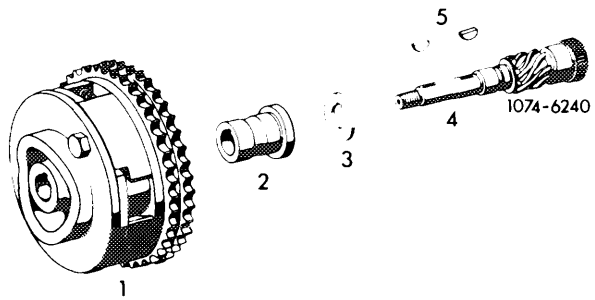
23 Check start of delivery adjusting if necessary (07.1–110 and 115).

24 Vent injection system (07.1–140).

25 Fit hollow hex-head bolt and torque to 40 Nm.

Attention:
Be sure to use hollow hex-head bolt only.

26 Check end play of intermediate sprocket shaft Specified value is 0.05–0.12 mm. Withdraw thrust ring (3) if necessary.



27 Insert camshaft sprocket bolt and torque to 80 Nm.

28 Check injection timing device for satisfactory operation, using a wrench to turn hexagon screw clockwise to stop. When screw is released, injection timing device must return to old position.

29 Fit vacuum pump with new gasket and connect vacuum lines.

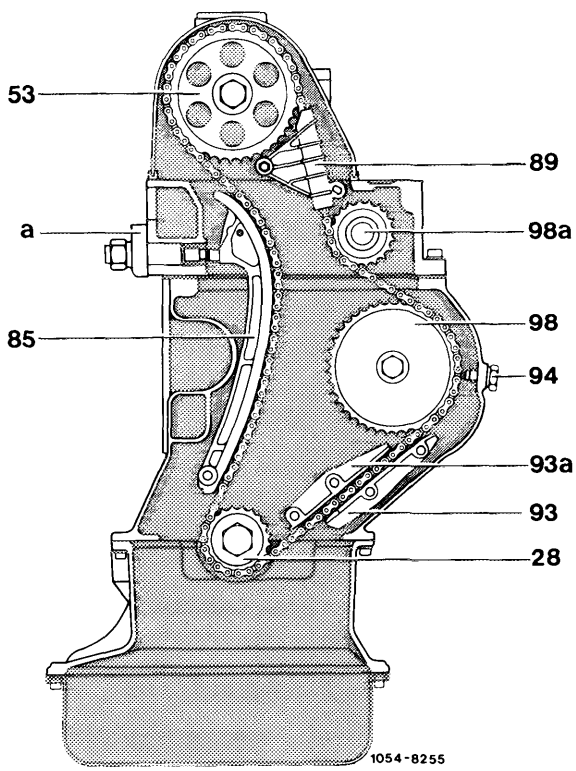
30 Hold guide rail (89) in position, insert drive pin and tighten.

31 Fit cylinder head cover, making sure that rubber gasket is correctly seated.

32 Attach and check control linkage, adjusting if necessary (30–300).

33 Fit radiator and connect all lines.

34 Run engine and check for leakage.



Removal

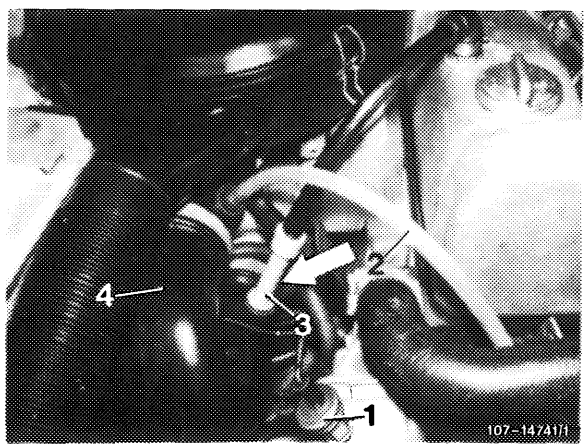
1 Detach intake hose at air filter.

2 Remove air filter cover.

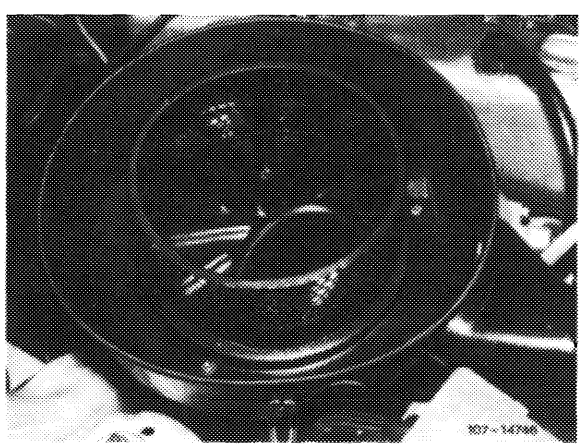
3 Unscrew vacuum line (2) for vacuum pump. On vehicles up to model year 1979 only.

4 Remove crankcase ventilation pipe (3).

5 Release hose clip (arrow) at intake line (4).



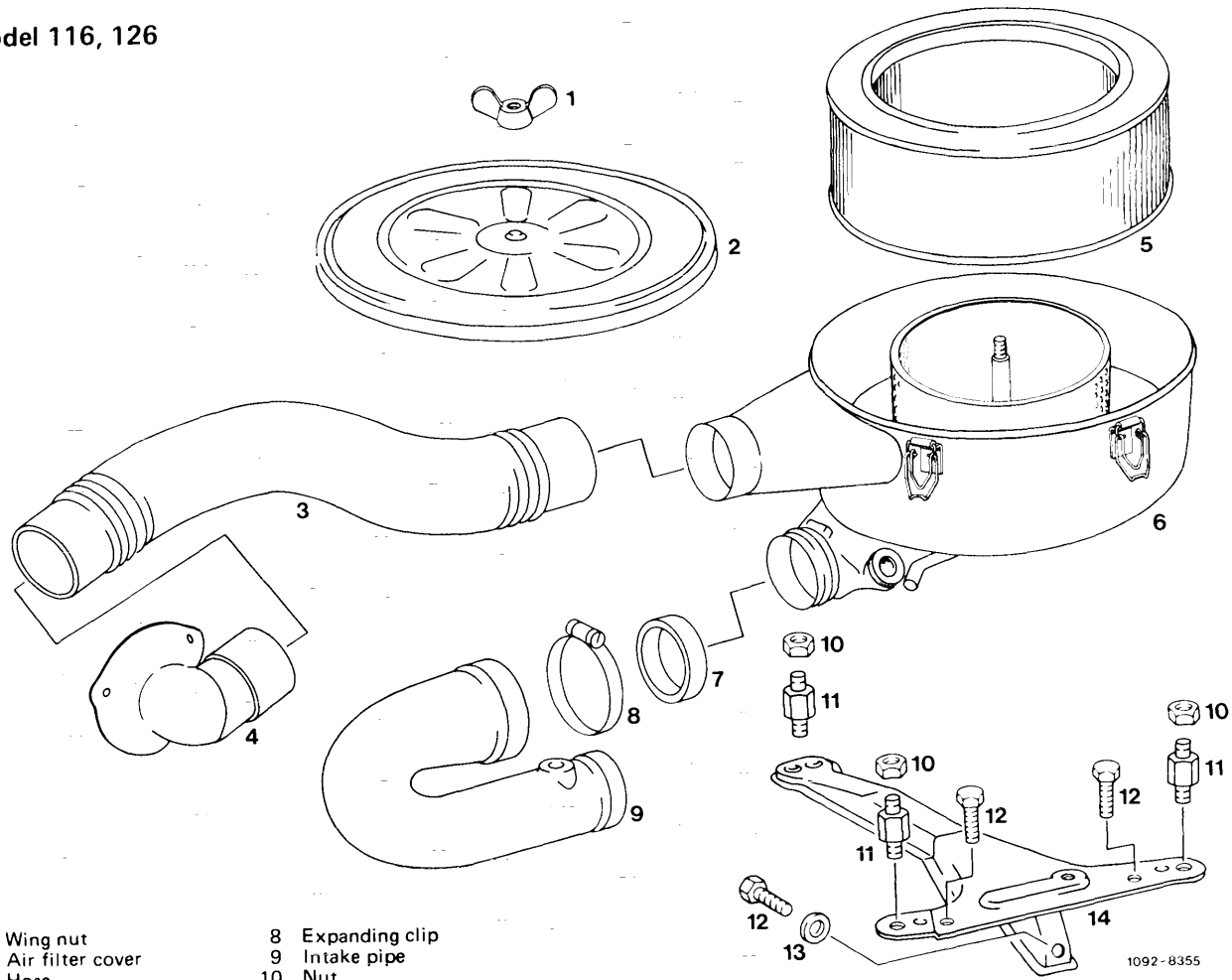
6 Unscrew fastening nuts inside air filter housing and withdraw air filter.



Installation

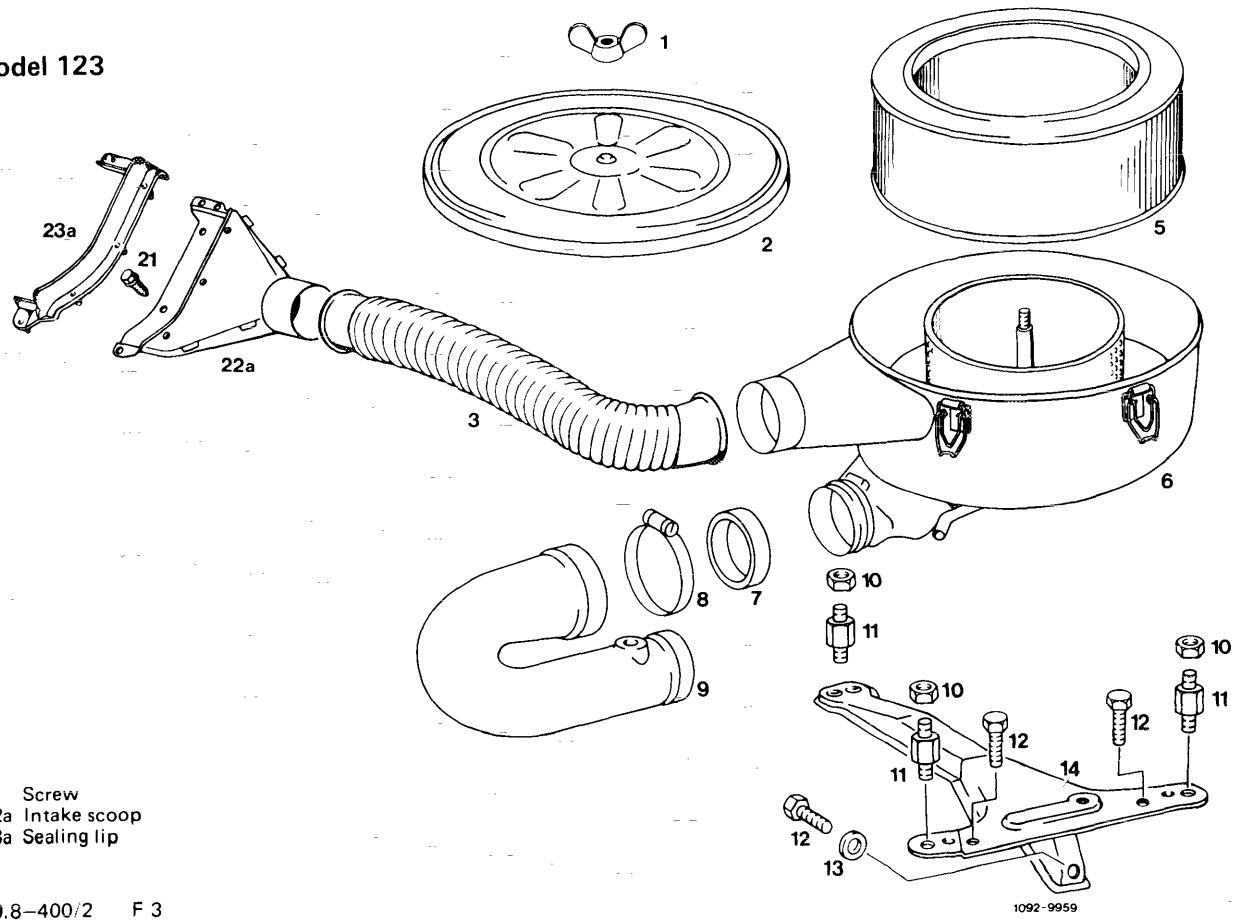
7 Install in reverse order, making sure that rubber ring is correctly seated at turbocharger flange.

Model 116, 126



1 Wing nut
2 Air filter cover
3 Hose
4 Air intake
5 Air filter element
6 Air filter
7 Rubber sealing ring
8 Expanding clip
9 Intake pipe
10 Nut
11 Rubber-bonded metal shock absorber
12 Bolt
13 Washer
14 Holder

Model 123



21 Screw
22a Intake scoop
23a Sealing lip

Test value

Boost pressure at full-load, driving range position „L" or „S" and n = 4000/min	0.7-0.8 bar gauge pressure

Special tool

Tester 0—1.6 bar gauge pressure		617 589 02 21 00

Conventional tester

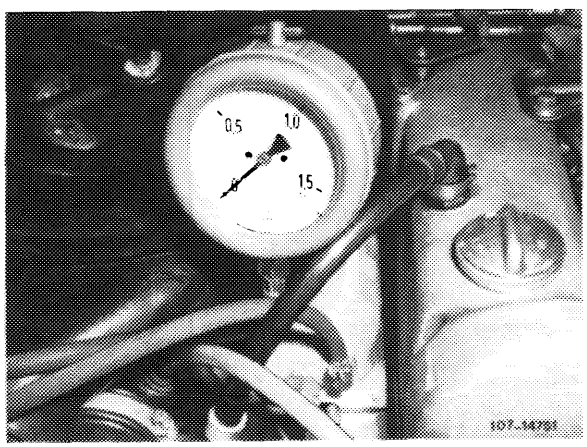
Digital tester (or revolution counter installed in vehicle)	e.g. Bosch, MOT 001.03

Checking

A. On boost air pipe

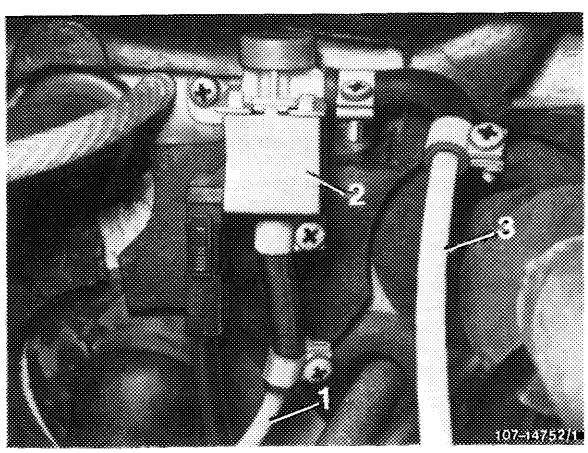
Connect boost pressure tester to intake manifold, unscrewing plug for this purpose.

Note: Tester connecting thread M 10 x 1.



B. On switchover valve

Connect boost air tester to switchover valve with Y-distributor, output of switchover valve.



1 Pressure line to boost air pipe
2 Switchover valve
3 Pressure line to ALDA capsule

1 Test on dynamometer.

Drive vehicle in driving range „S" at full-load and n = 4000/min. The prescribed boost pressure must be obtained.

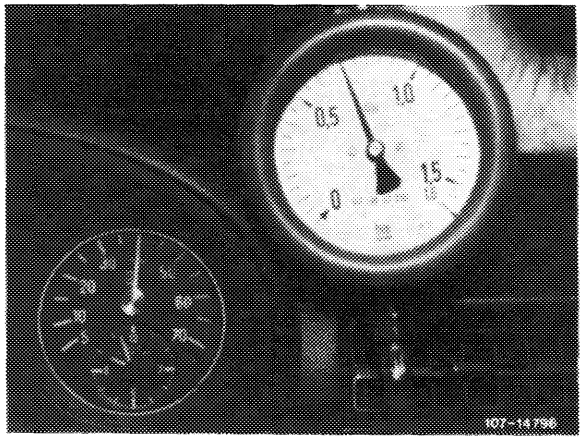
Check the trouble-shooting hints if system fails to reach specified boost pressure.

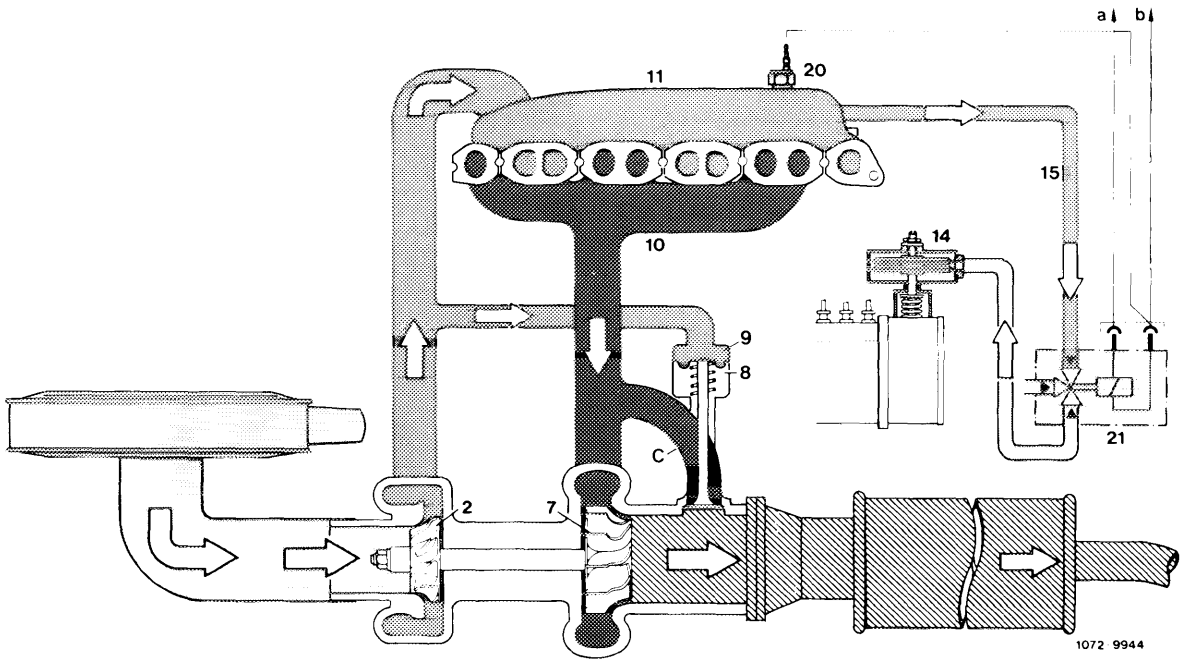
2 Road test.

Note: The full-load test must be kept as short as possible because the total driving energy has to be absorbed by the vehicle's own brakes.

Road-test the vehicle in driving range „L" or „S" at full-load and n = 4000/min, placing tester in vehicle interior for this purpose. Accelerate to full throttle while holding at 4000/min with the aid of service brakes (No. 2 in illustration). The prescribed boost pressure must be reached.

Check the trouble-shooting hints if system fails to reach specified boost pressure.





Compressor inlet (fresh air)

Compressor outlet (pre-compressed air)

Exhaust gases toward turbine wheel

Exhaust gas outlet

Function diagram

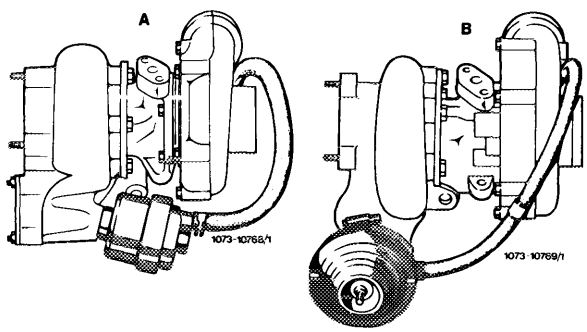
2 Compressor wheel
7 Turbine wheel
8 Boost pressure control valve
9 Connecting hose
10 Exhaust manifold
11 Boost air pipe
14 ALDA-capsule
15 Pressure line
20 Pressure switch boost air pipe
21 Switchover valve overload protection

a Fuse terminal 15
b Switching unit overload protection
c Exhaust gas toward bypass duct

Turbocharger designation

Garret	TA 0301
Kühnle Kopp and Kausch	KKK 532 679 60 31[1)]

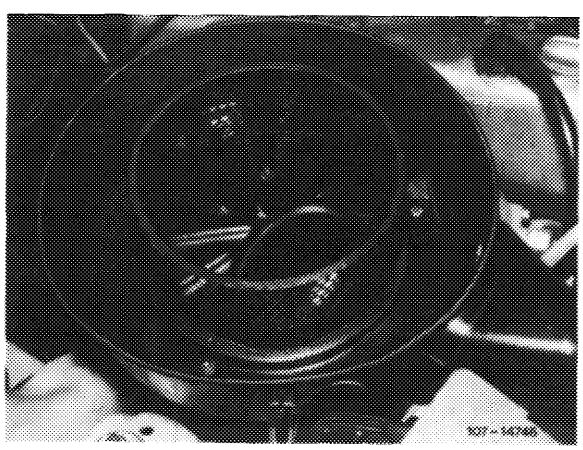
[1)] **Start of production**
World-wide except (USA): January 1983
(USA): February 1983



A Garret turbocharger
B KKK turbocharger

Removal

1 Remove air filter, detaching air filter cover and unscrewing 3 fastening nuts.

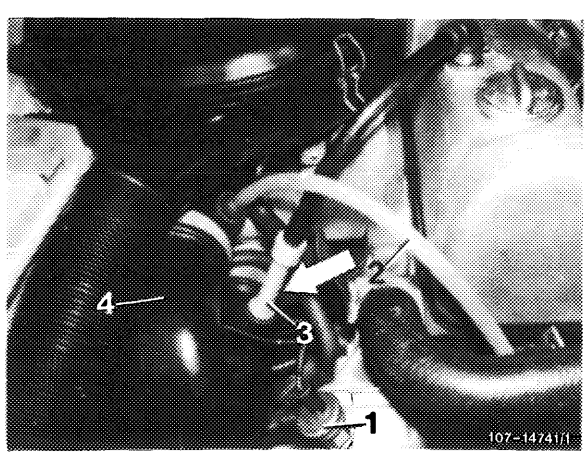


2 On vehicles with automatic climate control or air-conditioning remove electric line for 100° C temperature switch (1).

3 Release lower hose clip (arrow) on intake line (4) from air filter to compressor housing. On vehicles up to model 1979 only.

4 Remove vacuum line (2) and crankcase ventilation pipe (3).

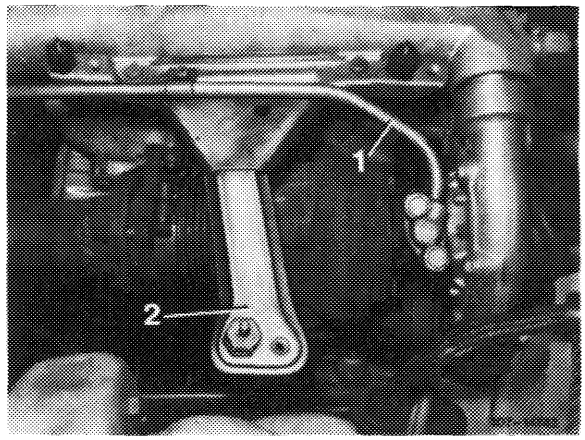
5 Remove air filter with intake line (4).



1 Temperature switch 100° C
2 Vacuum line
3 Crankcase ventilation pipe
4 Intake line

6 Unscrew engine oil supply line (1).

7 Unscrew air filter holder (2). To do so, release 3 hex-head bolts (2 from above, 1 from below) and remove holder.

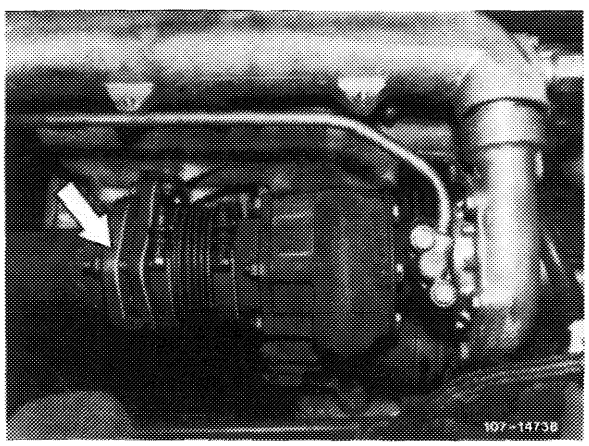


1 Engine oil supply line
2 Air filter holder

8 Unscrew exhaust flange (arrow).

9 Release and remove exhaust holder on automatic transmission.

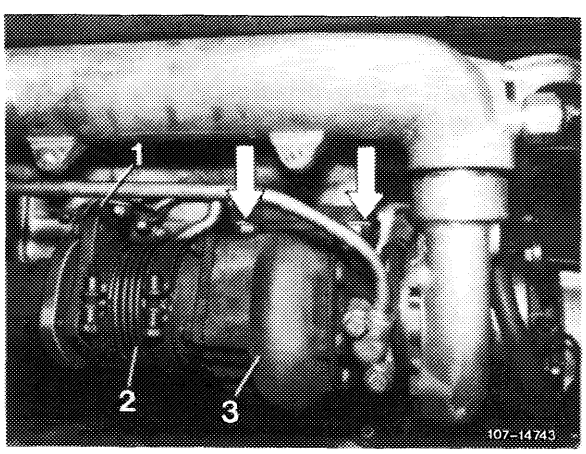
10 Force exhaust pipe toward rear.



11 Unscrew holder (1) for adapter fitting (2).

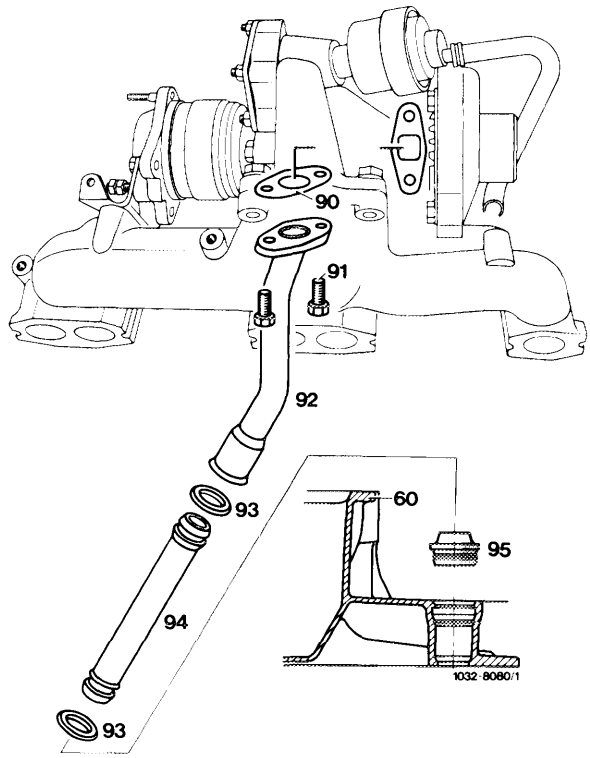
12 Unscrew 4 fastening nuts (arrows) at exhaust-driven turbocharger and remove turbocharger.

13 Unscrew adapter fitting (2) at exhaust-driven turbocharger (3).



1 Holder
2 Adapter fitting
3 Turbocharger

14 Unscrew oil return pipe (92) at turbocharger.



60 Oil pan, upper part
90 Gasket
91 2 bolts M 8 x 20
92 Oil return pipe (upper part)
93 O-ring
94 Oil return pipe (lower part)
95 Sectional seal

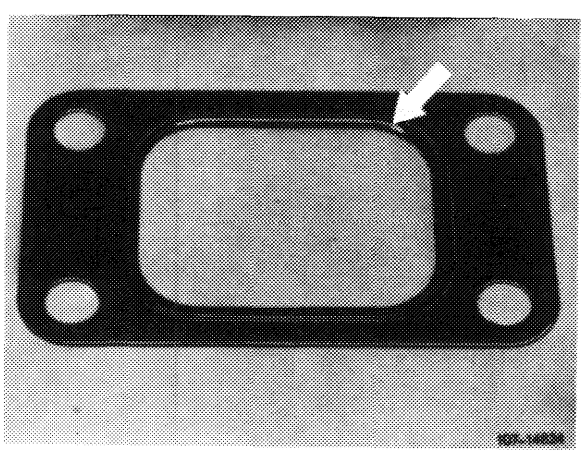
Installation

Install in reverse order, using new gaskets (repair set). Please note the following points:

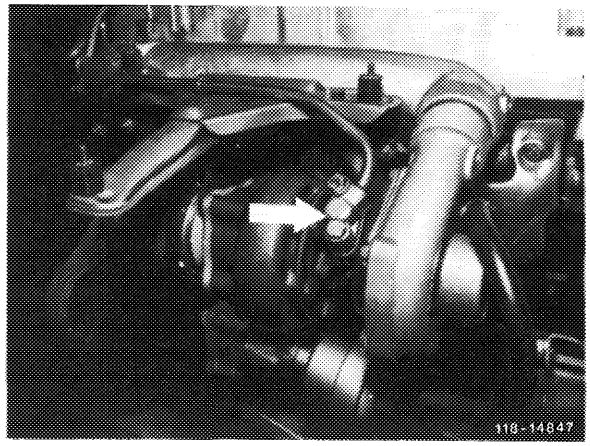
15 Prior to installing turbocharger, attach adapter fitting and oil return pipe. Correct positioning is absolutely essential.

16 Insert flange gasket between turbocharger and exhaust manifold so that bead (arrow) is at exhaust manifold side.

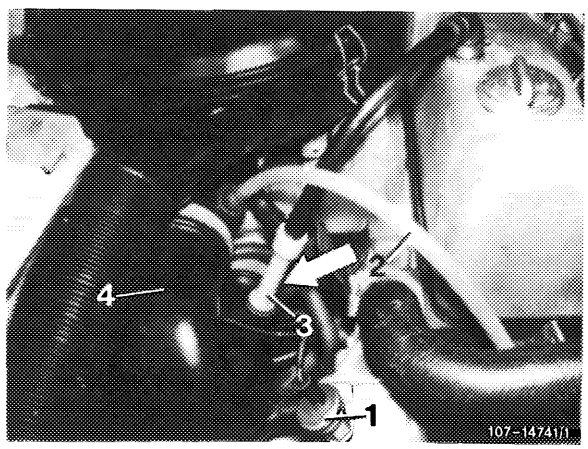
17 **Always use heat-resistant nuts and bolts** to attach the turbocharger.



18 Prior to using a replacement turbocharger, fill with approx. 1/8 l engine oil through engine oil supply hole (arrow).

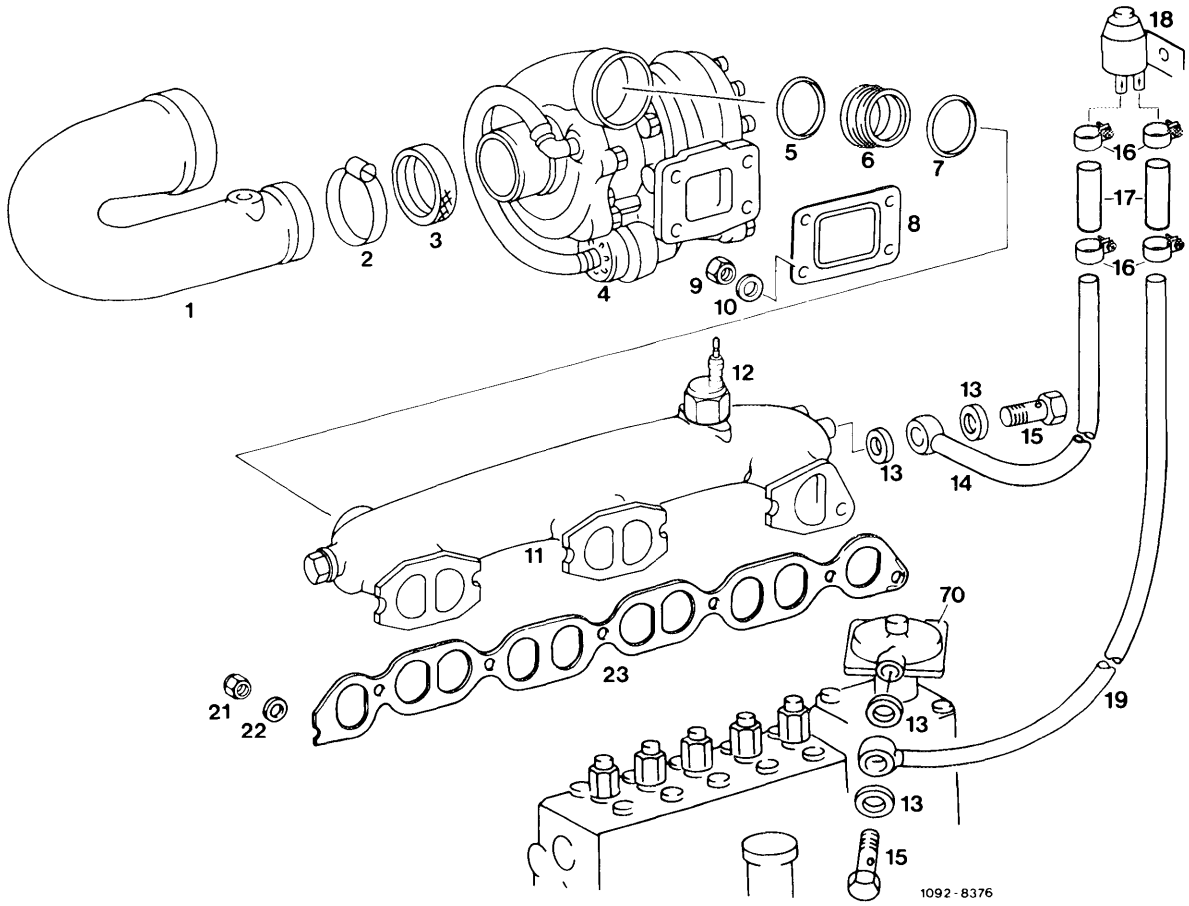


19 Make sure that intake line (4) is fitted in such a way that rubber sealing rings are correctly positioned.



1 Temperature switch
2 Vacuum line
3 Ventilation pipe
4 Intake line

A. Exhaust Gas Turbocharger



1 Intake line
2 Hose clip
3 Rubber sealing ring
4 Turbocharger
5 Rubber sealing ring
6 Adapter fitting
7 Rubber sealing ring
8 Flange gasket
9 Heat-resistant nut
10 Washer
11 Intake manifold
12 Pressure switch
13 Sealing ring
14 Delivery line from intake manifold
15 Union screw
16 Hose clip
17 Connecting hose
18 Switchover valve
19 Delivery line to aneroid compensator
21 Nut
22 Washer
23 Gasket
70 Aneroid compensator

A. Exhaust Gas Turbocharger

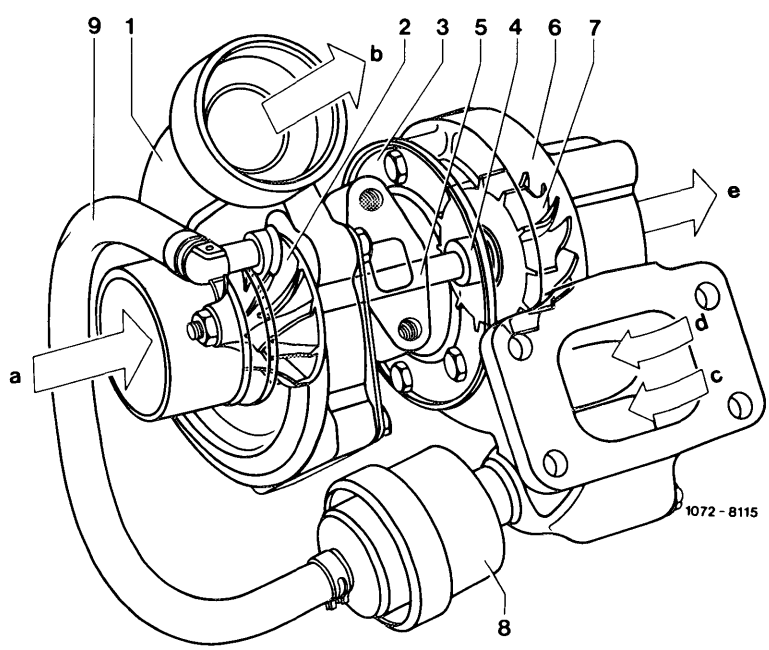
Exhaust gas turbocharger designation

Garret	TA 0301
Kühnle Kopp and Kausch	KKK 532 679 60 31

General

The exhaust gas turbocharger is a machine using the aerodynamic energy of the exhaust gases to drive a turbine which in turn propels a compressor via a shaft. The turbocharger is located between the exhaust manifold and exhaust pipe, being connected to the engine oil cycle for lubrication and cooling.

A boost pressure control valve on the turbine housing prevents a given boost pressure from being exceeded. In the event of a defective boost pressure control valve, an engine or an engine-transmission overload protection prevents breakdown of engine or transmission.



Layout of exhaust gas turbocharger with boost pressure control valve

1 Compressor housing
2 Compressor wheel
3 Center housing
4 Bearings
5 Shaft
6 Turbine housing
7 Turbine wheel
8 Boost pressure control valve
9 Connecting hose
a Compressor intake (fresh air)
b Compressor discharge (compressed air)
c Exhaust gases to bypass duct
d Exhaust gases to turbine wheel
e Exhaust gas discharge

Functional Description

The engine exhaust gases are routed via the exhaust manifold straight to the turbine housing (6) and the turbine wheel (7). The aerodynamic energy of the exhaust gases makes the turbine wheel (7) rotate, driving the compressor wheel (2) which is joined to the turbine wheel (7) via the shaft (5). Maximum speed amounts to about 100,000/min. The fresh air induced by the compressor wheel (2) is compressed and delivered to the engine.

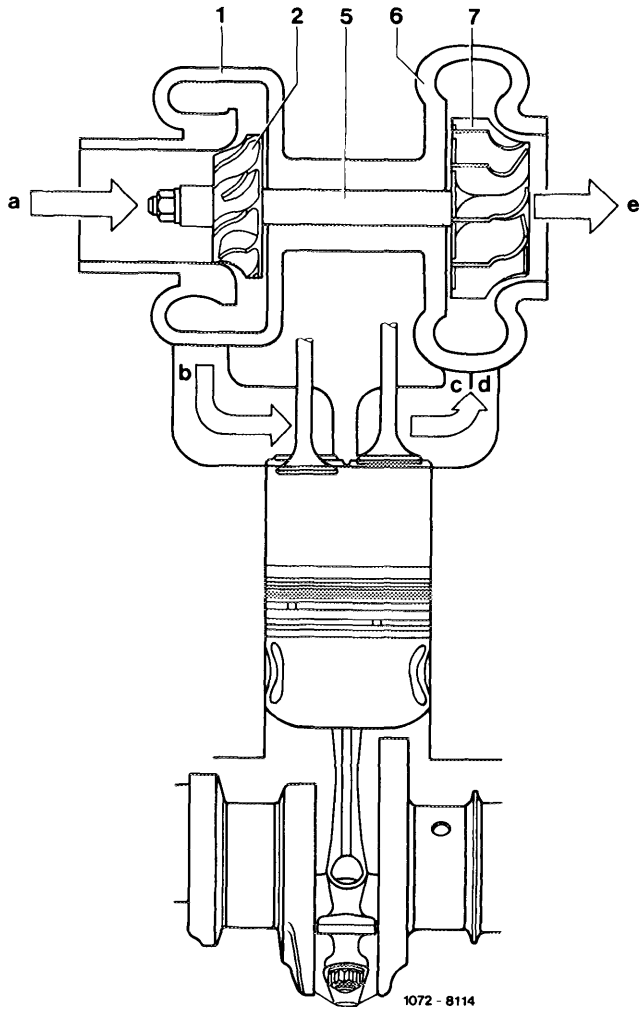
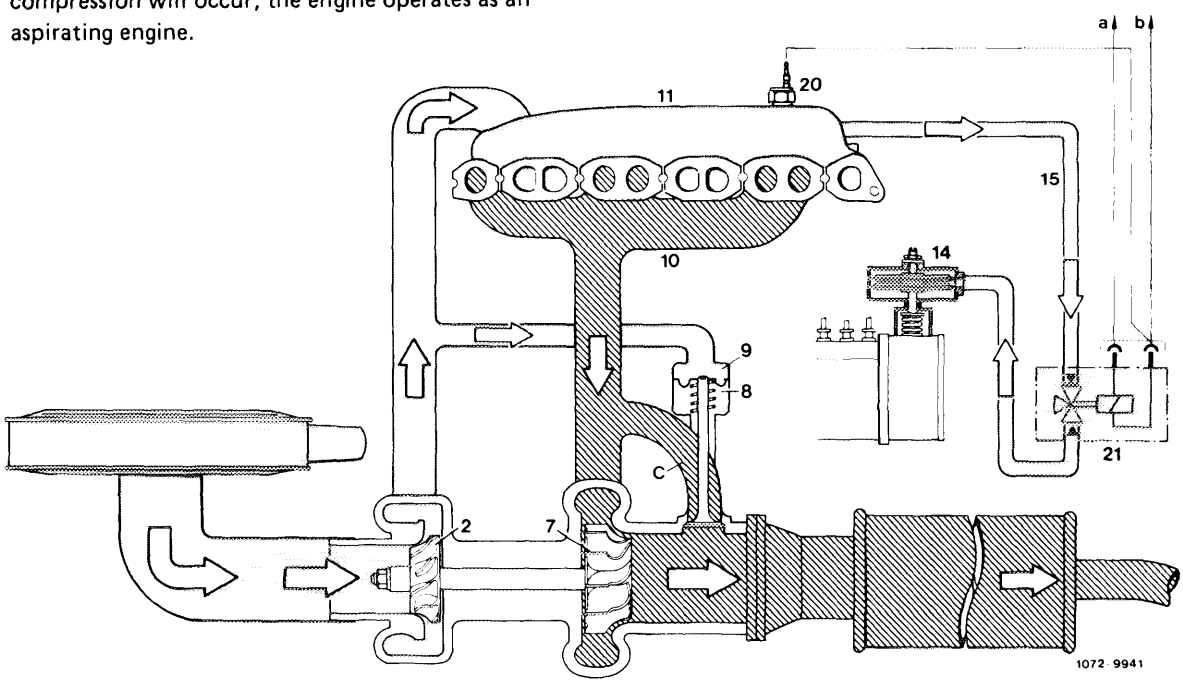


Diagram of fresh air and exhaust gas flow

1 Compressor housing
2 Compressor wheel
5 Shaft
6 Turbine housing
7 Turbine wheel
a Compressor intake (fresh air)
b Compressor discharge (compressed air)
c Exhaust gases from exhaust manifold
d Exhaust gases from exhaust manifold
e Exhaust gas discharge (to exhaust pipe)

Idle speed and lower partial load

At idle and lower partial load no worthwhile pre-compression will occur, the engine operates as an aspirating engine.



Compressor inlet (fresh air)

Exhaust gas outlet

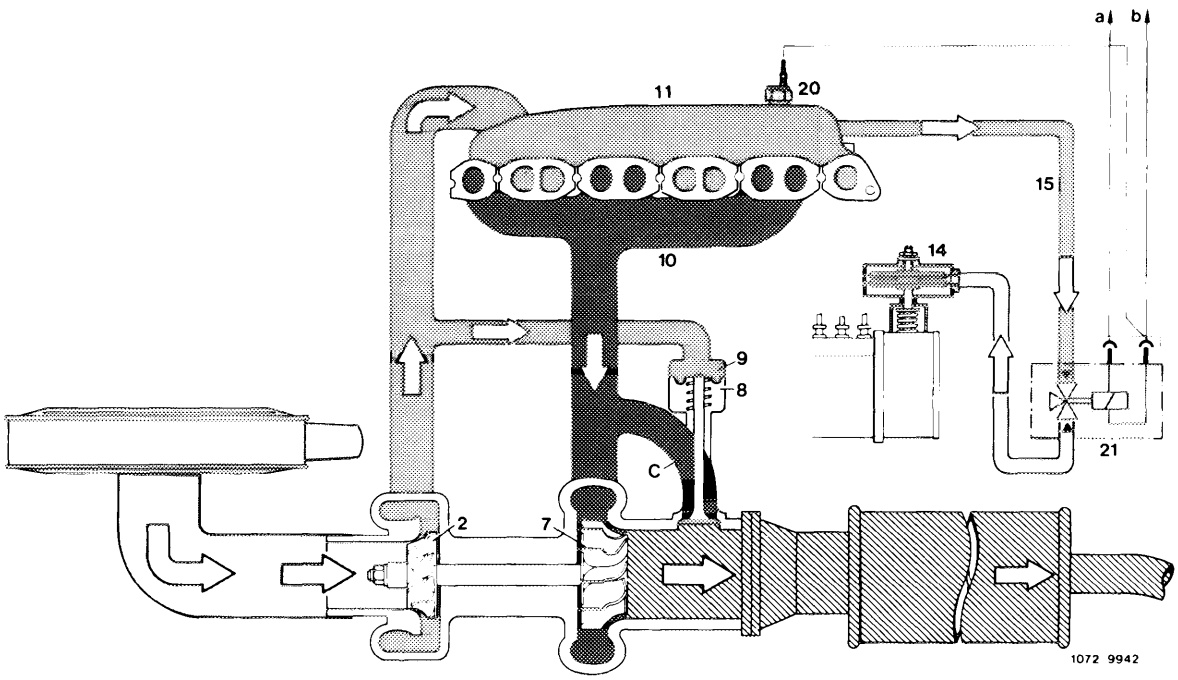
2 Compressor wheel
7 Turbine wheel
8 Boost pressure control valve
9 Connecting hose
10 Exhaust manifold
11 Boost air pipe
14 ALDA capsule
15 Pressure line
20 Pressure switch boost air pipe
21 Changeover valve

a Fuse terminal 15
b Switching unit overload protection
c Exhaust gas to bypass duct

Upper partial load and full load

With increasing load and speed, that is, with increasing exhaust gas flow, the turbine wheel (7) is accelerated and the compressor wheel (2) will then generate a boost pressure up to a given value. The compressed charge-air is fed to the indiviual cylinders by way of the boost air (charge-air) pipe. The boost pressure adds increased fuel quantities by way of the ALDA unit on injection pump.

During deceleration, boost pressure is available but fuel injection is stopped due to position of control rod.



Compressor inlet (fresh air)

Compressor outlet (pre-compressed air)

Exhaust gases to turbine wheel

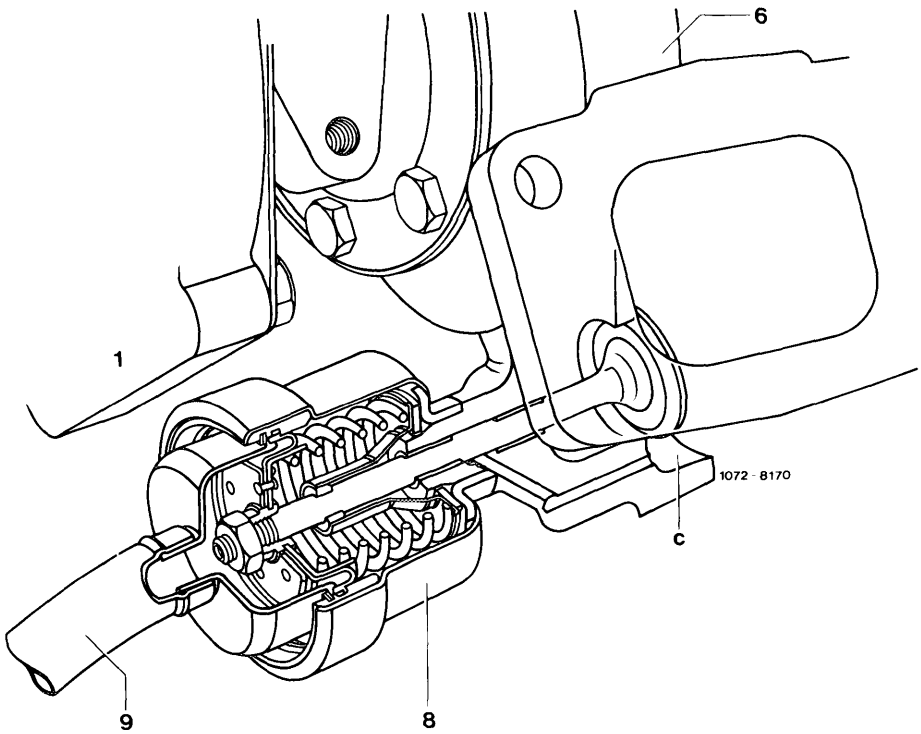
Exhaust gas outlet

2 Compressor wheel
7 Turbine wheel
8 Boost pressure control valve
9 Connecting hose
10 Exhaust manifold
11 Boost air pipe
14 ALDA capsule
15 Pressure line
20 Pressure switch boost air pipe
21 Changeover valve overload protection

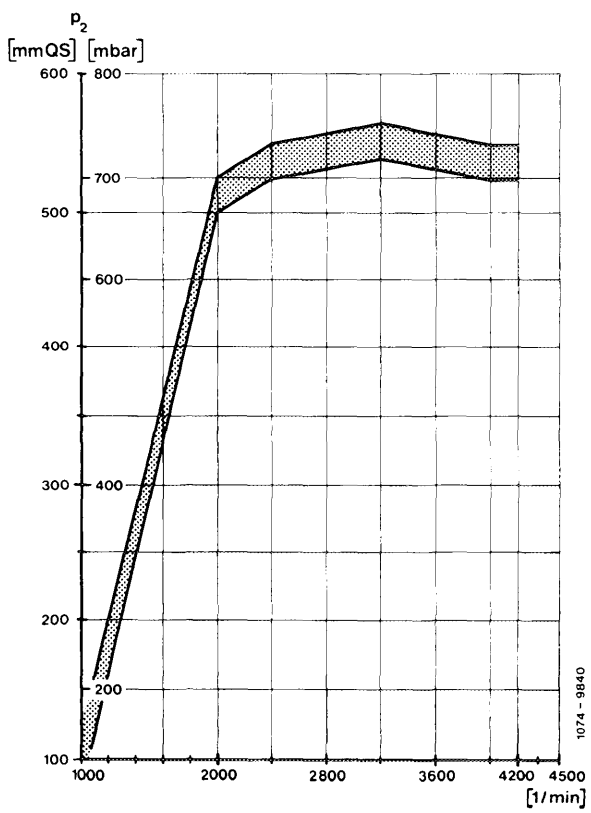
a Fuse terminal 15
b Switching unit overload protection
c Exhaust gas to bypass duct

Boost Pressure Control Valve

The turbine housing (6) bears a boost pressure control valve (8) designed to prevent the boost pressure from exceeding a given value. The boost pressure is tapped at the compressor housing (1) and passed to the boost pressure control valve (8) via the connecting hose (9). Once a given boost pressure is reached, the boost pressure control valve (8) begins to open the bypass duct (c). Some of the exhaust gases are now able to flow directly into exhaust pipe, keeping the boost pressure at a constant level



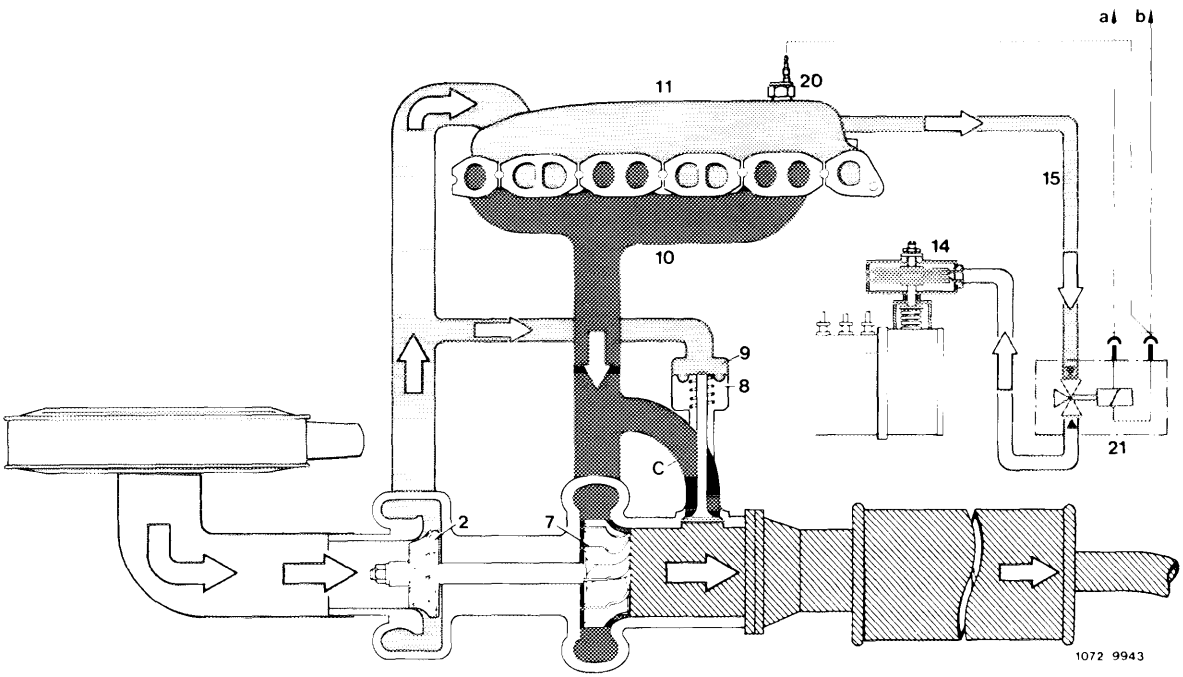
1 Compressor housing
6 Turbine housing
8 Boost pressure control valve
9 Connecting hose
c Bypass duct



Boost pressure diagram at full load.

Engine overload protection

For overload protection of mechanical engine components a pressure switch is mounted in boost air pipe. If the boost pressure increases above 1.1 ± 0.15 bar gauge pressure, the ALDA diaphragm capsule is positively vented via changeover valve and the fuel quantity is restricted to that of an aspirating engine.



Exhaust gases to turbine wheel

Compressor outlet (pre-compressed air)

Compressor inlet (fresh air)

Exhaust gas outlet

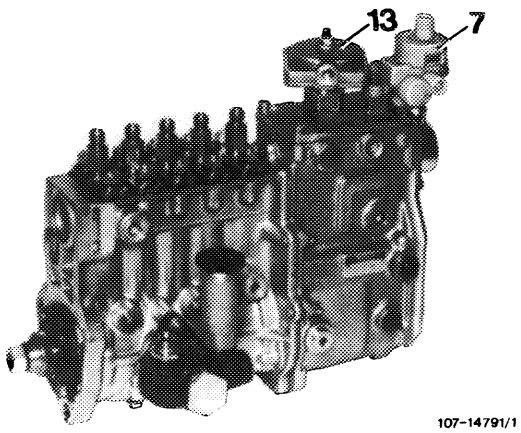
2 Compressor wheel
7 Turbine wheel
8 Boost pressure control valve
9 Connecting hose
10 Exhaust manifold
11 Boost air pipe
14 ALDA capsule
15 Pressure line
20 Pressure switch boost air pipe
21 Switchover valve overload protection

a Fuse terminal 15
b Switching unit overload protection
c Exhaust gas to bypass duct

B. Absolute-measuring boost pressure stop (ALDA)

The MW injection pump is provided with an absolute-measuring boost pressure stop (ALDA) and a vacuum control valve (7) for the modulating pressure of the automatic transmission.

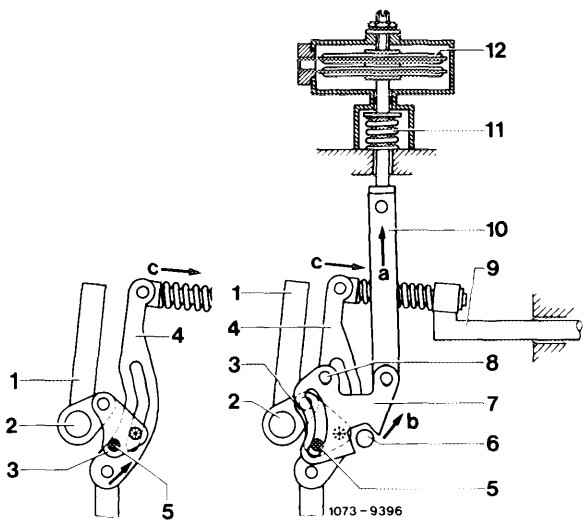
The ALDA equipment adapts the injected fuel quantity to the prevailing boost pressure and the respective altitude. As a result, the combustion chambers will always be provided with the correct injected fuel quantity of the respective cylinder charge to provide the best possible efficiency during the various operating modes. The ALDA capsule (13) is connected to the boost pressure pipe by means of a pressure line.



107-14791/1

Enrichment by means of boost pressure

The ALDA unit comprises 2 aneroid capsules (12), a compression spring (11), a connecting rod (10) and the slotted lever (7). Connecting rod (10) is connected to control rod (9) by way of the slotted lever (7), lever (3) and control lever (4). When the boost pressure increases, the aneroid capsules (12) are compressed and, assisted by compression spring (11), will move the connecting rod (10) in direction "a". This in turn will move the slotted lever (7) within its adjusting range in direction "b" and will push the control rod (9) in direction "c" via coupling lever (3) and control lever (4). The injected fuel quantity is increased.



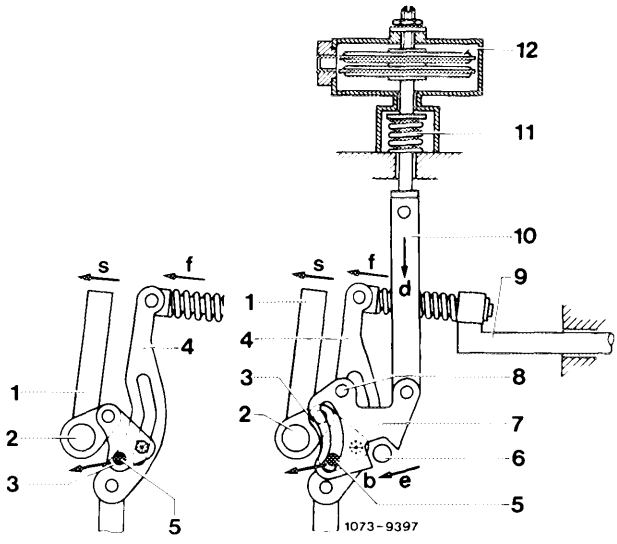
ALDA with control linkage

1	Adjusting lever	7	Slotted lever
2	Adjusting lever shaft	8	Pivot (slotted lever)
3	Coupling lever	9	Control rod
4	Control lever	10	Connecting rod
5	Bolt	11	Compression spring
6	Stop	12	Aneroid capsules

Correction at high altitudes

During operation at high altitudes the aneroid capsules (12) begin to expand due to the increasing atmospheric pressure and force the connecting rod (10) in direction "d" against the compression spring (11).

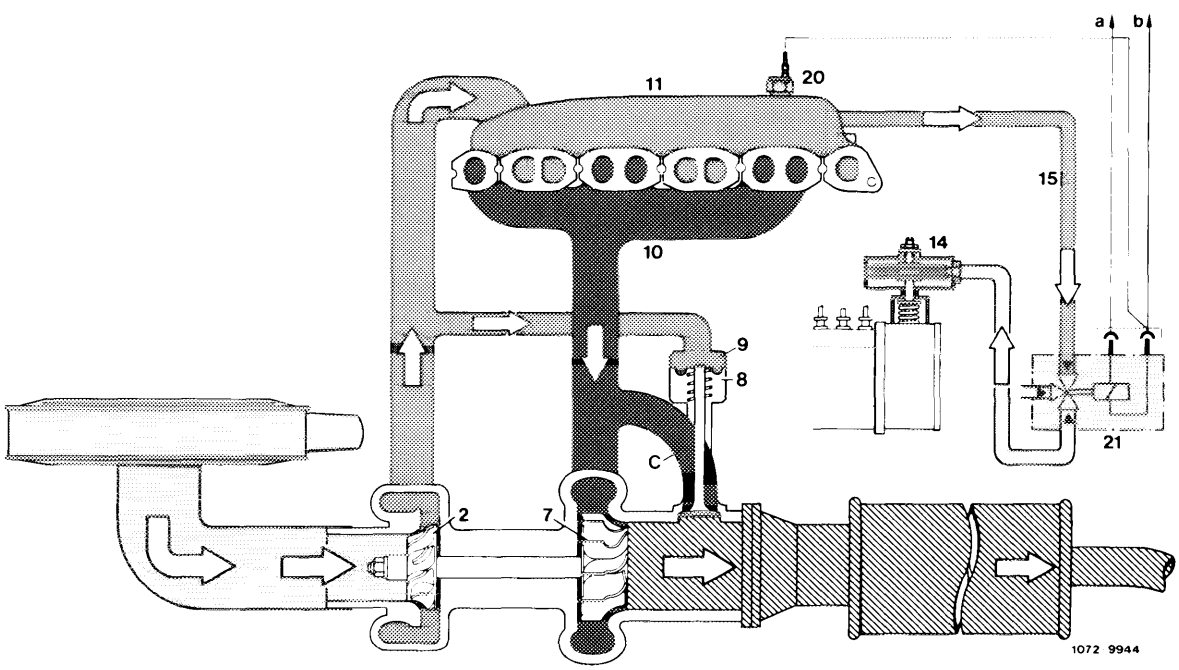
The slotted lever (7) then moves in direction "e" and hence pushes the control rod (9) in direction "f" via the coupling lever (3) and the control lever (4). The amount of fuel injected begins to drop.



Transmission overload protection

For overload protection of automatic transmission in extreme cases, e.g., moving-off uphill with a trailer, two values are decisive in influencing pressure conditions in ALDA aneroid capsule.

Below a modulating pressure of 0.3 bar gauge pressure and at engine speeds > 2000/min, the changeover valve will positively vent the ALDA aneroid capsule and will thereby limit the fuel quantity.



Compressor inlet (fresh air)

Compressor outlet (pre-compressed air)

Exhaust gases to turbine wheel

Exhaust gás outlet

2 Compressor wheel
7 Turbine wheel
8 Boost pressure control valve
9 Connecting hose
10 Exhaust manifold
11 Boost air pipe
14 ALDA capsule
15 Pressure line
20 Pressure switch boost air pipe
21 Changeover valve overload protection

a Fuse terminal 15
b Switching unit overload protection
c Exhaust gas to bypass duct

Adjusting data

V-belts (profile width in mm)	New V-belts (KG scale on measuring instrument)	Used V-belts (KG scale on measuring instrument)
9.5	30	20–25
12.5	50	40–45

Conventional tool

Measuring instrument (Krikit)	e.g. made by Gates GmbH Gravener Straße 191–193, D–4018 Langenfeld 2
	e.g. made by Gates Rubber Company 999 S. Broadway, USA–80217 Denver/Colorado

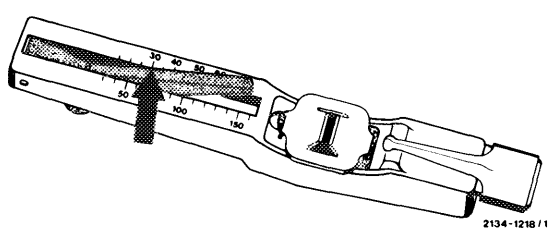
Checking condition of V-belts

Cracked, porous, burnt or worn V-belts should be replaced.

Checking tension

For handling of instrument, refer to operating instructions, renewing and tensioning V-belts (13–340).

The respective adjusting data refer to KG scale of measuring instrument (arrow).



Used V-belts

Check tension of V-belts and compare with values named in table for used V-belts (e.g. V-belt, profile width 9.5 mm = adjusting value 20—25) and retension, if required.

Mounting and tensioning of new V-belts

Perfect mounting of a V-belt requires loosening of respective auxiliary unit or of tensioning device of V-belt to the extent that the belt can be easily mounted. In addition, the running surfaces for the V-belts on pulleys must be free of burr, rust and dirt.

Keep free of oil, grease, chemicals. Do not use belt wax or similar agents. Subsequent optimal adjustment of belt tension (for adjusting values refer to table) serves to prevent complaints such as squeaking V-belts and low life.

In scope of maintenance jobs, mount V-belts prior to engine checkup and tension to value for **new V-belts** named in table (e.g. V-belt, profile width 9.5 mm = adjusting value 30).

If the V-belt tension is checked during final acceptance or following a test drive, the value measured in such a case should be in agreement with the value named in table for **used V-belts** (e.g. V-belt with profile width 9.5 mm = adjusting value 20—25). If less, retension V-belt to this value.

V-belt dimensions and adjusting values

V-belts		A Alternator Coolant pump	B Refrigerant compressor	C Power steering pump
Dimensions		9.5 x 1035[1]) (2 each)	12.5 x 925	12.5 x 1145
Adjusting value KG scale on measuring instrument	new	30	50	
	used	20–25	40–45	

[1]) Double V-belts may be installed in pairs and from one manufacturer only.

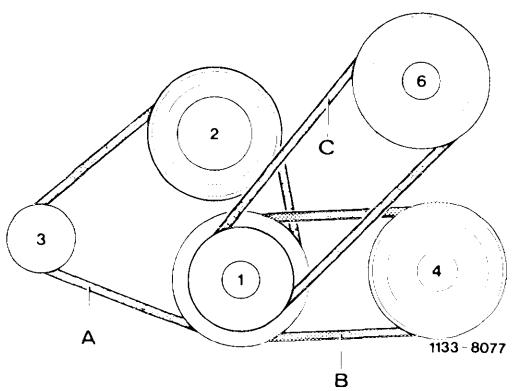
Conventional tool

Measuring instrument (Krikit)	e.g. made by Gates GmbH Gravener Straße 191–193, D–4018 Langenfeld 2
	e.g. made by Gates Rubber Company 999 S. Broadway, USA–80217 Denver/Colorado

Note

The Krikit measuring instrument is recommended for testing V-belt tension.

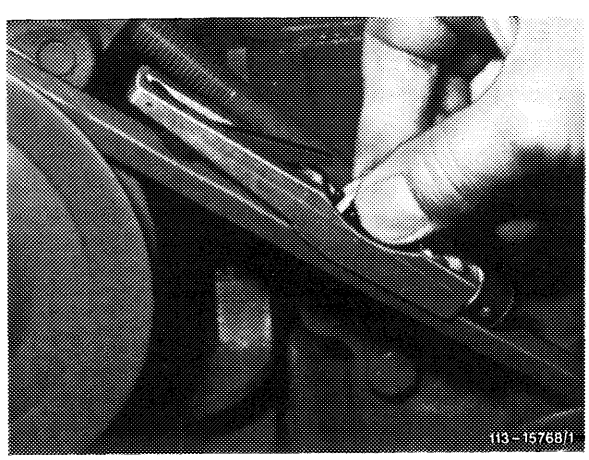
1 Crankshaft
2 Coolant pump
3 Alternator
4 Refrigerant compressor
6 Power steering pump



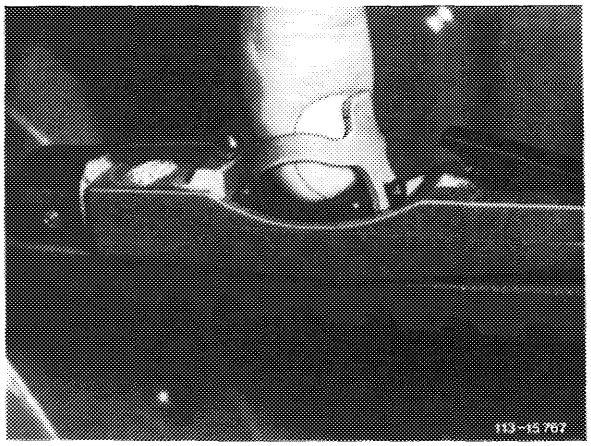
Handling of measuring instrument

For testing V-belt tension the measuring instrument can be handled in various ways:

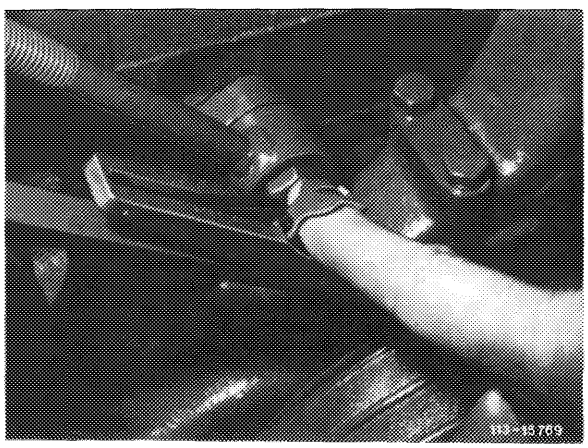
a) With thumb and forefinger against rubber loop, with the finger tips resting on pushbutton.



b) With forefinger from above in rubber loop.



c) With forefinger laterally between rubber loop and pushbutton.

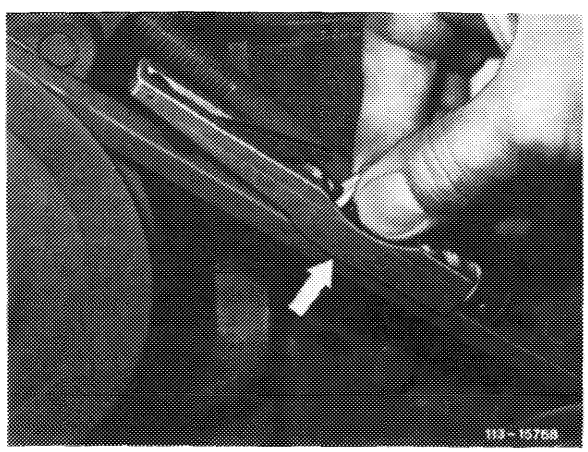


Testing

1 Lower indicator arm on measuring instrument.

2 Place measuring instrument on V-belt in center between pulleys. The lateral stop of the measuring instrument should rest laterally against V-belt (arrow).

Attention!
On double belt drive, make sure that the measuring instrument rests on one V-belt only.



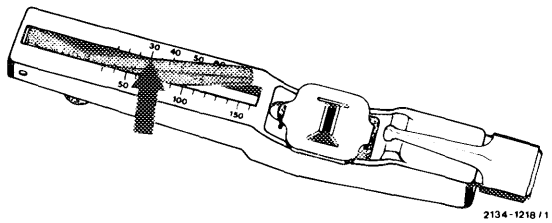
3 Exert a uniform, vertical pressure on V-belt upper surface by means of pushbutton, until click spring is audibly (or noticeably) disengaging.

Note: Upon disengagement of click spring, do not continue pushing on measuring instrument, since otherwise a wrong measuring value will be indicated.

4 Carefully lift measuring instrument from V-belt. Avoid knocks against instrument and do not change position of indicator arm.

5 Read tensioning value at point of intersection of indicator arm and upper scale (KG scale, arrow).

The respective adjusting values refer to upper scale of measuring instrument.



Replacement

Check condition of V-belt

Replace cracked, porous, burnt or worn V-belts.

Attention!
If one of the two V-belts of double belt drive for alternator and coolant pump fails due to wear, always replace both V-belts on principle.

Use only V-belts in pairs made by one and the same manufacturer.

V-belts are available as spare parts in sets only.

1 Move tensioning device or units into starting position.

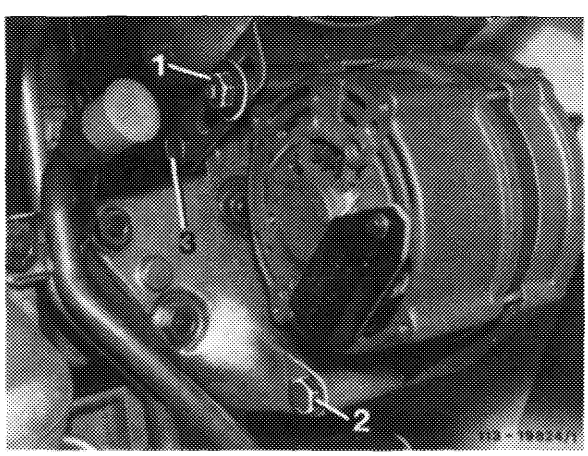
2 Mount V-belt without using force.

3 Tension V-belt.

Tensioning

V-belt A Alternator – coolant pump

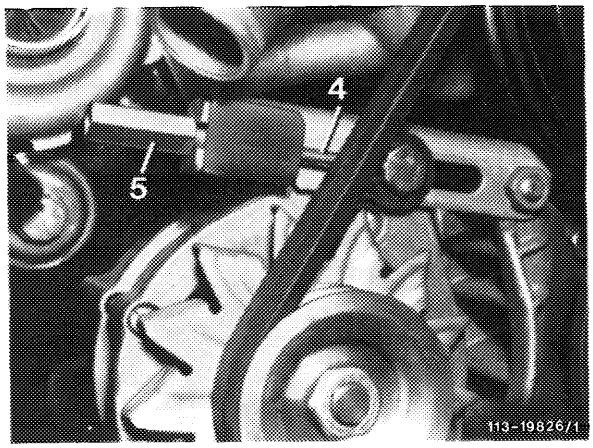
1 Loosen nut (1) and screws (2 and 3).



2 Tension V-belt by means of nut (5) of tensioning screw (4).

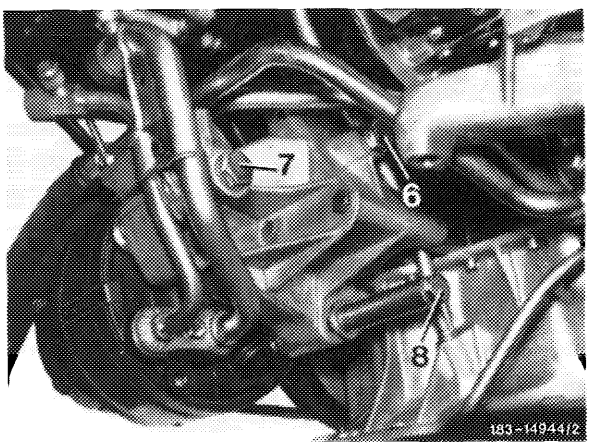
3 Tighten nut (1) and screws (2 and 3).

4 Continue turning nut (5) by approx. 1/4 to 1/2 turn (to tight seat).



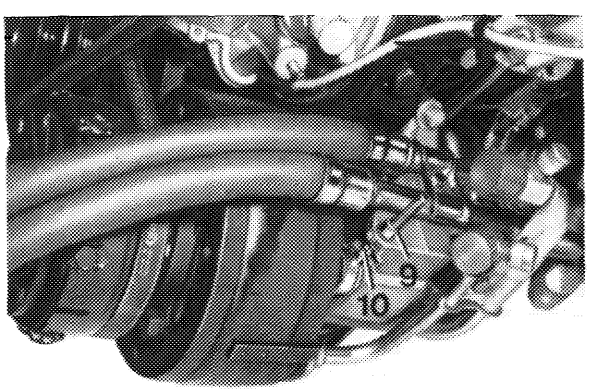
V-belt B Refrigerant compressor

1 Loosen screws (6, 7 and 8).



2 Tension V-belt by means of nut (9) of tensioning screw (10).

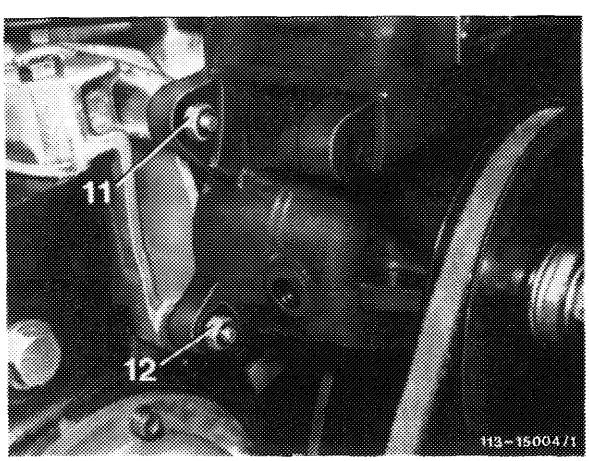
3 Tighten screws (6, 7 and 8).



183-14945/2

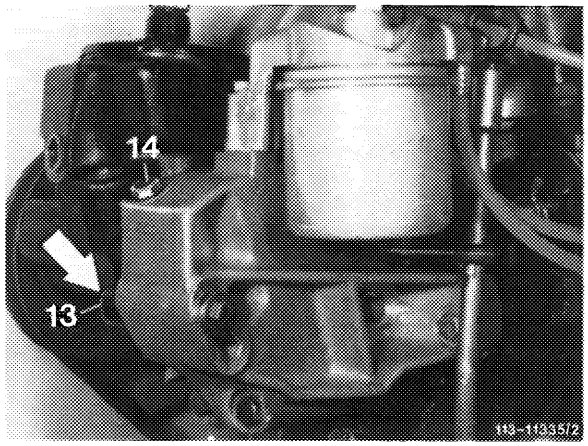
V-belt C Power steering pump

1 Loosen nuts (11, 12 and 13).

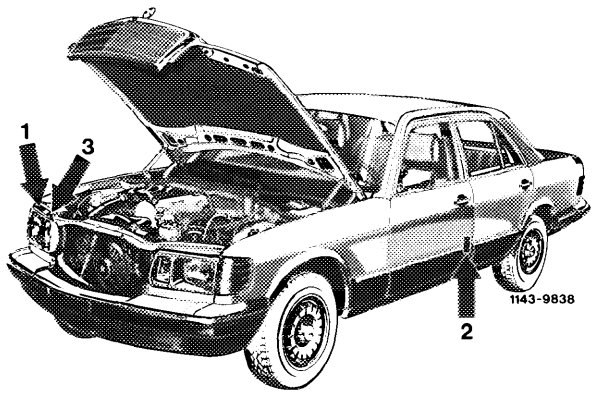


2 Tension V-belt by means of tensioning screw (14).

3 Tighten nuts (11, 12 and 13).

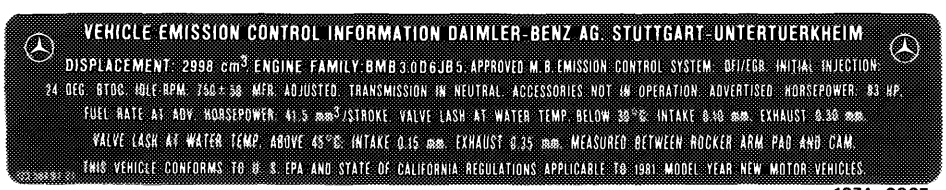


California vehicles are identified with three, and Federal version vehicles with two emission control labels.



Emission control identification label on radiator cross member (1)

This label contains the engine identification data as well as the most important engine adjustment data.


VEHICLE EMISSION CONTROL INFORMATION DAIMLER-BENZ AG, STUTTGART-UNTERTUERKHEIM

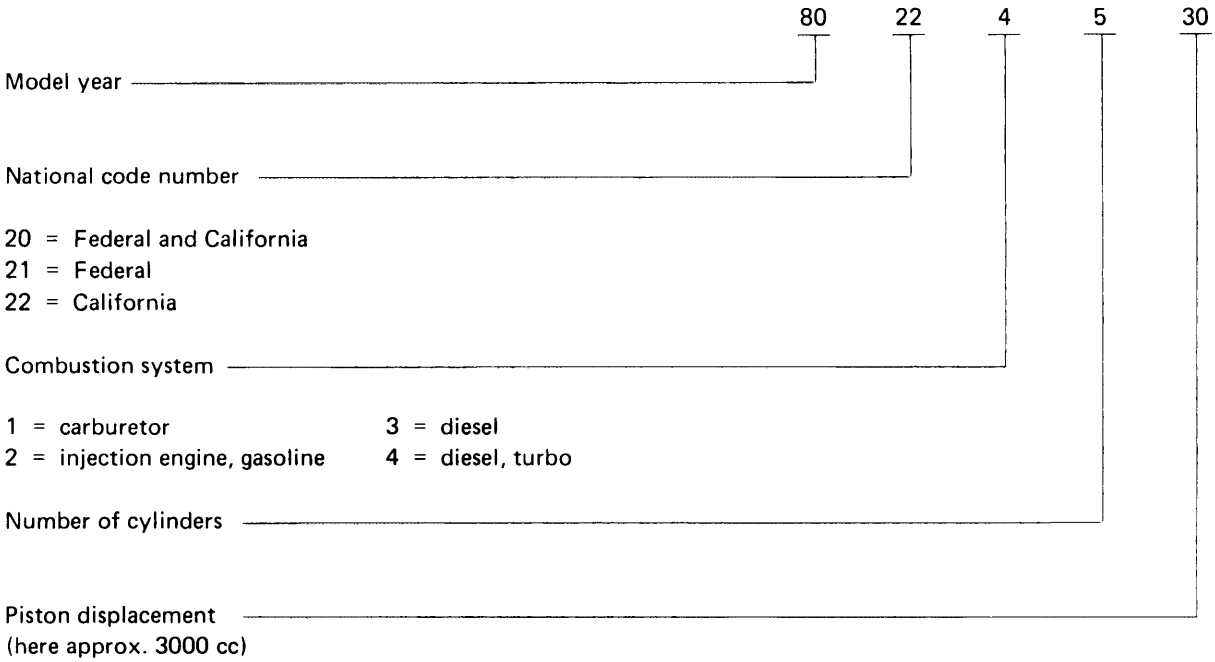
DISPLACEMENT: 2998 cm³ ENGINE FAMILY: BMB 3.0D6JB5. APPROVED M.B. EMISSION CONTROL SYSTEM: DFI/EGR. INITIAL INJECTION: 24 DEG. BTDC. IDLE RPM: 750 ± 50 MFR. ADJUSTED. TRANSMISSION IN NEUTRAL. ACCESSORIES NOT IN OPERATION. ADVERTISED HORSEPOWER: 83 HP. FUEL RATE AT ADV. HORSEPOWER: 41.5 mm³/STROKE. VALVE LASH AT WATER TEMP. BELOW 38 °C: INTAKE 0.40 mm. EXHAUST 0.30 mm. VALVE LASH AT WATER TEMP. ABOVE 45 °C: INTAKE 0.15 mm. EXHAUST 0.25 mm. MEASURED BETWEEN ROCKER ARM PAD AND CAM. THIS VEHICLE CONFORMS TO U. S. EPA AND STATE OF CALIFORNIA REGULATIONS APPLICABLE TO 1981 MODEL YEAR NEW MOTOR VEHICLES.

1074–9907

The key for engine identification data is an 8-digit code number for model year 1980 and a 10-digit code number for model year 1981.

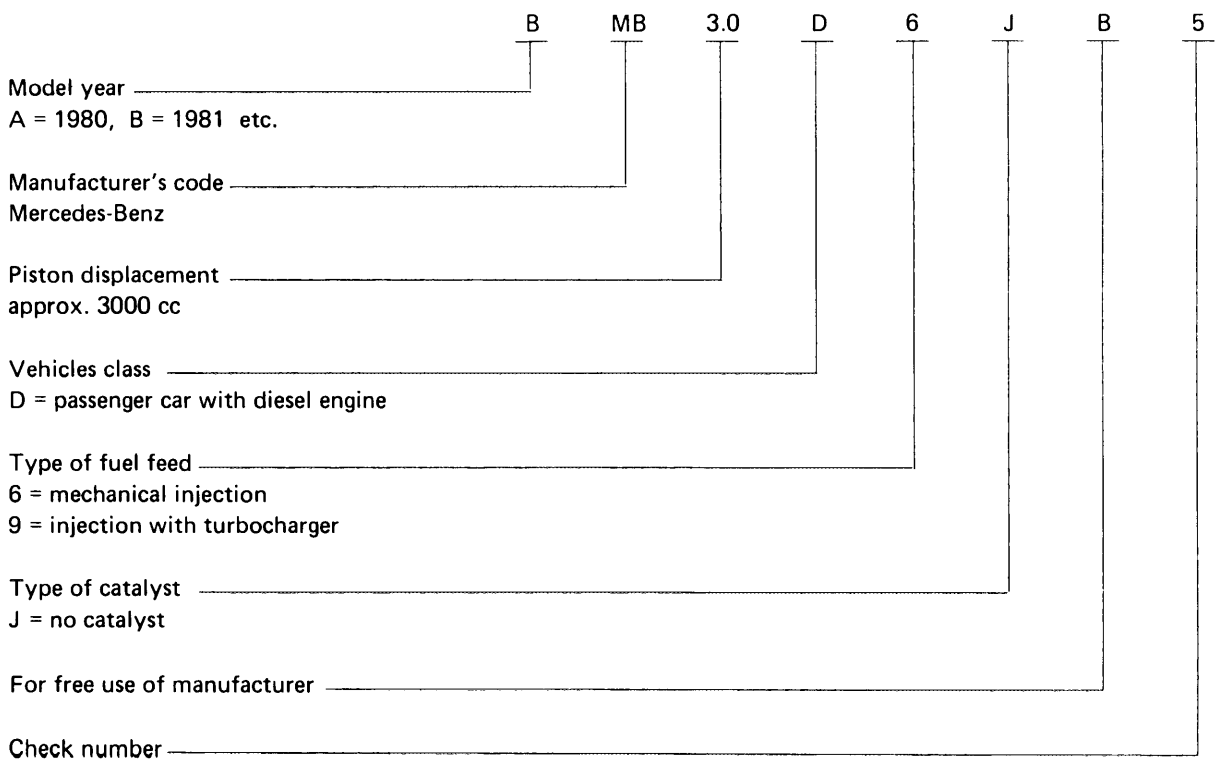
Example model year 1980:

Engine Family 80.22.45.30



Example model year 1981:

Engine Family B MB 3.0 D 9 J B 3



Basic color/lettering

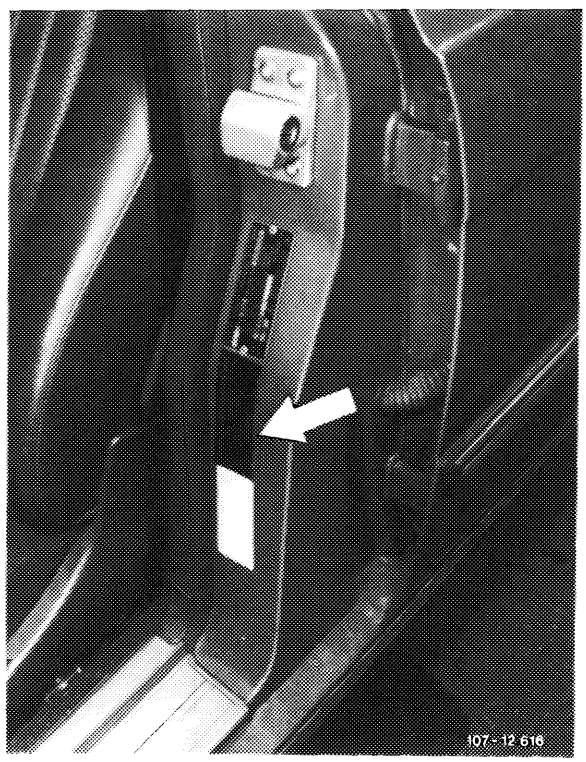
Model year	Federal version	California version
1980	black/white	yellow/black
1981[1])	black/white	

[1]) For model year 1981 there is only one version for Federal and California.

Identification label on door pillar of driver's door (2)

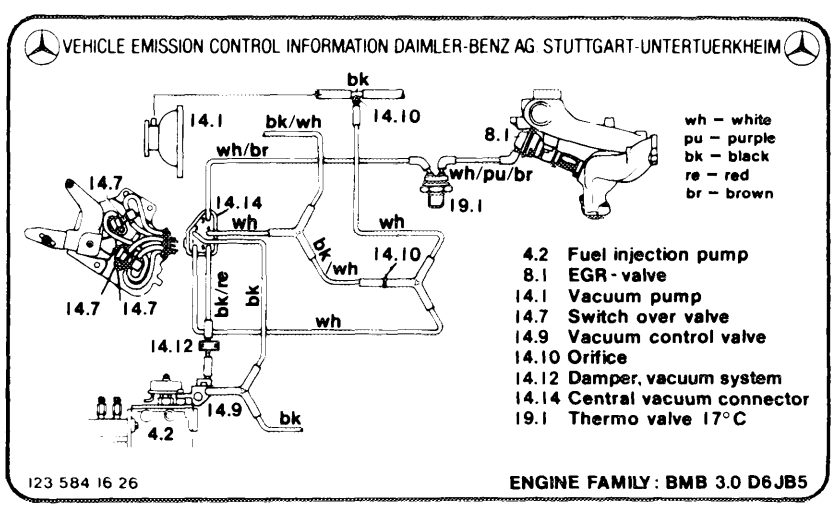
This label shows whether the vehicle is equipped with or without catalysts.

Vehicles with diesel engines are not provided with a catalyst (NON CATALYST).



Identification label (3, California only)

This label shows a diagram of the vacuum line routing in the engine compartment for all emission-related components.



1143-9841

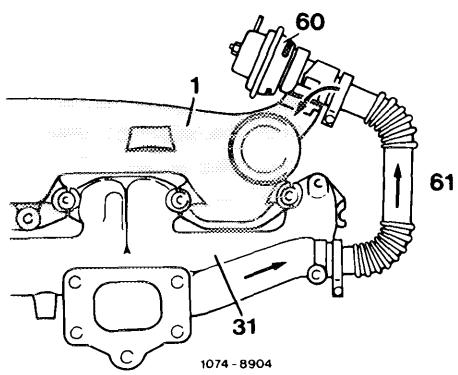
A. General information

In (USA) version starting model year 1980 for California and starting model year 1981 for Federal and California, engine 617.95 is provided with exhaust gas recirculation (EGR).

To reduce nitric oxides in exhaust gases, a portion of the exhaust gases is returned from exhaust manifold to intake manifold by means of a valve.

The returned exhaust gas is vacuum-controlled by means of the accelerator pedal (depending on load) or is turned off at given driving conditions.

EGR has no influence on driving characteristics.



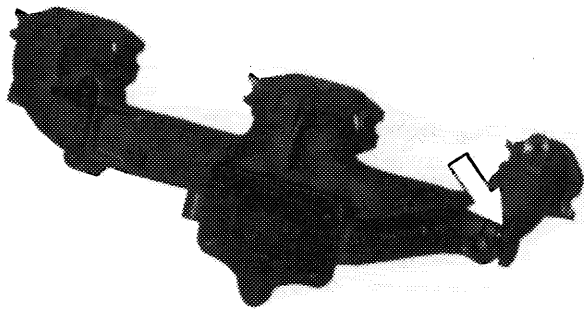
Operational diagram EGR

1 Intake manifold
31 Exhaust manifold
60 EGR valve
61 Corrugated tubing

B. EGR components

Exhaust manifold

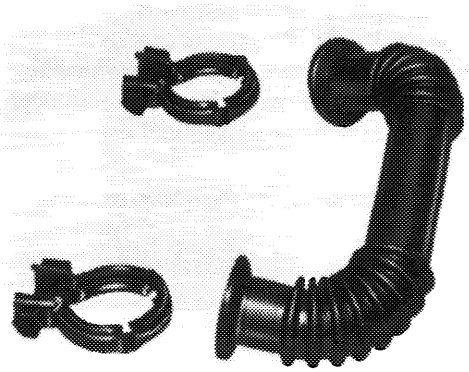
The exhaust manifold is provided with a connection (arrow) for tapping the exhaust gases about to be recirculated.



147-17010

Corrugated tubing

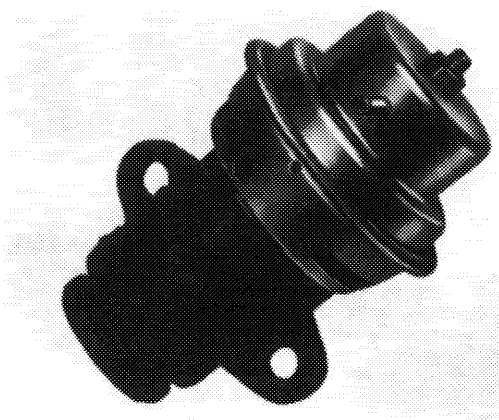
A corrugated tube is installed between exhaust manifold and EGR valve, through which the exhaust gases are routed from exhaust manifold to EGR valve.



107-17022

EGR valve

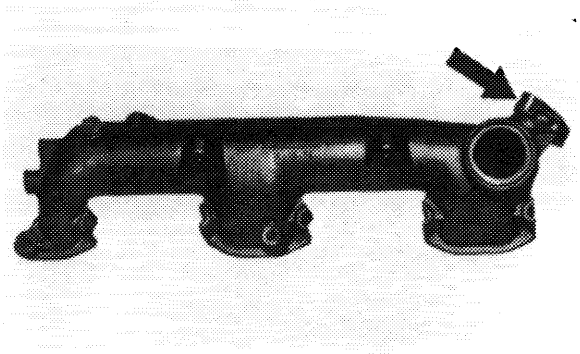
The EGR valve is flanged to intake manifold and controls the quantity of the returned exhaust gases depending on operating conditions.



107-17013

Intake manifold

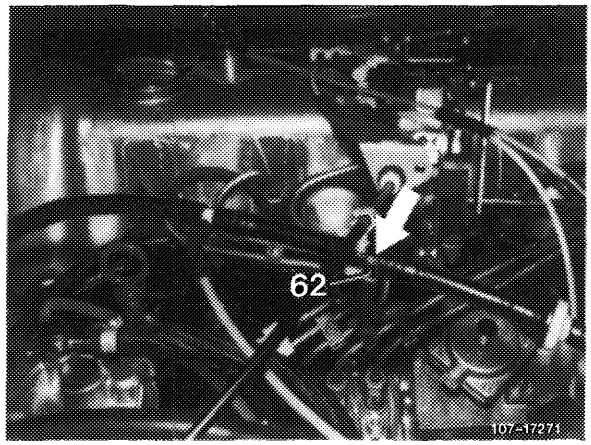
The intake manifold is provided with a two-hole flange (arrow) for attaching EGR valve. The recirculated exhaust gases are distributed to the individual cylinders.



107-17021

Vacuum tapping point with orifice (62, color code black)

The vacuum for controlling EGR is taken from vacuum line between vacuum pump and brake booster (arrow). The tapping point has a black orifice (62) with an ID of 0.6 mm (not exchangeable).

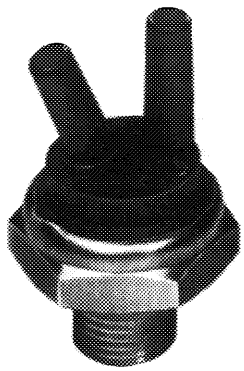


Thermovalve 40 °C (color code blue)

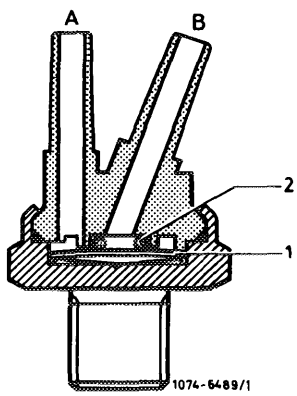
The thermovalve is screwed into thermostat housing. The designation "50 AB 5" is punched into metal part.

Below 40 °C/104 °F coolant temperature the bimetallic plate rests against O-ring and closes connection "B".

Starting at approx. 40 °C/104 °F coolant temperature the bimetallic plate will snap in downward direction under influence of heat. Both connections are connected to each other.



The vacuum line (white/brown) to distributor should be plugged to connection "B", since this alone will guarantee perfect sealing between bimetallic plate and O-ring.

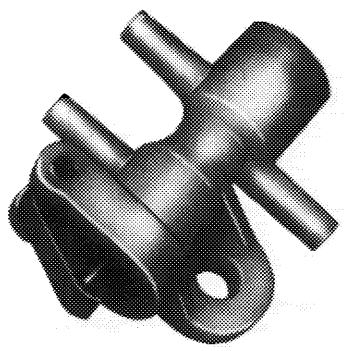


1 Bimetallic plate
2 O-ring
A To switchover valve (64a)
B To distributor (vacuum)

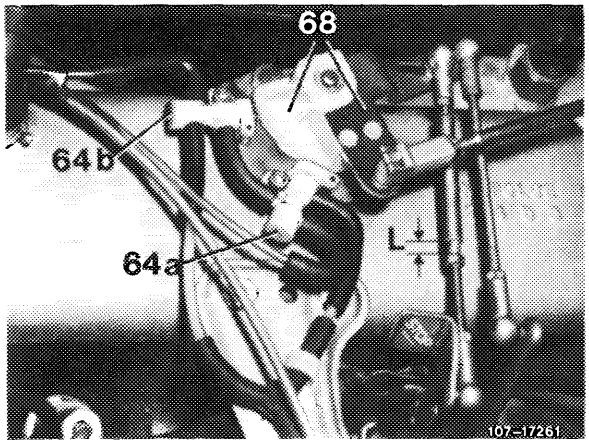
Switchover valve (64a, model year 1980)

The switchover valve is switched via guide lever (68) and cam.

The valve serves the purpose of venting the vacuum line to EGR valve for the purpose of switching off EGR at idle (throttle) linkage against idle speed stop).



If the throttle linkage is actuated to the extent that the idle path (L) at idle path rod is bridged, the switchover valve has switched over and the largest possible EGR will proceed.

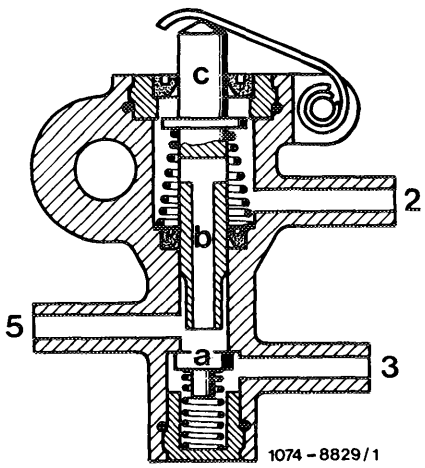


Switchover valve (64b)

The switchover valve is switched over by the second cam on guide lever (68) shortly before attaining full throttle position. As a result, the vacuum line (white/purple/brown) to EGR valve will be vented and there will be no EGR.

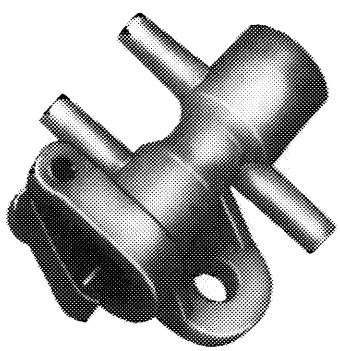
Attention!
The link and the cam running surface should be clean and **not lubricated.** They should be covered during engine preservation.

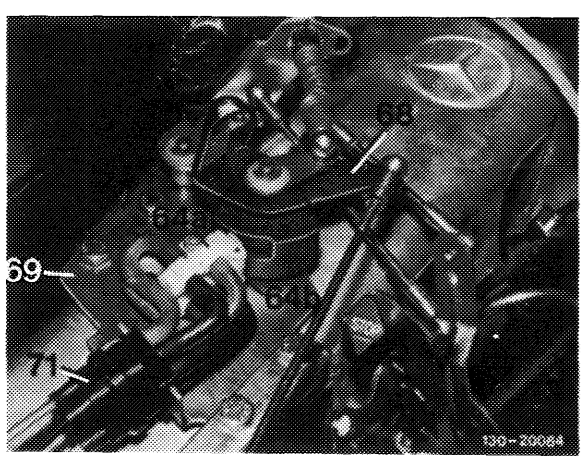
Note: At idle position (without idle path bridge "L") both switchover valves may have passage from 2 to 5 only. With switchover valves switched through, passage should be available from 3 to 5.



Switchover valves (model year 1981)

To control EGR, the switchover valves known from model year 1980 are used again, but their arrangement has been modified. Both switchover valves are now located on valve plate one above the other. Connection is made by a central plug (71). A cover plate is attached to prevent dirt collecting on plastic running surface.

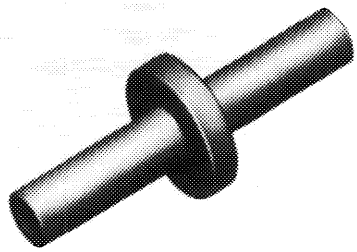




64a Switchover valve idle shutoff – EGR
64b Switchover valve full throttle shutoff – EGR
68 Guide lever
71 Central plug

Orifice (63)

Orifices of different diameter may be installed between the two distributors on vacuum control valve (65).

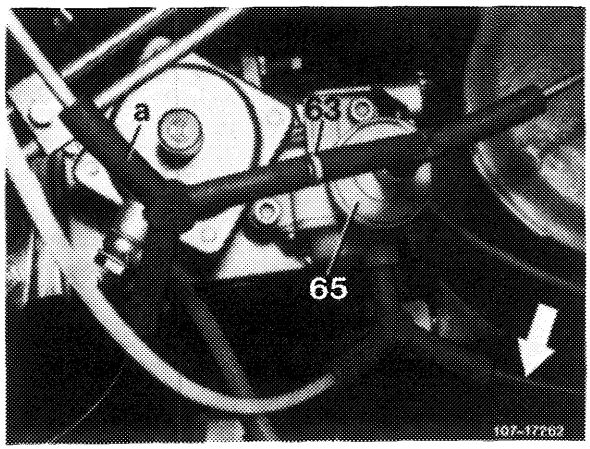


107-17058

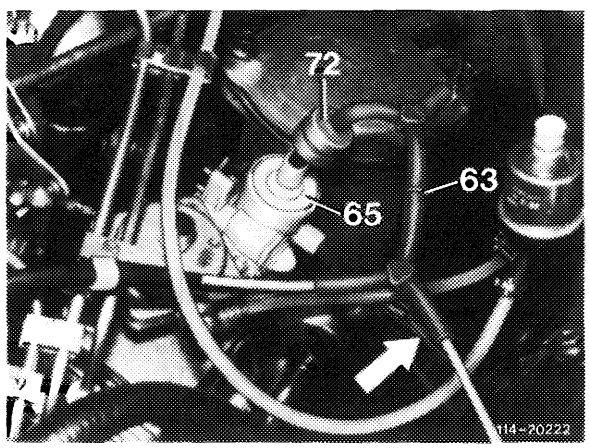
Color code and diameter of orifices

green = 0.7 mm
white = 0.8 mm
blue = 1.0 mm
red = 1.1 mm
yellow = 2.0 mm (unthrottled)

The ID of the orifice depends on the tolerances of the adjusting angle on regulating lever (1) of injection pump and vacuum control valve (65).



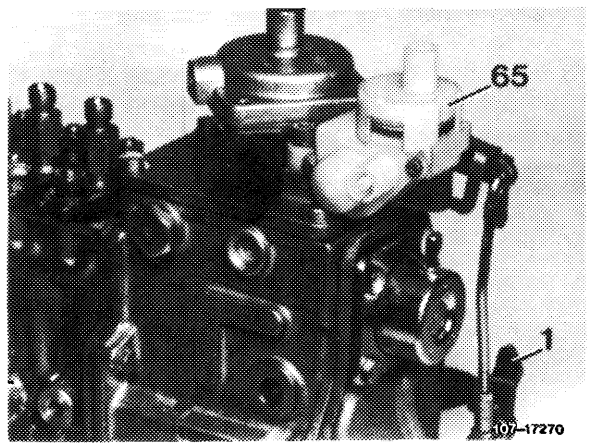
Model year 1980



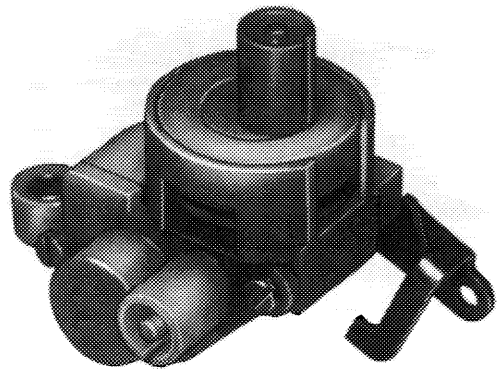
Model year 1981

Vacuum control valve (65)

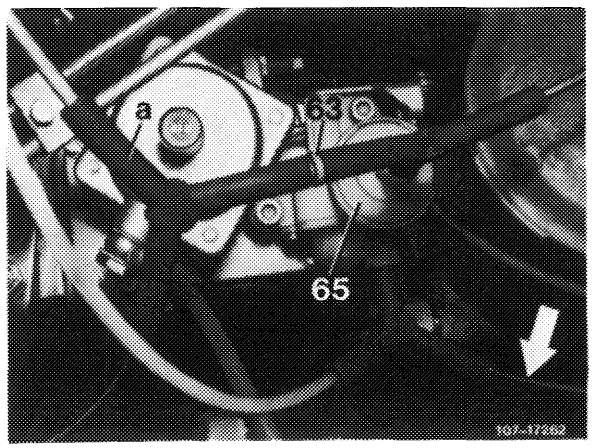
The vacuum control valve serves to control venting of EGR valve. At idle, the vacuum line to automatic transmission, to thermovalve 40 °C/104 °F and switch-over valve (64a) is constantly vented by way of a small annular gap in vacuum control valve. The vacuum amounts to approx. 350–500 mbar.



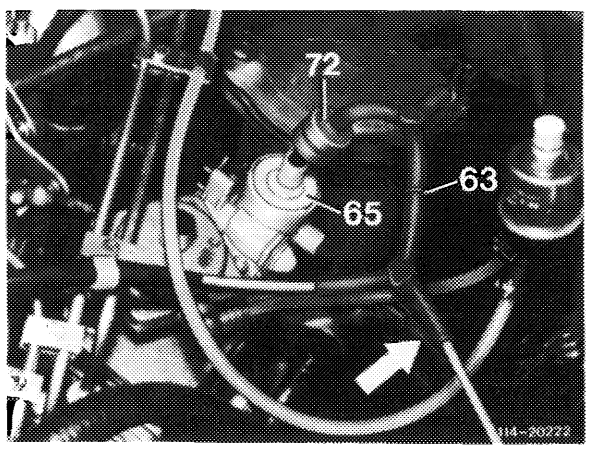
After bridging the idle path, the vent cross section in vacuum control valve is constantly increased under the increasing load and the vacuum is therefore continuously reduced. Venting proceeds via black plastic line (arrow) leading into passenger compartment.



107-17057



Model year 1980



Model year 1981

Damper (vacuum, 72) model year 1981 only

To reduce the high vacuum peaks, a damper is installed into vacuum line from vacuum control valve to central plug (valve plate).

C. Total operation (USA) model year 1980

EGR begins:

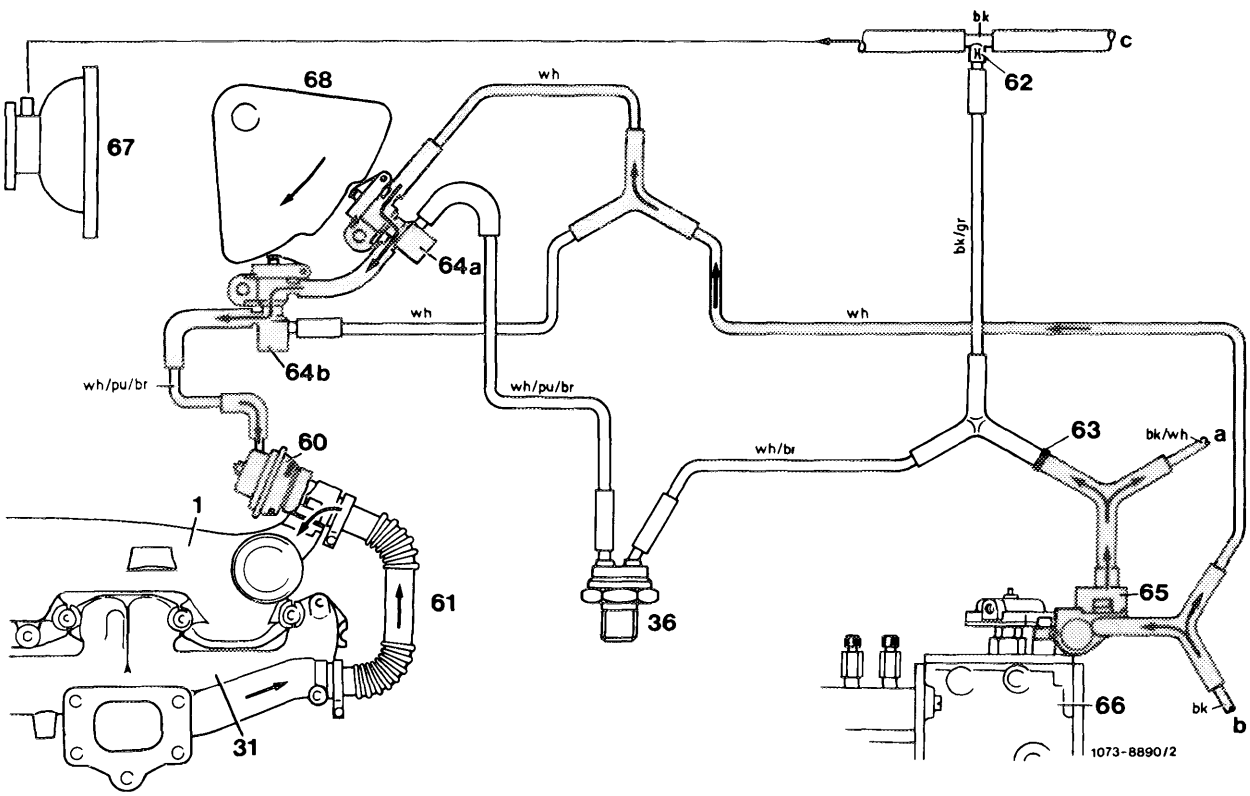
- Above approx. 40 °C/104 °F coolant temperature: After the free travel of the free travel rod has been eliminated.

In partial load range up to final EGR shutoff shortly before full throttle stop.

Below approx. 40 °C/104 °F coolant temperature the thermovalve (36) is closed. The vacuum cannot move to EGR valve. There will be **no EGR.**

Starting at a coolant temperature of approx. 40 °C/ 104 °F the thermovalve (36) opens. The vacuum, at idle 350–500 mbar, moves to the switchover valve (64a).

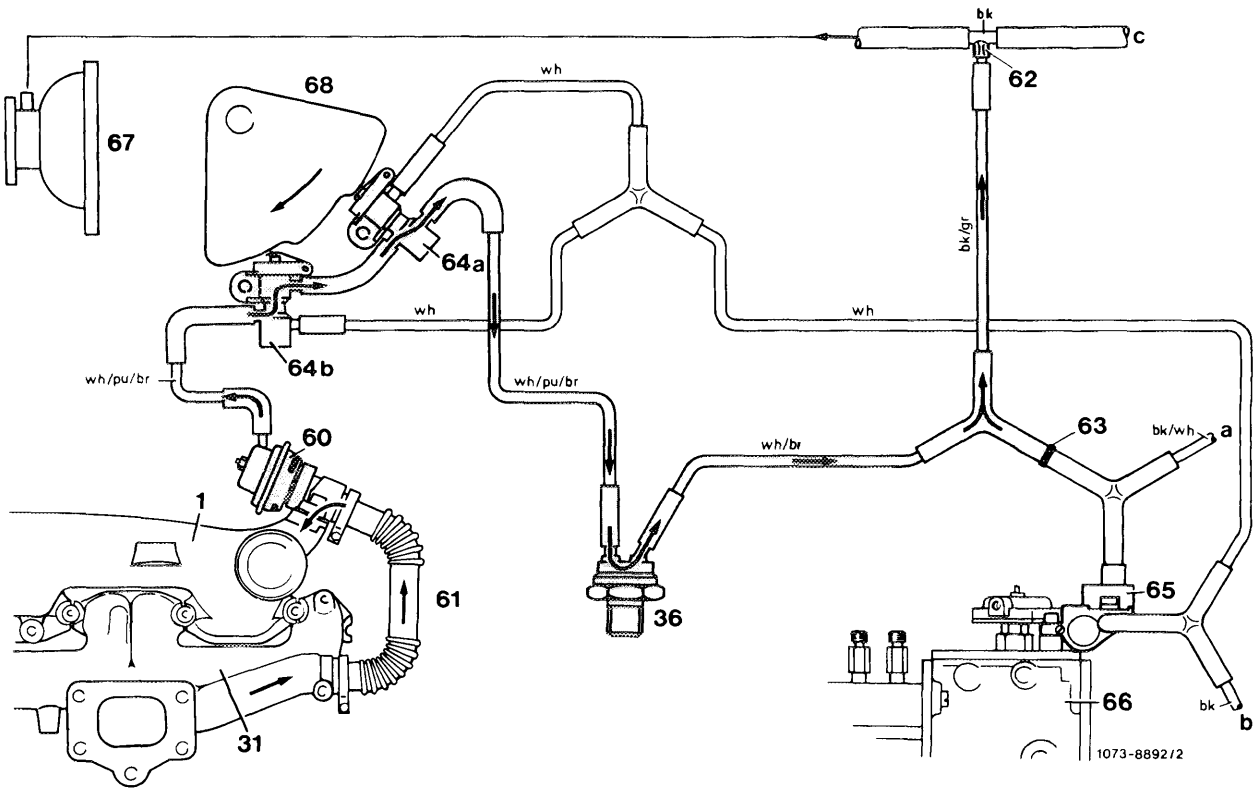
If the control linkage is at the idle speed stop, the EGR valve (60) is vented externally. There will be **no EGR.**



Vaccum routing at idle, throttle linkage at idle speed stop

1	Intake manifold	65	Vacuum control valve	bk	= black
31	Exhaust manifold	66	Injection pump	br	= brown
36	Thermovalve 40 °C/104 °F	67	Vacuum pump	gr	= green
60	Exhaust gas recirculation valve (EGR)	68	Guide lever with cam	pu	= purple
61	Corrugated tubing			re	= red
62	Orifice	a	Automatic transmission	wh	= white
63	Orifice	b	Vent to passenger compartment		
64a	Switchover valve, idle speed shutoff – EGR	c	Brake unit		
64b	Switchover valve, full throttle shutoff – EGR				

If the throttle linkage is opened so that the free travel in the free travel rod is eliminated, the switchover valve (64a) is operated by the cam of the guide lever (68). The vacuum now moves via the two switchover valves (64a and 64b) to the EGR valve and opens the valve completely. This results in **max. possible EGR.**



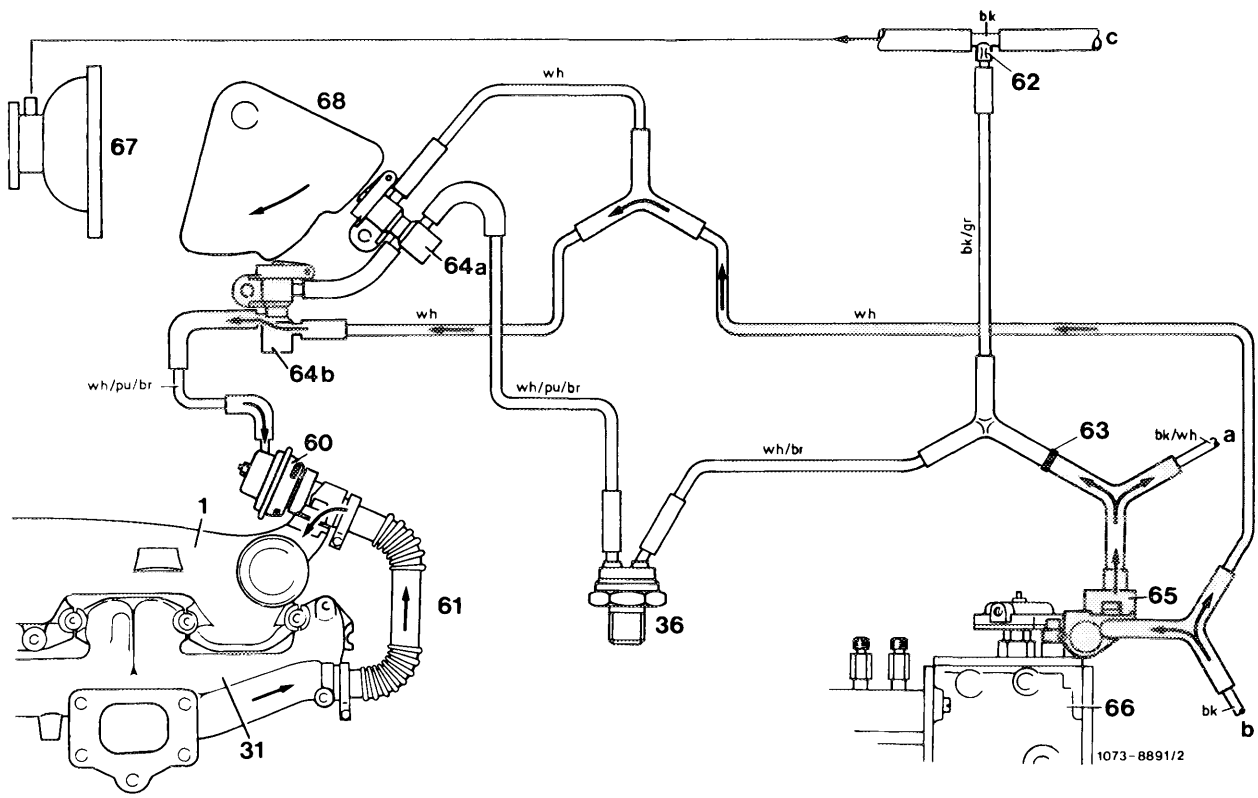
Vacuum routing after eliminating free travel

1 Intake manifold
31 Exhaust manifold
36 Thermovalve 40 °C/104 °F
60 Exhaust gas recirculation valve (EGR)
61 Corrugated tubing
62 Orifice
63 Orifice
64a Switchover valve, idle speed shutoff – EGR
64b Switchover valve, full throttle shutoff – EGR
65 Vacuum control valve
66 Injection pump
67 Vacuum pump
68 Guide lever with cam

a Automatic transmission
b Vent to passenger compartment
c Brake unit

bk = black
br = brown
gr = green
pu = purple
re = red
wh = white

At increasing load the vacuum is gradually decreased via vacuum control valve (65). This also reduces the amount of recirculated exhaust gas. Shortly before reaching full throttle position, the switchover valve (64b) is vented to atmosphere via cam of guide lever (68). The vacuum is completely removed, there is **no EGR.**



Venting process in full throttle position

1 Intake manifold
31 Exhaust manifold
36 Thermovalve 40 °C/104 °F
60 Exhaust gas recirculation valve (EGR)
61 Corrugated tubing
62 Orifice
63 Orifice
64a Switchover valve, idle speed shutoff – EGR
64b Switchover valve, full throttle shutoff – EGR
65 Vacuum control valve
66 Injection pump
67 Vacuum pump
68 Guide lever with cam

a Automatic transmission
b Vent to passenger compartment
c Brake unit

bk = black
br = brown
gr = green
pu = purple
re = red
wh = white

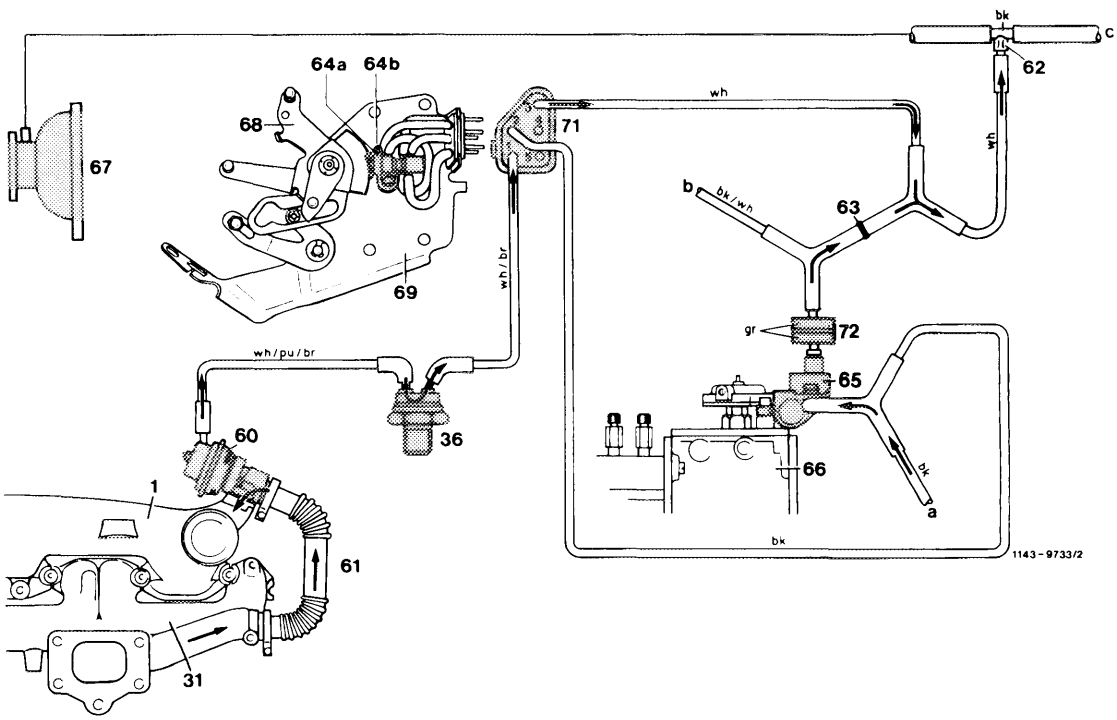
Total operation (USA) starting model year 1981

EGR begins above approx. 40 °C/104 °F coolant temperature after free travel of free travel rod is eliminated, EGR takes place in total partial load range.

Starting at a coolant temperature of approx. 40 °C/ 104 °F the thermovalve (36) opens. The vacuum, at idle 350–500 mbar, moves to switchover valve (64a).

If the control linkage is at idle speed stop, the EGR valve (60) is vented externally. There is **no EGR.**

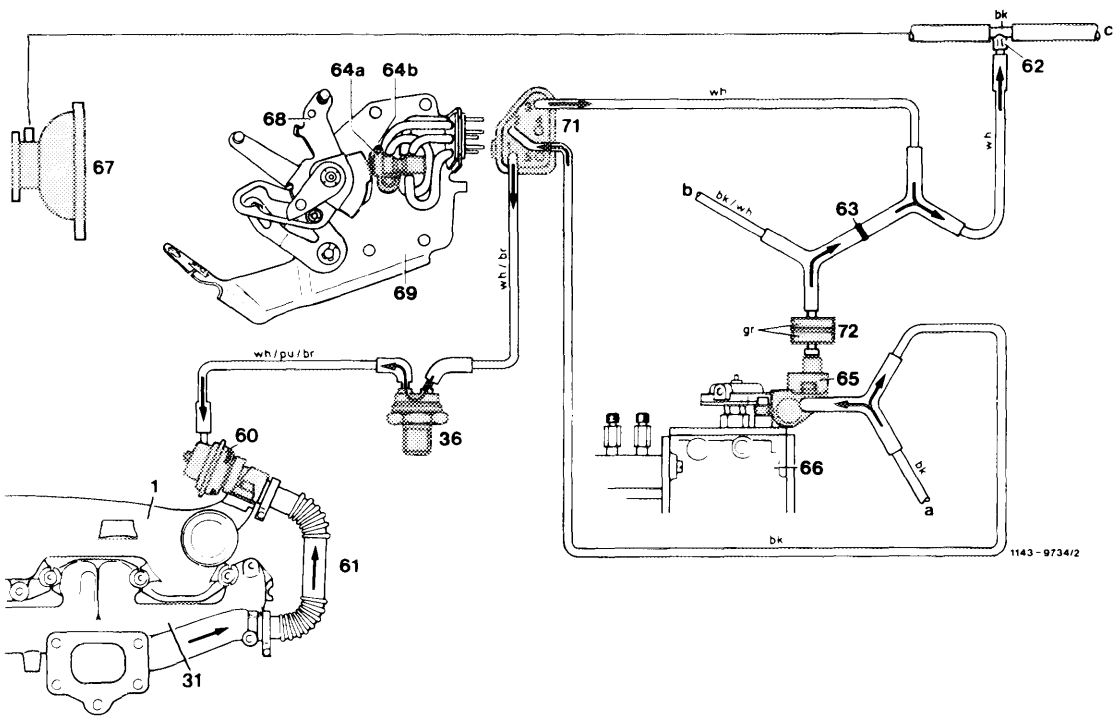
If the throttle linkage is opened so that the free travel in the free travel rod is eliminated, the switchover valve (64a) is switched over by the cam of guide lever (68). The vacuum now moves via the two switchover valves (64a and 64b) to EGR valve and opens the valve completely. This results in **max. possible EGR.**



Vacuum routing after eliminating free travel

1	Intake manifold	66	Injection pump	bk	= black
31	Exhaust manifold	67	Vacuum pump	br	= brown
36	Thermovalve 40 °C/104 °F	68	Guide lever with cam	gr	= green
60	Exhaust gas recirculation valve (EGR)	69	Valve plate	pu	= purple
61	Corrugated tubing	71	Central plug	re	= red
62	Orifice	72	Damper, vacuum	wh	= white
63	Orifice	a	Vent to passenger compartment		
64a	Switchover valve, idle speed shutoff – EGR	b	Automatic transmission		
64b	Switchover valve, full throttle shutoff – EGR	c	Brake unit		
65	Vacuum control valve				

At increasing load, the vacuum is gradually decreased via vacuum control valve (65). This also reduces the amount of recirculated exhaust gas. Shortly before reaching full load position, the switchover valve (64b) is vented to atmosphere via the cam of guide lever (68). The vacuum is completely removed, there will be no EGR.



Venting process when actuating full throttle shutoff

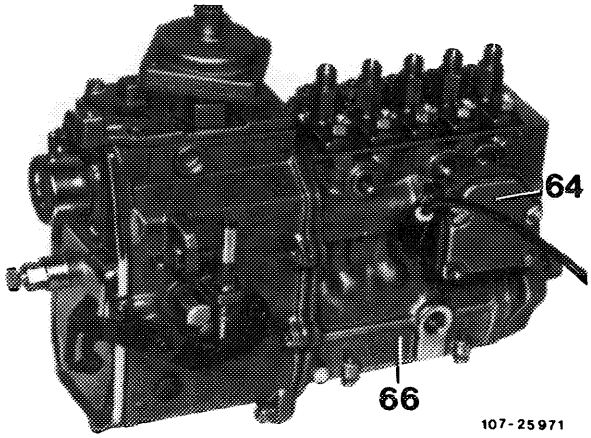
1 Intake manifold
31 Exhaust manifold
36 Thermovalve 40 °C/104 °F
60 Exhaust gas recirculation valve (EGR)
61 Corrugated tubing
62 Orifice
63 Orifice
64a Switchover valve, idle speed shutoff – EGR
64b Switchover valve, full throttle shutoff – EGR
65 Vacuum control valve
66 Injection pump
67 Vacuum pump
68 Guide lever with cam
69 Valve plate
71 Central plug
72 Damper, vacuum
a Vent to passenger compartment
b Automatic transmission
c Brake unit

bk = black
br = brown
gr = green
pu = purple
re = red
wh = white

E. Components with operation (USA) model year 1984 California

Injection pump

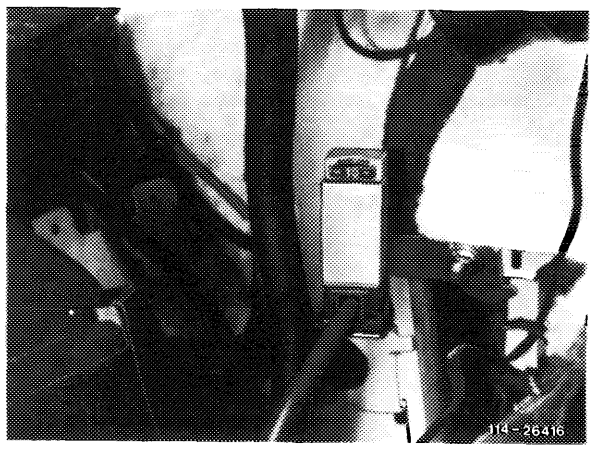
The emission control system requires a control rod travel indicator. The indicator is attached to pump housing inside in range of control rod.



64 Control rod travel indicator
66 Injection pump

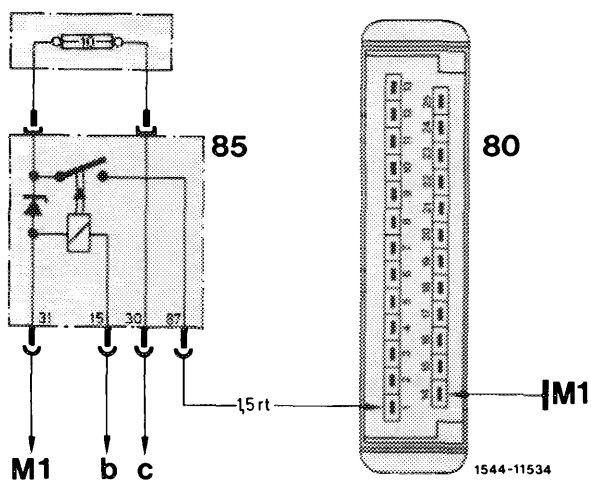
Overvoltage protection

Located in fusebox on model 126 and behind glove box on model 123. Serves to protect the electronic control unit. Fuse 10 A is installed at top of overvoltage protection.



Layout model 123

When the ignition is switched on, terminal 15 is energized. The relay attracts and the control unit is provided with battery voltage.



80 Control unit
85 Overvoltage protection
M1 Main ground behind instrument cluster
b Fuse capsule terminal 15
c Supporting lug terminal 30

Electronic control unit

Attached in legroom at the right behind side panelling.

Control unit is connected to battery voltage after ignition has been switched on.



The following signals are put in:

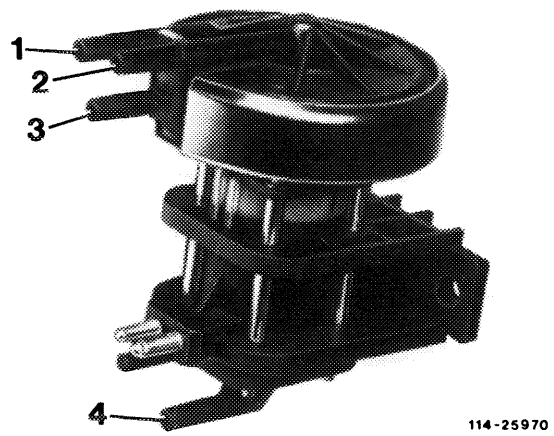
- Coolant temperature
- Engine rpm
- Control rod travel
- Barometric pressure

The inside of the control unit is provided with bellows (for altitude corrections).

The input signals are processed and the pressure converter (84) or the switchover valve (81) are pertinently activated.

Pressure converter

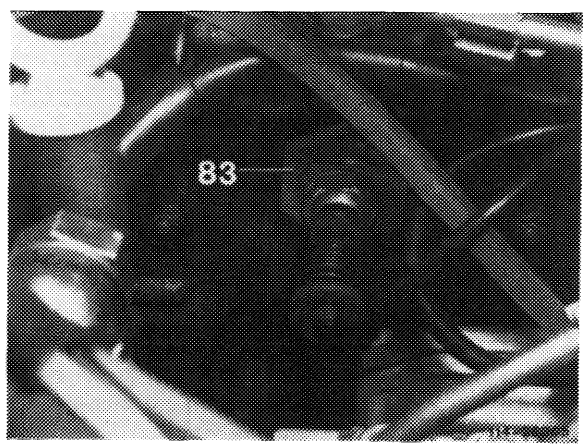
The vacuum generated by the vacuum pump of the engine is converted into a load-dependent vacuum signal by the pressure converter. The signal serves for controlling the EGR-valve.



1 EGR-valve connection
2 Vacuum pump connection
3 Positive vent line
4 Positive vent line

Temperature sensor coolant (NTC)

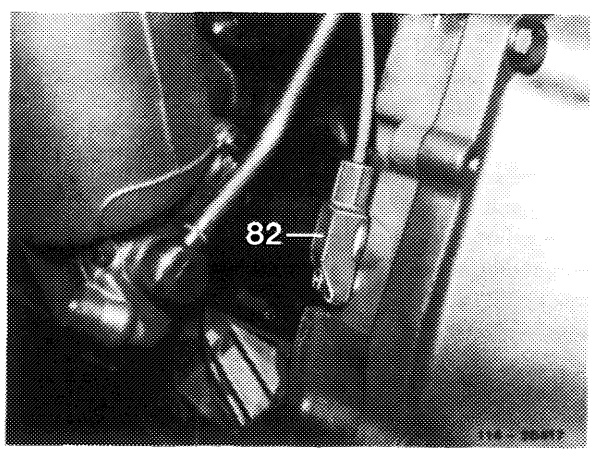
The coolant temperature is obtained by a temperature sensor (83), which is installed on lefthand side of cylinder head. The resistance of the temperature sensor changes in dependence of the coolant temperature.



Rpm sensor

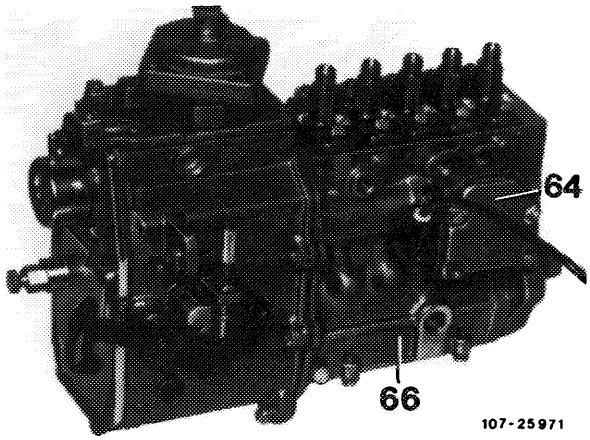
An inductance indicator which is screwed in on intermediate flange to automatic transmission (arrow).

The indicator comprises a magnetic core and a coil. It will pick up the engine speed for transmission to control unit in the shape of an AC voltage.



Control rod travel indicator

The control rod travel indicator is attached to pump housing at the right at level of control rod.

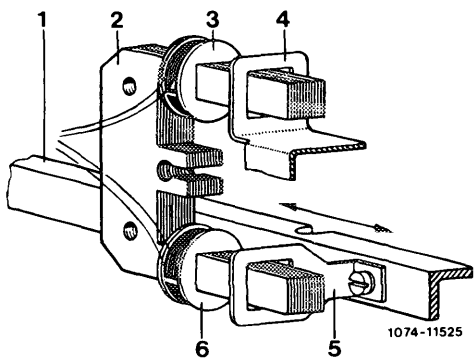


64 Control rod travel indicator
66 Injection pump

Layout

The control rod travel indicator comprises an iron core, two coils (measuring and fixed value coil) and two short circuit rings. It is connected to the electronic control unit by means of a 3-pole plug.

Coils (3) and (6) are attached to an iron core (2) fixed in housing. The short circuit ring (5) is connected to control rod (1) and slides this control rod free of contact on lower leg of iron core. The fixed value coil (3) and the short circuit ring (4) are attached to upper leg.



1 Control rod
2 Iron core
3 Fixed value coil
4 Bypass ring (fixed)
5 Short circuit ring (movable)
6 Measuring coil

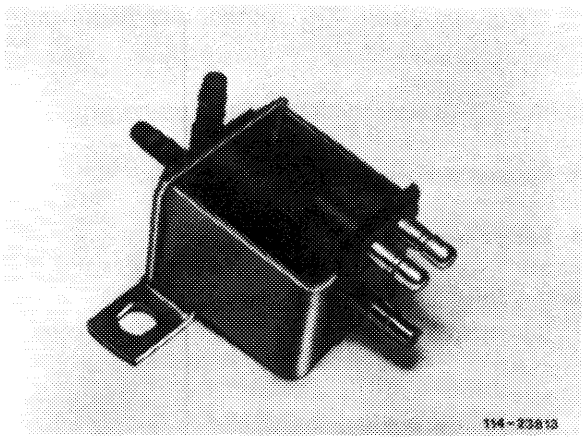
Operation

Together with short circuit ring (4) the fixed value coil (3) provides a constant inductance.

The distance between short circuit ring (5) and measuring coil (6) is changed depending on change of location of control rod (1). The resulting variable inductance is compared with the constant. From these data, the electronic control unit determines the control travel.

Switchover valve (electric)

This valve is activated depending on load condition of engine by way of control unit and provides the vacuum for the circulating air safety valve.



Layout model 123

Circulating air safety valve

Integrated on compressor housing of exhaust gas turbocharger. The EGR quantity is increased in partial load range by partial reduction of boost pressure.

When the circulating air safety valve is activated with a vacuum, the valve will open and will let a part of the boost air in front of compressor flow back in a bypass system.

F. Total operation (USA) model year 1984 California

EGR proceeds after the following points have been met:

- Coolant temperature > 40 °C and < 90 °C.
- Engine speed > 500/min.
- Load signal of injection pump:
  Idle speed auxiliary units switched off. Selector lever in position "P" or "N".

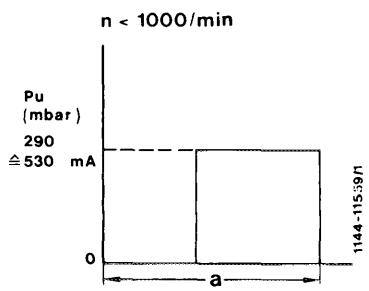
  Partial load auxiliary units switched on and selector lever in driving position.

The resistance of the coolant temperature sensor changes in dependence of the coolant temperature and thereby provides the input signal for the EGR electronic control system.

Engine speed > 500/min < 1000/min

In this rpm range (without load) the pressure converter (84) is activated with approx. 530 mA. The result is a vacuum at EGR-valve of approx. 290 mbar. The valve opens completely; max. possible EGR will result.

By engaging a driving position and switching on auxiliary units, a given load signal will be exceeded. The pressure converter will be deenergized and the vacuum toward EGR valve will be exhausted. There will be no more EGR.



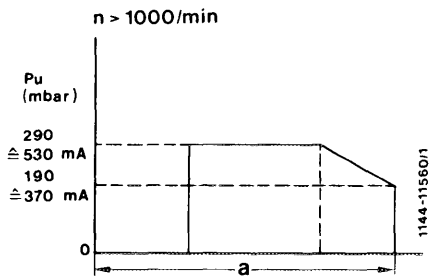
a Load signal injection pump

Engine speed > 1000/min

At engine speeds > 1000/min the pressure converter is also activated with approx. 530 mA in partial load range. Max. possible EGR will result.

With increasing load the current is reduced to 370 mA and the pressure converter will be deenergized as from a given load signal. In parallel with the reducing current the vacuum on EGR-valve will be exhausted and the EGR quantity will be reduced.

At 370 mA the vacuum on EGR-valve amounts to 190 mbar. This is the closing point of the EGR-valve; there will be no more EGR.



a Load signal injection pump

In addition, the circulating air safety valve will be completely opened at an engine speed > 1000/min and the respective load signal of the circulating air safety valve.

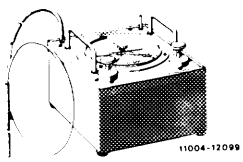
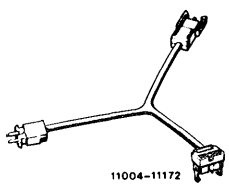
With increasing altitude a bellows integrated in control unit serves to reduce the EGR quantity in accordance with the prevailing air pressure.

For complaints such as: Very poor engine performance, black or blue smoke.

Test conditions: Throttle linkage correctly adjusted, connect tachometer, engine at operating temperature, run engine at idle (750 ± 100/min), steering in straightahead position, air conditioning turned off, selector lever of automatic transmission in position "P".

Tested: Exhaust gas recirculation (EGR).

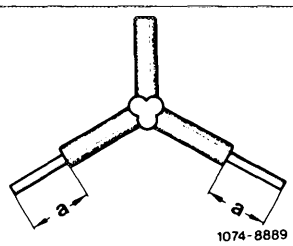
Special tools

Tester 0–100 mbar for vacuum and gauge pressure	 11004-12099	201 589 13 21 00
Clamp	 11004-6190	000 589 40 37 00
Test cable	 11004-11172	102 589 04 63 00
Adjusting roller		916 589 00 21 00

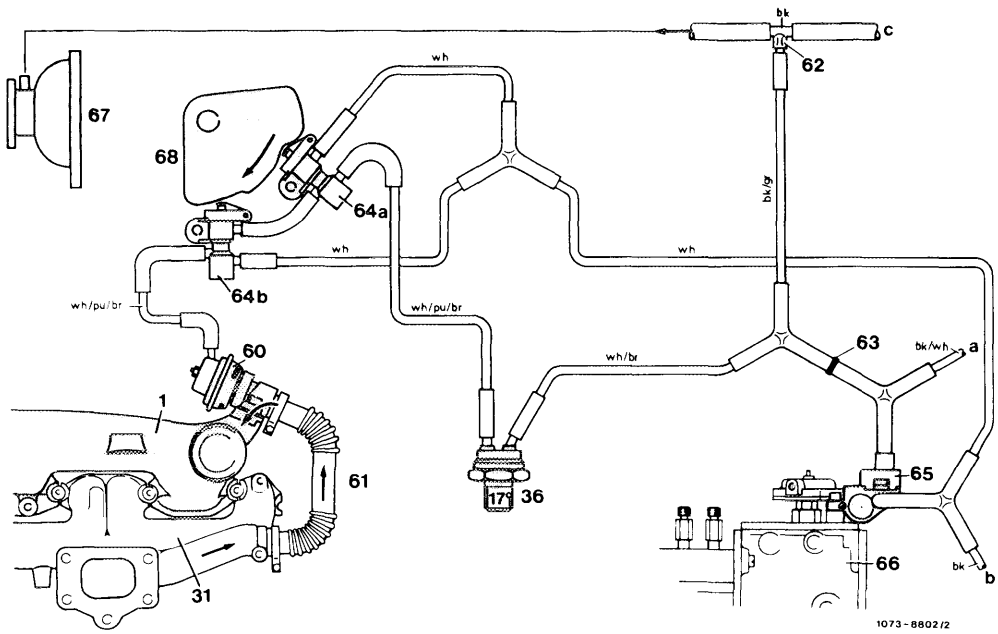
Conventional tools

Digital tester	e.g. Bosch, MOT 001.03 e.g. Sun, DIT 9000 e.g. Sun, 1019
Multimeter	e.g. Sun, DMM–5

Self-made test connection

Distributor a Vacuum line 4 x 1 x 400 mm	 1074-8889	117 078 01 45
Test line 4 x 1 x 400 mm		

A. (USA) model year 1980



Operational diagram vacuum line layout

1 Intake manifold
31 Exhaust manifold
36 Thermovalve 17 °C/63 °F
60 Exhaust gas recirculation valve (EGR)
61 Corrugated tubing
62 Orifice
63 Orifice
64a Switchover valve, idle speed shutoff – EGR
64b Switchover valve, full load shutoff – EGR
65 Vacuum control valve
66 Injection pump
67 Vacuum pump
68 Guide lever with cam

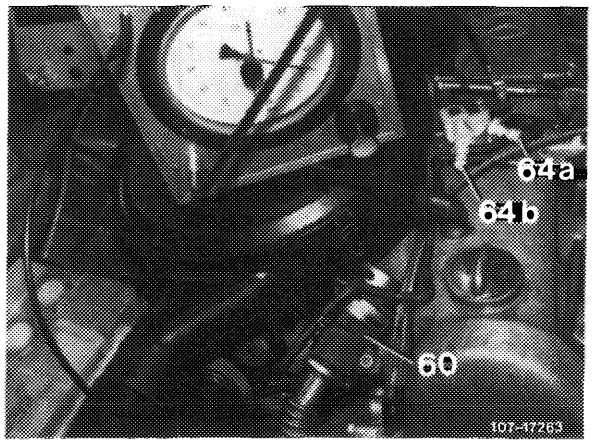
a Automatic transmission
b Vent to passenger compartment
c Brake unit

bk = black
br = brown
gr = green
pu = purple
re = red
wh = white

Testing EGR

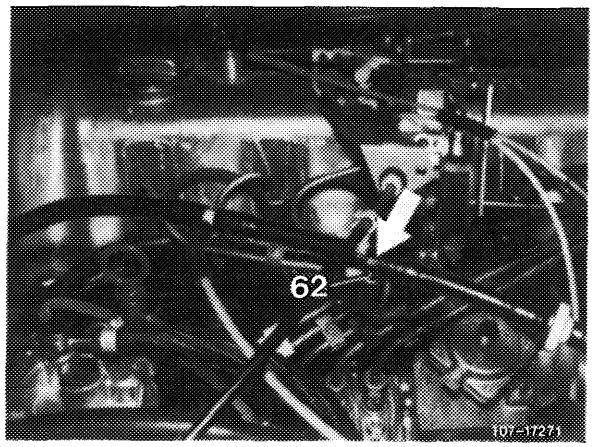
Connect vacuum tester between EGR valve (60) and switchover valve (64b) to vacuum line (white/purple/brown). At idle, with throttle linkage at idle stop, no vacuum should be indicated. Advance control linkage until free travel of free travel rod is eliminated (do not pull on stop lever). Vacuum should now amount to 350–500 mbar.

Vacuum nominal value of 350–500 mbar is attained.	Vacuum nominal value is not attained or exceeded.

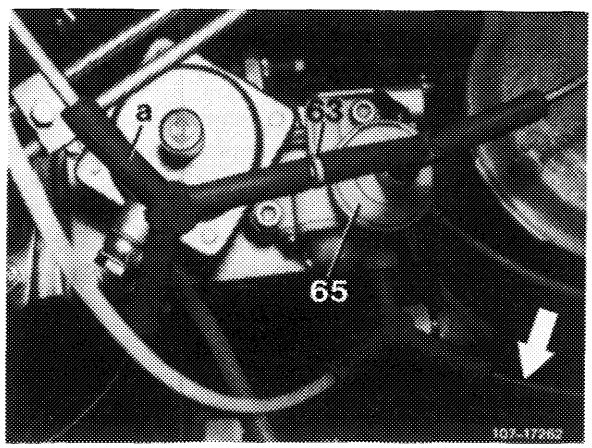


Check vacuum lines

Check all vacuum lines for control of EGR system and of automatic transmission according to **operational diagram vacuum line layout** for correct connection and leaks. Blow through orifice (62) at vacuum tapping point.



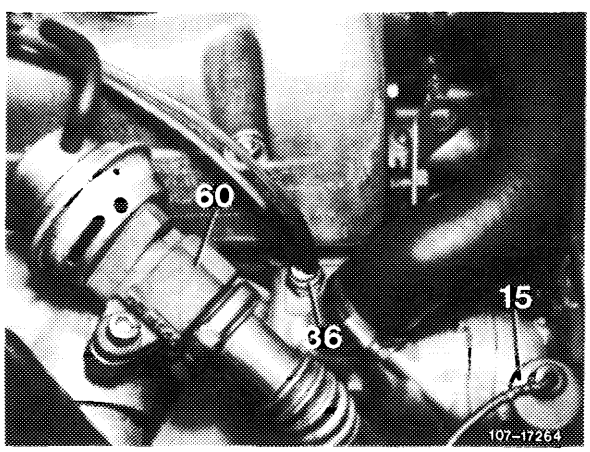
Check black vent line (arrow) from vacuum control valve to passenger compartment for free passage.



Check thermovalve 40 °C/104 °F (36, color code blue)

Pull off vacuum line (white/purple/brown) on diagonal connection of thermovalve.

Check vacuum line (white/brown) on distributor (a) and check for passage. If there is no passage, replace thermovalve.

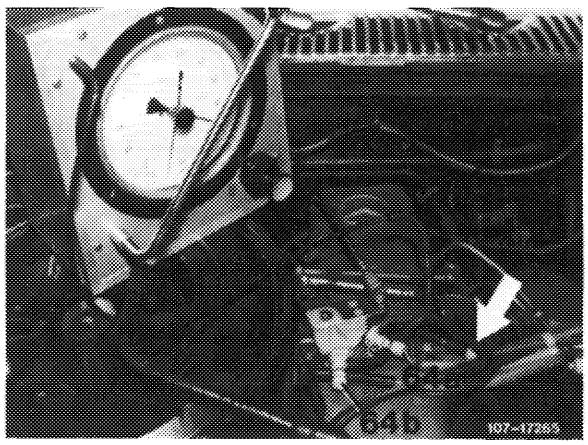


When thermovalve is **cooling down,** thermovalve should have no passage at temperatures below 7 °C/45 °F.

Check switchover valve (64a)

Pull connection (arrow) of vacuum line (white/purple/brown) from switchover valve.

Connect vacuum tester to free connection of switchover valve and connect with pulled off vacuum line. Vacuum readout approx. 350–500 mbar (regulating linkage at idle speed stop).



Leak test

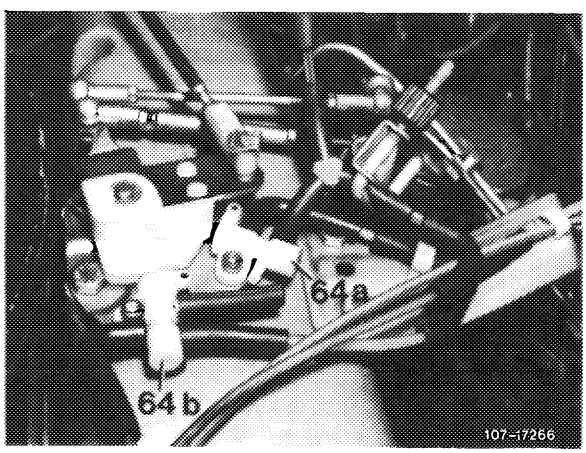
Disconnect distributor of white/purple/brown vacuum line.
Vacuum should remain constant for approx. 2 minutes.

If vacuum drops, replace switchover valve.

If vacuum remains constant, check **switchover:**

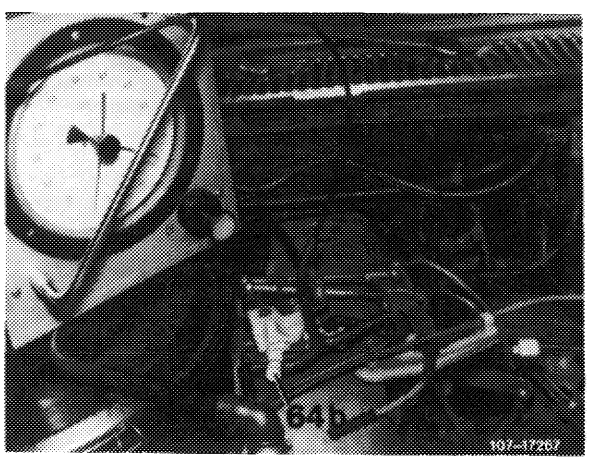
For this purpose, remove clamp, pull off connecting hose between the two switchover valves and bridge free travel on free travel rod.

Vacuum should distinctly drop. If vacuum is not dropping, replace switchover valve.



Checking switchover valve (64b)

Pull off vacuum line (white) on switchover valve (64b). Pull off vacuum line (white/purple/brown) on switchover valve (64a). Connect vacuum tester to free connection of switchover valve (64b) and connect with pulled off vacuum line (white/purple/brown). Vacuum readout 350–500 mbar.



Leak test

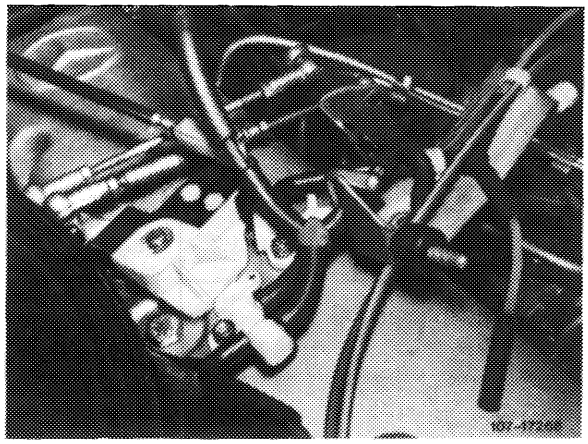
For this purpose, disconnect distributor of vacuum line (white/purple/brown). Vacuum should remain constant for approx. 2 minutes.

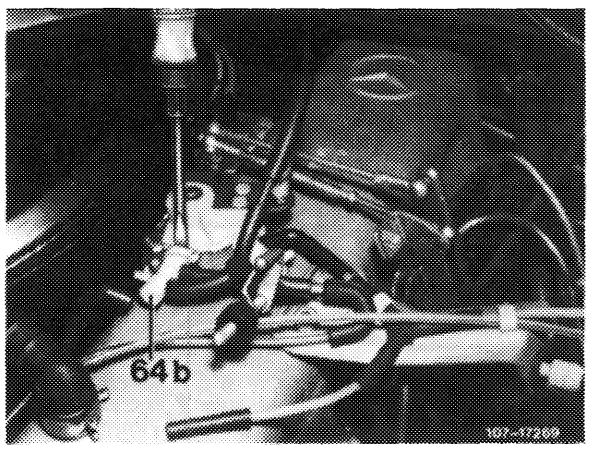
If vacuum drops, replace switchover valve.

If vacuum remains constant, **check switchover:**

For this purpose, remove clamp and pull off vacuum line (white/purple/brown) on switchover valve (64b). Switch over switchover valve with screwdriver. Vacuum should drop to "0".

If vacuum is not dropping to "0", replace switchover valve.

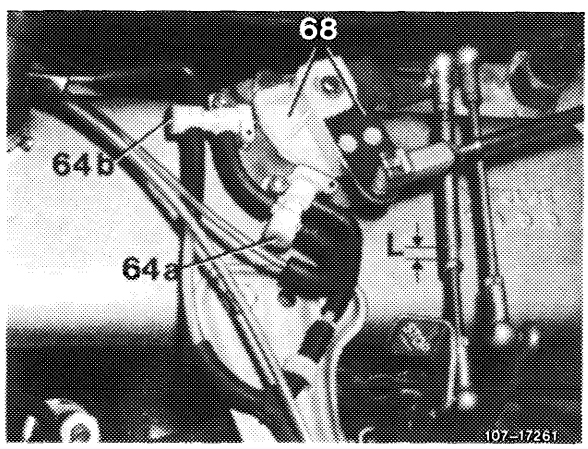




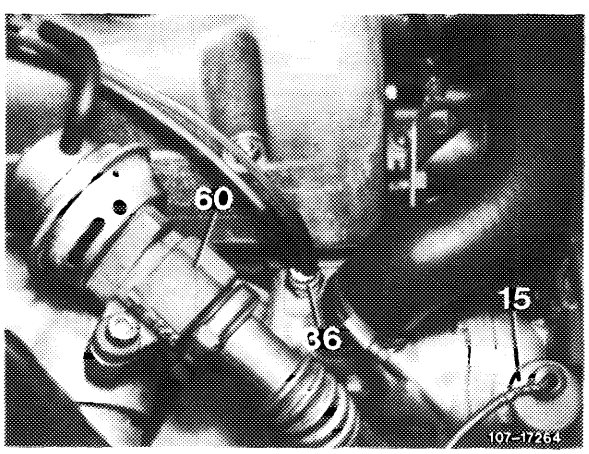
Checking EGR valve (60)

Switch over switchover valve (64a) by bridging free travel "L" on free travel rod. Pull off vacuum line on EGR valve and plug on again.

EGR valve should **audibly** close.	EGR valve not closing.



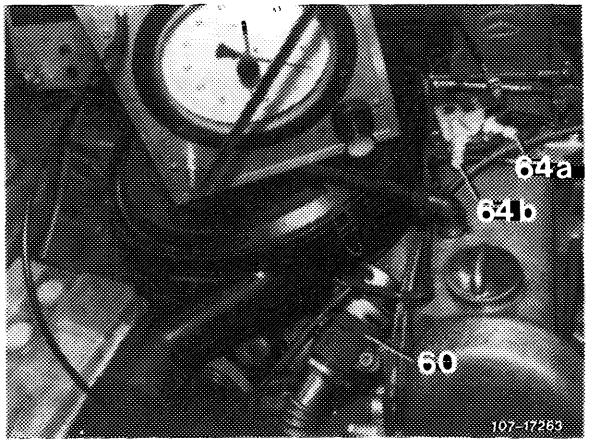
Replace EGR valve (60).



Checking vacuum control

Connect vacuum tester to vacuum line between EGR valve (60) and switchover valve (64b). Increase idle speed to 1000 ± 10/min by operating regulating linkage (do not pull on stop lever)

Vacuum amounts to 320–350 mbar.	Vacuum is below or above specified value.



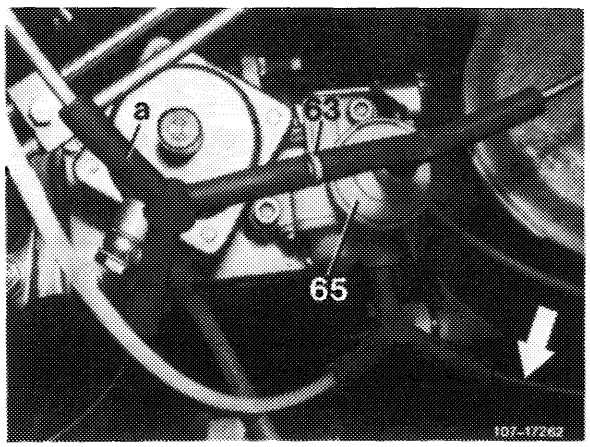
Check orifice (63)

Check if orifice is open and blow through, if required.

Change orifice (63)

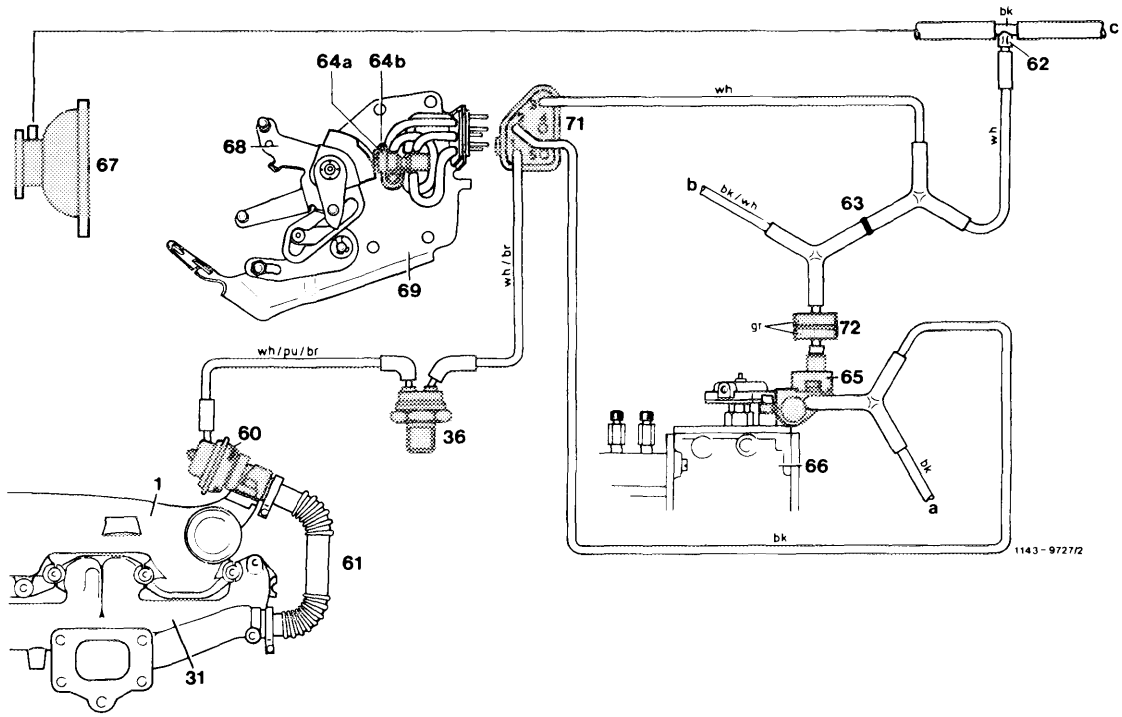
If the vacuum is not attained or is exceeded, install the next larger size orifice, if the vacuum is too high and the next smaller orifice if the vacuum is too low.

If the correct vacuum is **not** attained by the installation of another orifice, replace **vacuum control valve (65).**



End of test

B. (USA) starting model year 1981



Operational diagram, vacuum line layout

1 Intake manifold
31 Exhaust manifold
36 Thermovalve 40 °C/104 °F
60 Exhaust gas recirculation valve (EGR)
61 Corrugated tubing
62 Orifice
63 Orifice
64a Switchover valve, idle speed shutoff – EGR
64b Switchover valve, full throttle shutoff – EGR
65 Vacuum control valve
66 Injection pump
67 Vacuum pump
68 Guide lever with cam
69 Valve plate
71 Central plug
72 Vacuum damper
a Vent to passenger compartment
b Automatic transmission
c Brake unit

bk = black
br = brown
gr = green
pu = purple
re = red
wh = white

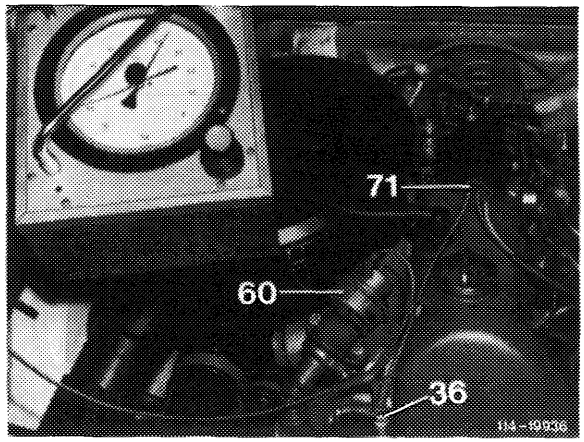
Checkup

Note: At begin of test, yellow orifice (63) should be installed.

Testing EGR

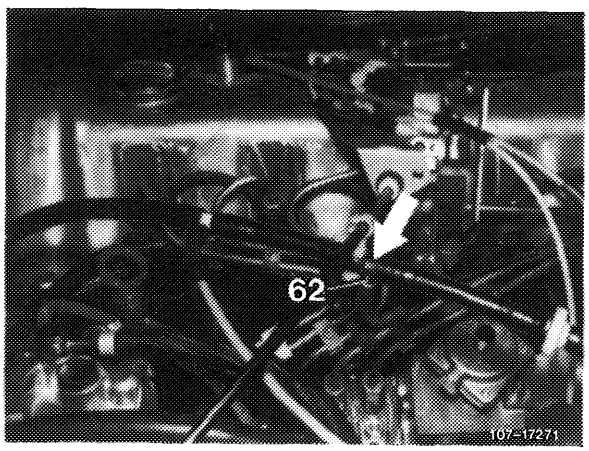
Connect vacuum tester between EGR valve (60) and straight connection of thermovalve (36). At idle, with throttle linkage at idle stop, no vacuum should be indicated. Advance control linkage until free travel of free travel rod is eliminated (do not pull on stop lever). The vacuum should now amount to 350–500 mbar.

Idle, no vacuum present. Vacuum of 350–500 mbar is attained.	Vacuum present. Vacuum not attained or exceeded.

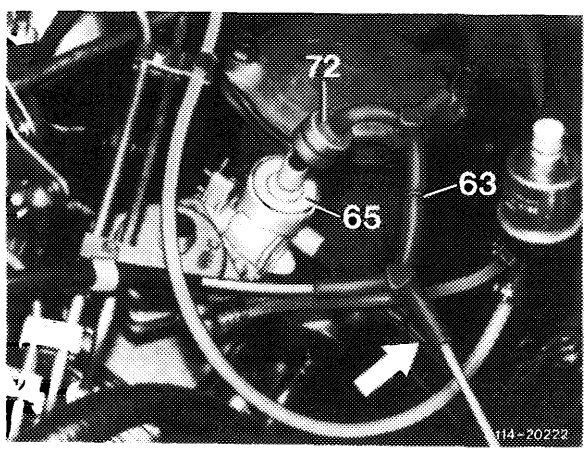


Check vacuum lines

Check all vacuum lines for control of EGR and automatic transmission according to **operating diagram vacuum line layout** for correct connection and leaks. Blow through orifice (62) in vacuum tapping point, if required.



Check black vent line (arrow) from vacuum control valve to passenger compartment for free passage.

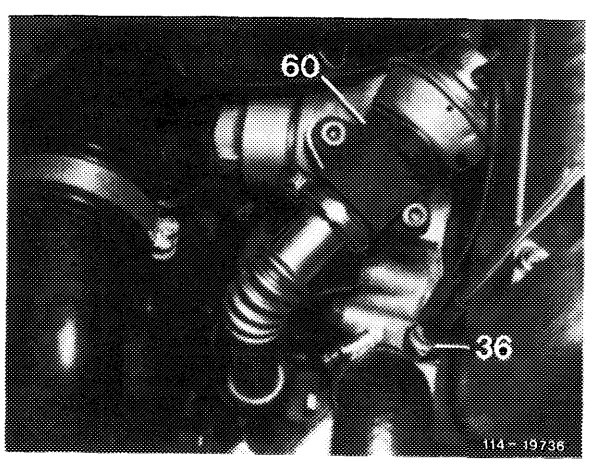


Check thermovalve 40 °C/104 °F (36, *color code blue*)

Pull off white/brown vacuum line on diagonal connection of thermovalve.

Pull off white/purple/brown vacuum line on EGR valve and blow through.

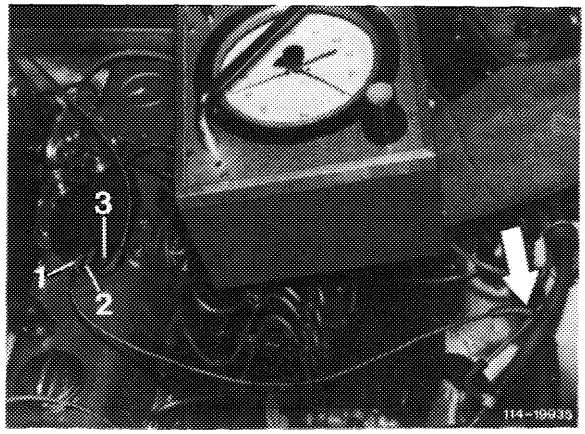
If there is no passage, remove thermovalve.



Check switchover valve (64a)

Pull central plug (71) from valve plate (69). Connect test line between tapping point (black orifice, arrow) on vacuum line for brake unit and valve plate connection (1). Connect vacuum tester to connection (3). Close connection (2).

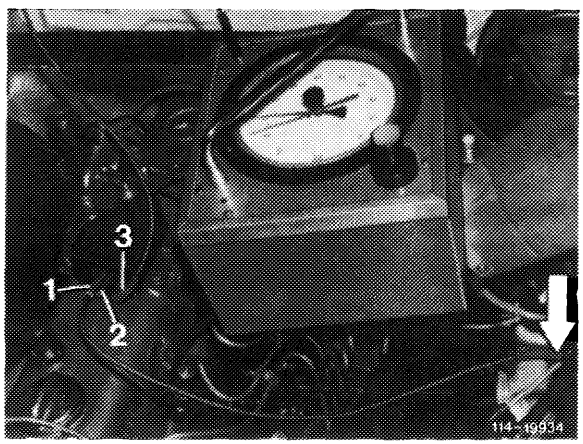
Vacuum readout at switchover:
Idle speed (throttle linkage at idle speed stop) "0" mbar.
Bridge idle speed (do not pull on stop lever) approx. 700–800 mbar.



Leak test:
Let throttle linkage return to idle speed stop, stop engine.

Vacuum should remain constant for approx. 2 minutes.
Pull closing cap from connection (2).
Bridge idle speed.
Vacuum should drop to "0".

If test values are not attained:
Replace switchover valve (64a).

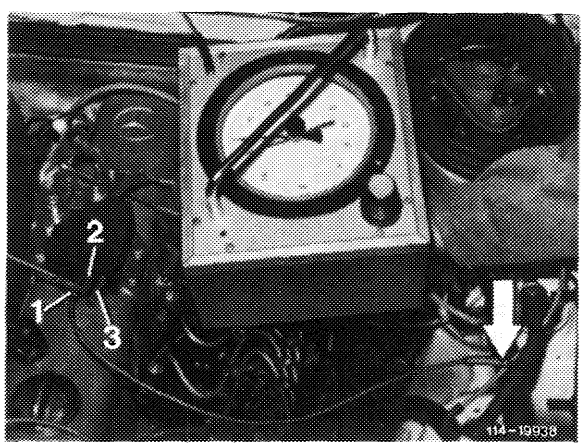


Check switchover valve (64b)

Pull central plug (71) from valve plate (69). Connect test line between tapping point (black orifice, arrow) on vacuum line brake unit and valve plate connection (1). Connect vacuum tester to connection (2).

Close connection (3), start engine.

Vacuum readout:
Idle speed (regulating linkage on idle speed stop) approx. 700–800 mbar.

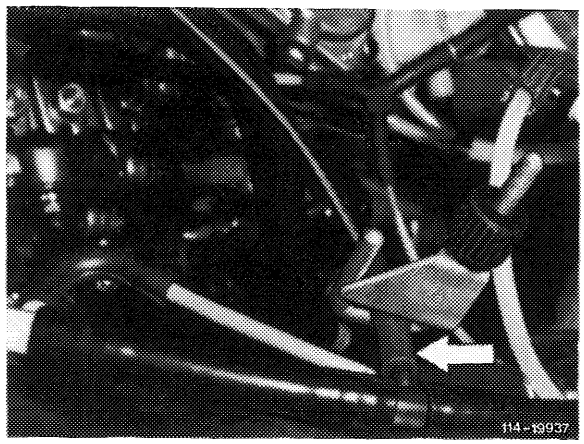


Leak test:
Disconnect tapping point for test line (arrow). Stop engine, vacuum should remain constant for approx. 2 minutes.

Vacuum readout at switchover:
Throttle linkage at full throttle stop, vacuum should remain constant.
Let throttle linkage return to idle speed stop and pull off test line.

Vacuum should drop to "0".

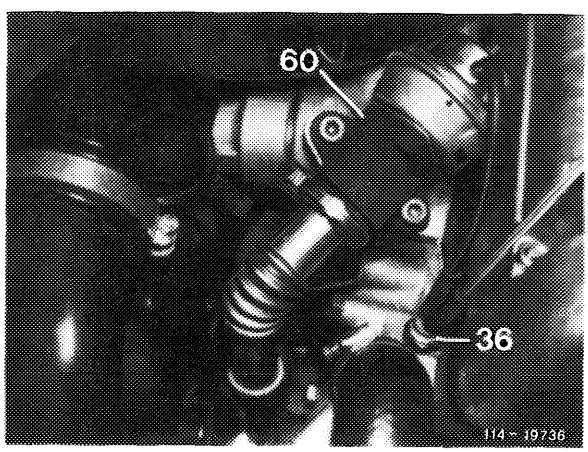
If test values are not attained, renew switchover valve (64b).



Checking EGR valve (60)

Start engine. Operate switchover valve (64a) by eliminating free travel "L" on free travel rod. Pull off vacuum line on EGR valve and plug-on again.

EGR valve should **audibly** close.	EGR valve not closing.



Replace EGR valve (60).

Note: Check adjustment of vacuum control valve prior to test.

Testing vacuum control

Connect vacuum tester between EGR-valve (60) and straight connection of thermovalve (36a). Disconnect connecting rod (5) on ball head. Start engine, increase rpm to approx. 900/min. Place adjusting roller on vacuum control valve (65) and set lever against stop (arrow).
Note: Engage connecting rod after test.

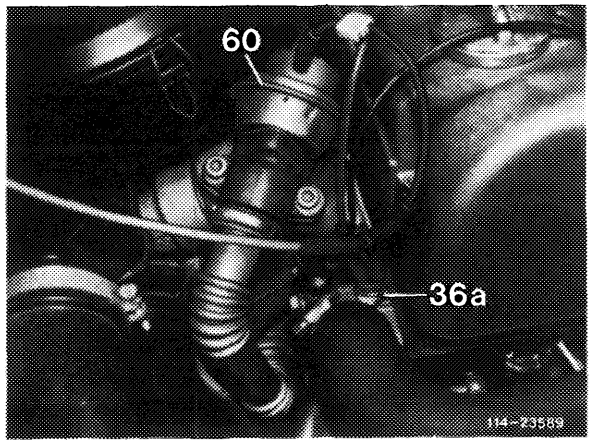
Vacuum readout 150–190 mbar	Vacuum is above or below requirements.

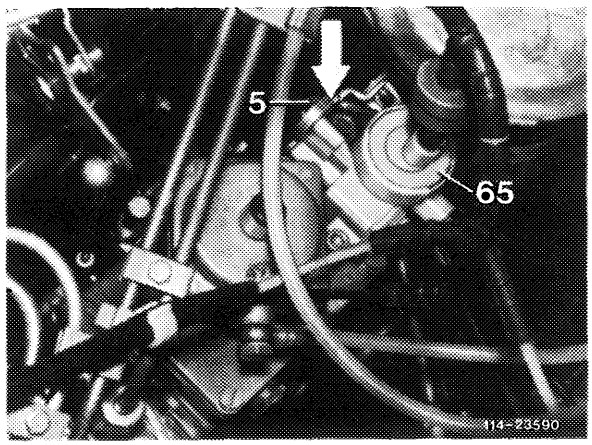
Test orifice (63)

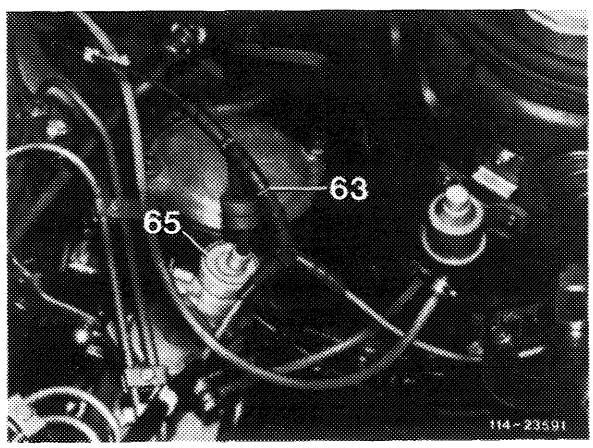
Test orifice for free passage and blow out, if required.

If the vacuum is not within tolerance, install the next larger orifice if the vacuum is too high, and the next smaller orifice if the vacuum is too low. If the specified vacuum is not attained by installing another orifice, replace vacuum control valve (65).

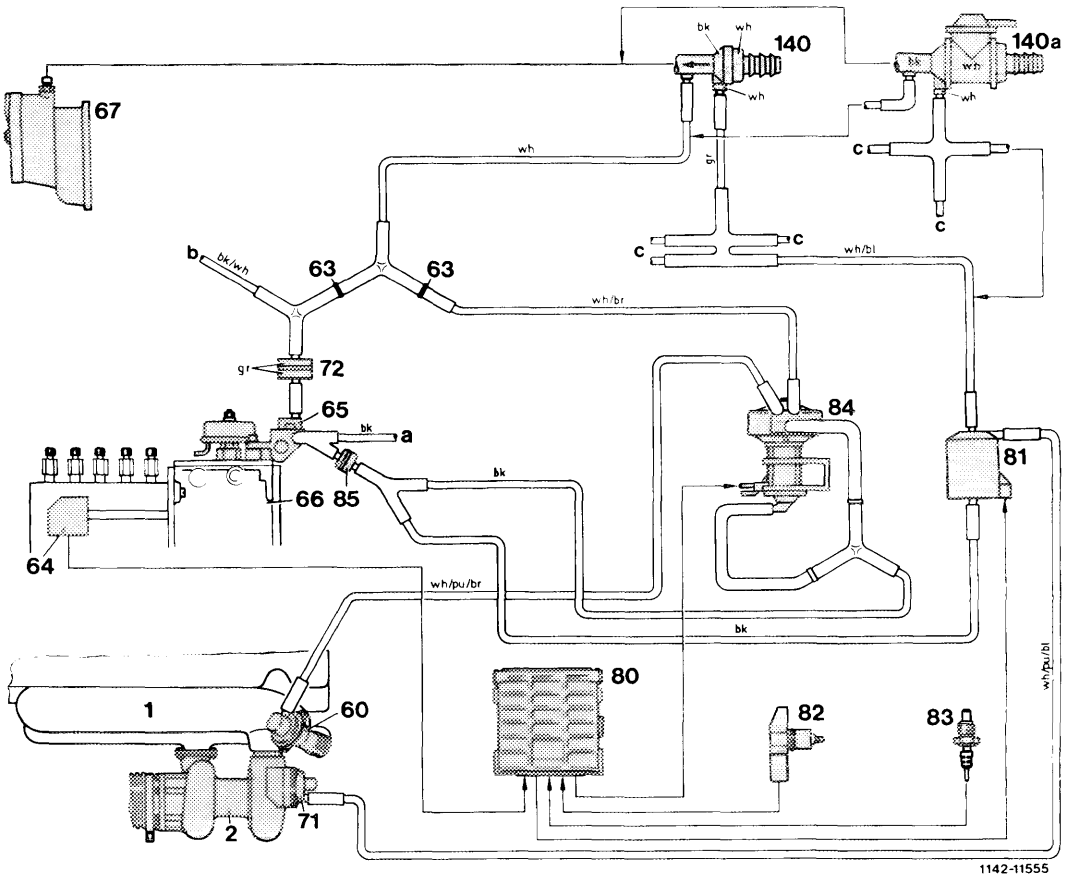
End of test





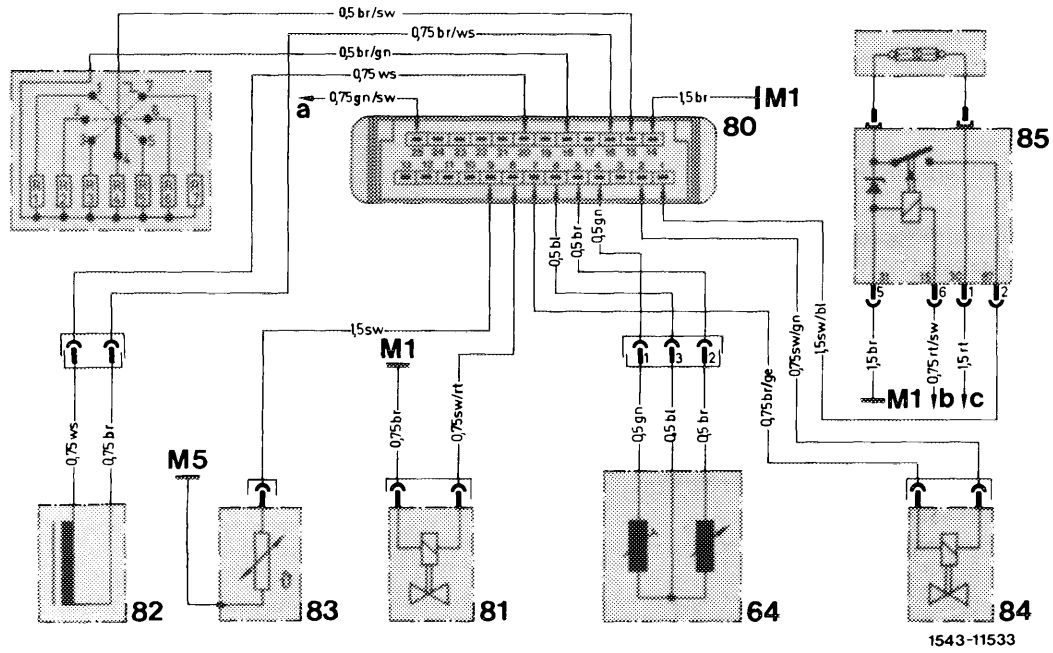


C. (USA) model year 1984 California



Function diagram vacuum line installation

1	Intake manifold	81	Switchover valve	bk	= black
2	Exhaust gas turbocharger	82	Rpm sensor	bl	= blue
50	EGR-valve	83	Temperature sensor coolant (NTC)	br	= brown
63	Orifice 0.5 mm	84	Pressure converter	gr	= green
64	Control rod travel indicator	85	Vent filter	pu	= purple
65	Vacuum control valve	140	Check valve, model 123	re	= red
66	Injection pump	140a	Check valve, model 126	wh	= white
67	Vacuum pump	a	Vent line to passenger compartment		
71	Circulating air safety valve	b	To automatic transmission		
72	Vacuum damper	c	Remaining consumers		
80	Control unit				



Electric wiring diagram

64 Control rod travel indicator
80 Control unit
81 Switchover valve
82 Rpm sensor
83 Temperature sensor
84 Pressure converter
85 Overvoltage protection
86 Compensating plug

M1 Main ground behind instrument cluster
M5 Ground, engine
a To revolution counter
b To fuse capsule, terminal 15
c To supporting lug, terminal 30

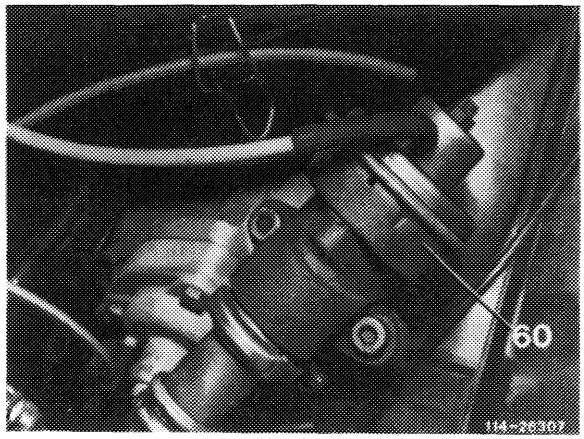
bl = blue
br = brown
ge = yellow
gn = green
rt = red
sw = black

Short test

Test EGR-valve (60) with engine stopped

Activate EGR-valve with approx. 300 mbar vacuum. Pull off vacuum line.

EGR-valve closes audibly	not closing

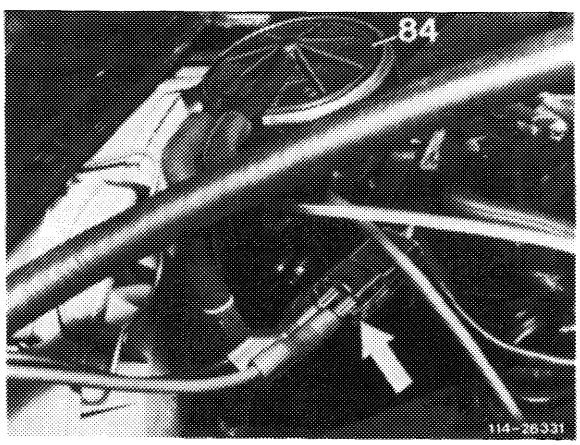


Renew EGR-valve.

Testing voltage at pressure converter (84)

Engine stopped, ignition switched on. Pull plug from pressure converter and connect with multimeter (arrow), push button "V=" and read nominal value 12 V.

Readout in order	not in order



Test overvoltage protection and electric activation according to wiring diagram.

Testing vacuum control

Connect vacuum tester with Y-distributor to EGR-valve (60).

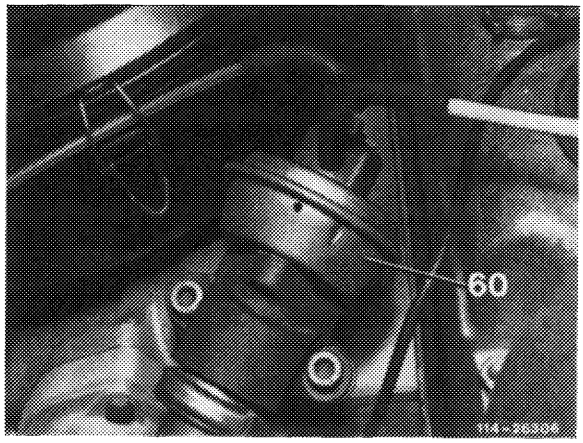
Read vacuum values at the following engine speeds:

1/min	mbar
700–2600 from approx. 2400	280–360 slowly dropping
3000	approx. 60

Vacuum values in order	not in order

Perform testing individual components.

End of test



Testing individual components

Testing temperature sensor for coolant (83)

Engine stopped.
Pull plug from temperature sensor for coolant.
Test resistance against ground.

For nominal value refer to diagram.
Test resistance at three temperature measuring points.

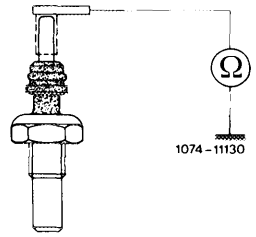
Example:
+ 20 °C = 2.2–2.8 kΩ
+ 80 °C = 290–364 Ω
+100 °C = 140–222 Ω

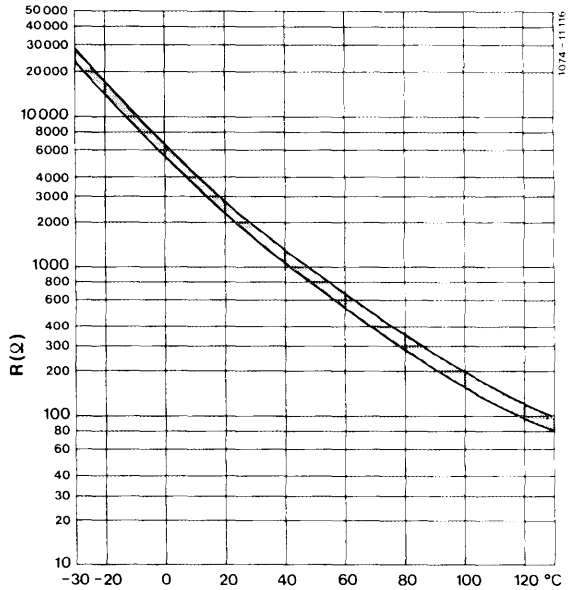
Test

values in order	not in order

Renew temperature sensor

End of test



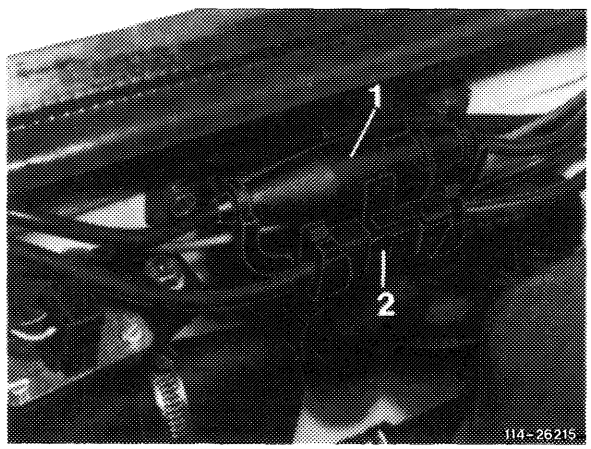


Testing rpm sensor (82)

Engine stopped.
Separate clutch (2) and test resistance with multimeter.
Readout: 1.9 ± 0.2 kΩ

in order	not in order

Renew rpm sensor.

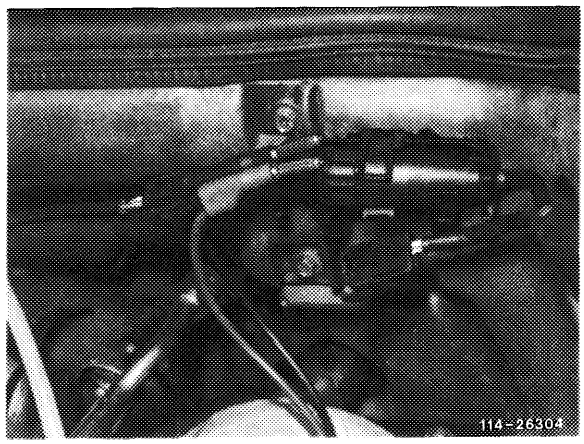


Connection as above.
Push "V" button.
Read test value at the following engine speed:

1/min	V ~
700–800	> 4[1])

Test values in order	not in order

Renew rpm sensor.



End of test

[1]) Voltage increasing with increasing engine speed.

Testing control rod travel indicator

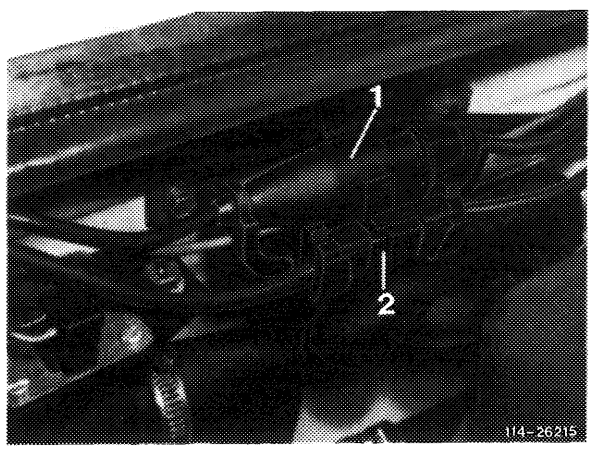
Engine stopped, separate clutch (1). With multimeter in position Ω (measuring range up to approx. 100 Ω) and test resistance according to drawing.

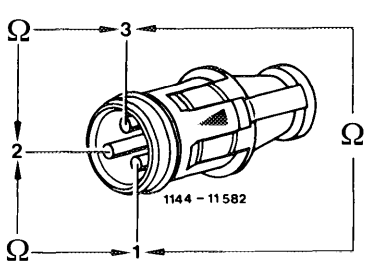
Readout: 1–2 = approx. 25 ± 2
2–3 = approx. 25 ± 2
1–3 = approx. 50 ± 6

Readout in order	not in order

Exchange injection pump with control and travel indicator.

Attention!
The control rod travel is set by manufacturer on test bench. Do not remove or change its function.





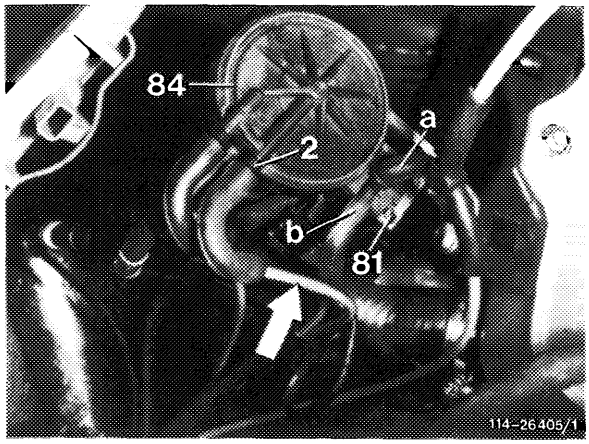
End of test

Testing pressure converter (84)

Connect vacuum tester to vacuum line of connection (2). Run engine at idle speed. Read vacuum value. Nominal value approx. 450 mbar.

Vacuum in order	not in order

Test vacuum lines according to function diagram. Test vacuum pump (43–660).



Connect vacuum tester with Y-distributor to connection (1). Connect multimeter with test cable to pressure converter. Push button „mA"

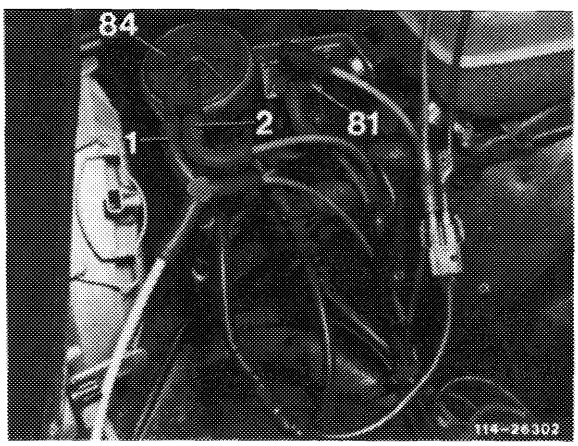
Read test values at the following engine speeds:

1/min	mbar	mA
700–2600	280–360	≙ 530
from approx. 2400	dropping slowly	≙ 370
approx. 3000	approx. 60	0

Test values in order	not in order

Current values in order, renew pressure converter.

Current values not in order, perform activation test according to electric wiring diagram. Renew control unit, if required.

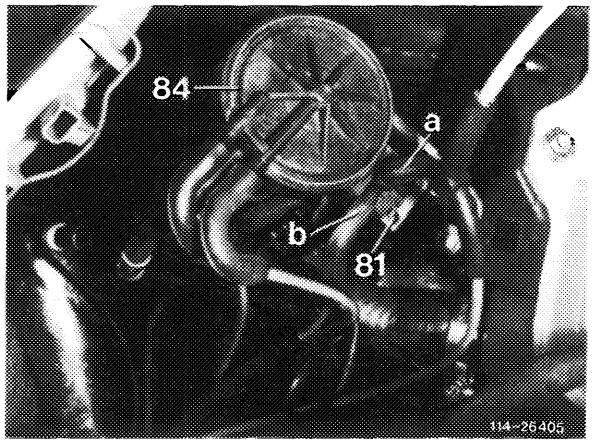


End of test

Testing switchover valve (81)

Connect vacuum tester with Y-distributor to connection (a). Run engine at idle speed. Read vacuum value. Nominal value > approx. 600 mbar.

Vacuum in order	not in order

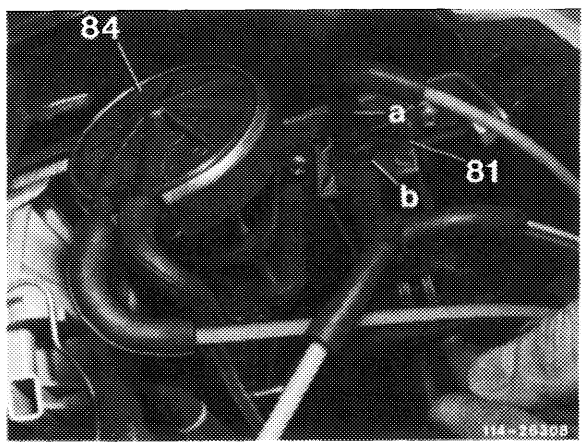


Test vacuum lines according to vacuum diagram. Test vacuum pump (43–660).

Connect vacuum tester with Y-distributor to connection (b). Connect multimeter with switchover valve. Push button "V=". Read test values at the following engine speeds:

1/min	mbar	Volt
700–800	0	0
1000–2500	approx. 600	approx. 12
> 3000	0	0

Test values in order	not in order



Voltage data in order, renew switchover valve.

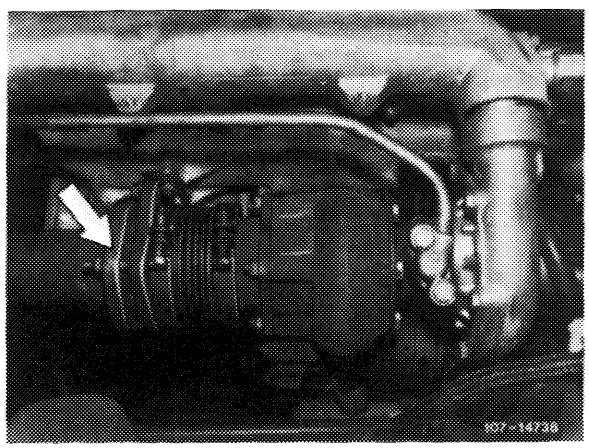
Voltage data not in order, perform activation test according to electric wiring diagram. Renew control unit, if required.

End of test

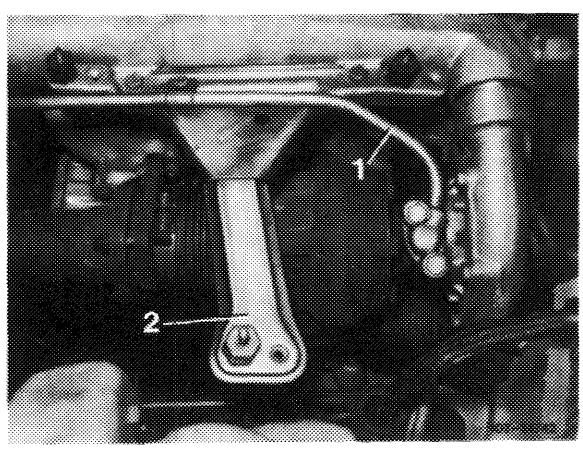
Removal

1 Remove air cleaner (09–400).

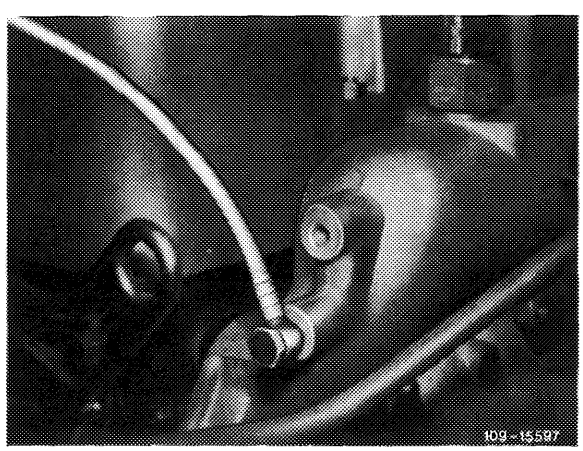
2 Unscrew fastening nuts (arrow) on exhaust flange.



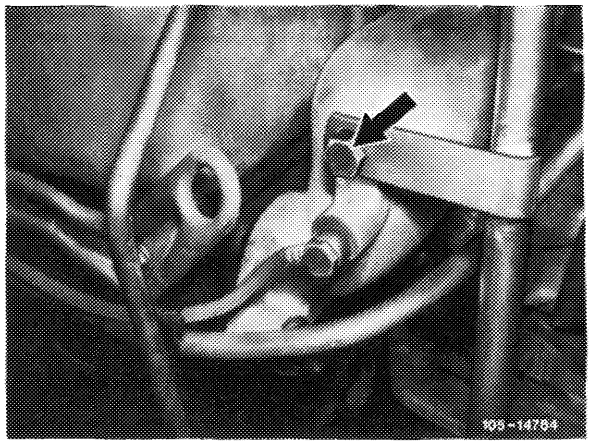
3 Unscrew engine oil feed line (1) on turbocharger and fastening clamp.



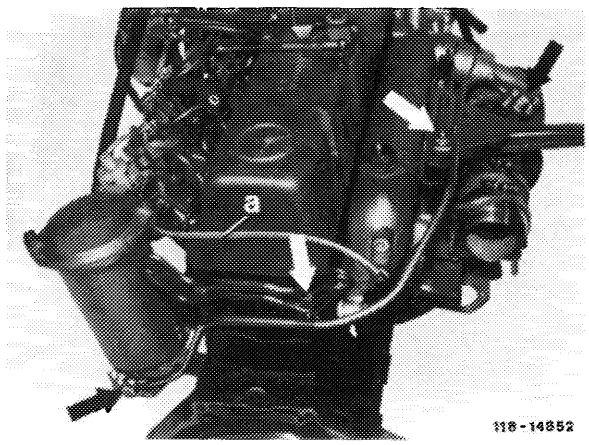
4 Unscrew pressure line to switchover valve on intake manifold.



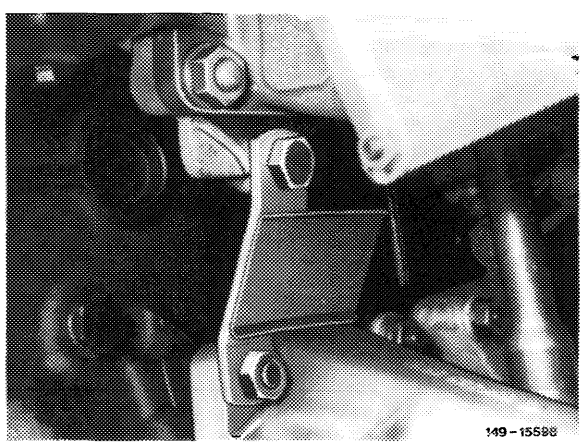
5 Unscrew fastening bracket (arrow) for oil pipe of automatic transmission.



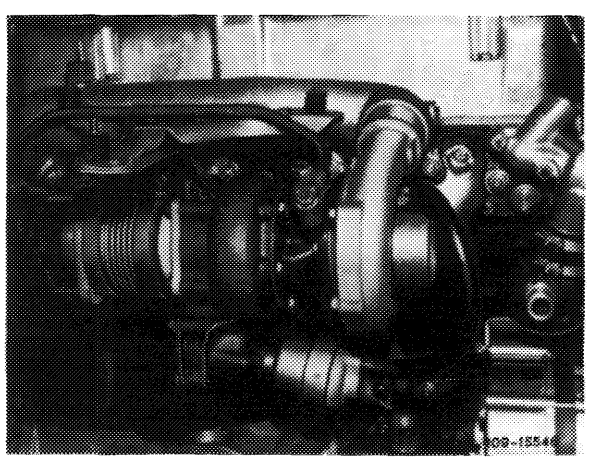
6 Loosen engine oil line (arrow) on oil filter and fastening clamp for engine oil line on cylinder head. On model 126, remove center part of partition for better access.



7 Unscrew supporting bracket for exhaust manifold on engine carrier.



8 Unscrew fastening nuts for intake manifold and exhaust manifold, remove intake manifold and exhaust manifold together with exhaust gas turbocharger.



9 Clean intake manifold and exhaust manifold. Check flange surfaces with straightedge and refinish on surface plate, if required.

10 When replacing intake manifold or exhaust manifold, unscrew all unscrewable parts and mount on new parts.

Installation

11 For installation proceed vice versa using new gasket and new exhaust nuts.

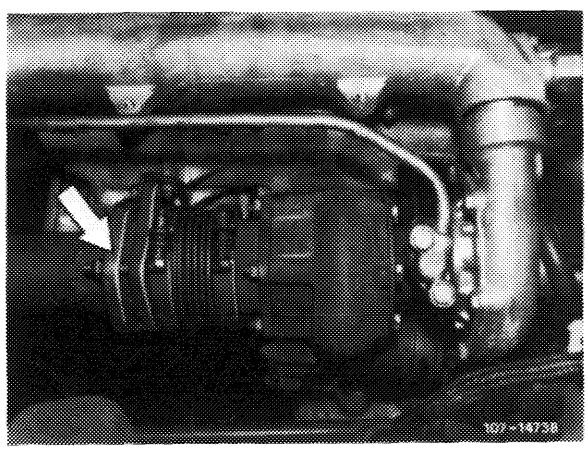
12 Adjust throttle linkage (30–300).

13 Adjust idle speed (07.1–100).

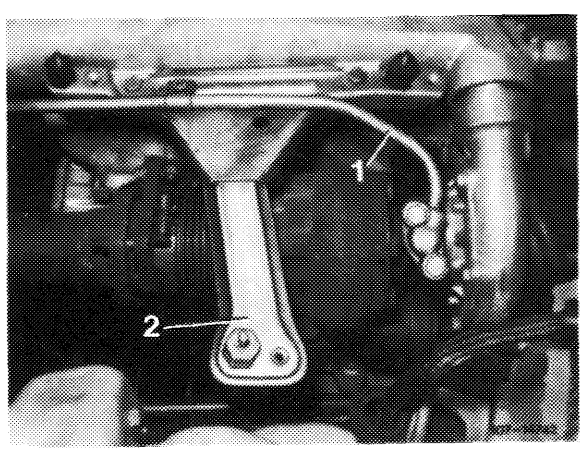
Removal

1 Remove air cleaner (09—400).

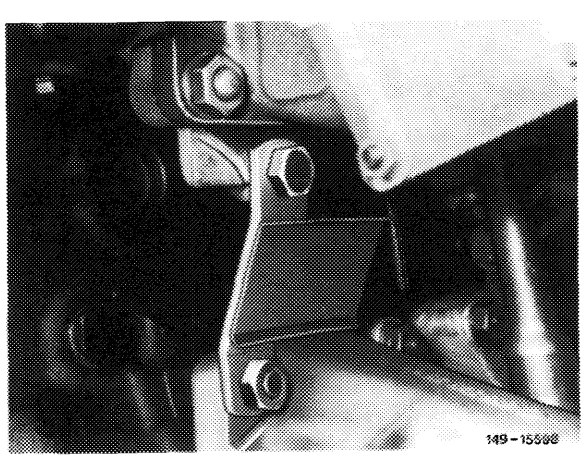
2 Unscrew fastening nuts (arrow) on exhaust manifold.



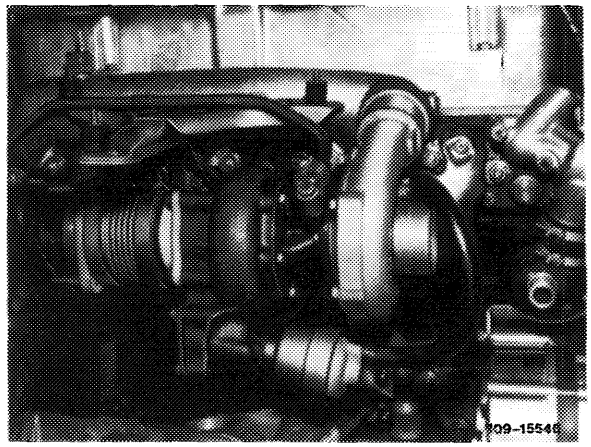
3 Unscrew engine oil feed line (1) on exhaust gas turbocharger and fastening clamp.



4 Unscrew supporting bracket for exhaust manifold on engine carrier.



5 Unscrew fastening nuts for intake manifold and exhaust manifold, remove intake manifold and exhaust manifold together with exhaust gas turbocharger.



6 Clean exhaust manifold and intake manifold, check flange surfaces with straightedge. Refinish on surface plate, if required.

7 When renewing exhaust manifold or intake manifold, unscrew all unscrewable parts and mount on new parts.

Convert exhaust gas turbocharger (09—430).

Installation

8 For installation proceed vice versa, using new gaskets and new exhaust nuts.

A. General information

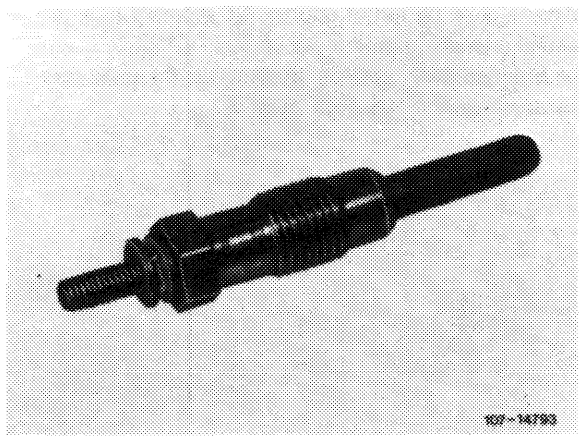
On a diesel engine, combustion is effected by self-ignition of the fuel sprayed into the highly compressed and thereby highly heated combustion air.

In the cold engine, the self-ignition temperature is not attained by compression alone. A preglow system is therefore required, which serves the purpose of increasing the temperature of the compressed air to facilitate the firing of the cold engine by the ignition of fuel particles on filament of glow plug.

The duration of preglowing depends on temperature of engine and on ambient temperature.

Design of pencil element glow plugs

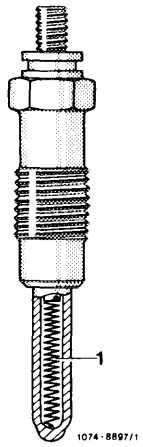
Pencil element glow plugs consist essentially of a housing with M 12 x 1.25 screw-in threads and a pencil element pressed into housing.



The single-pole connecting pin is glued to housing by means of a non-releasable round aluminum nut.

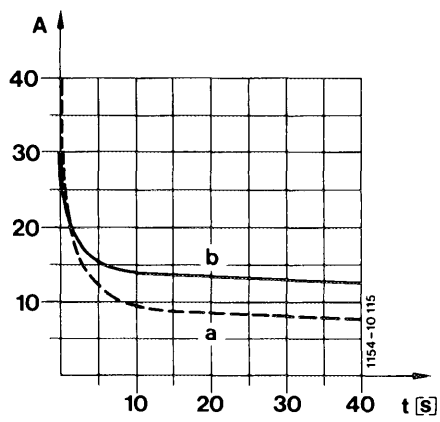
The pencil element glow plugs are designed for a current of 11 volts and are operated in parallel.

The pencil element is heated indirectly by means of a heater element. This heater element, a coil made of a resistance wire, is embedded and insulated in a ceramic compound.



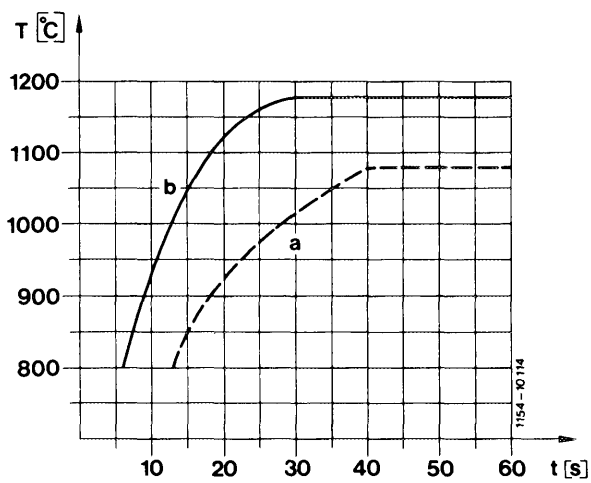
When the glow system is switched on, each glow plug is subject to a current of approx. 20 amps (peak impulse of approx. 40 amps).

Under the influence of increasing heat, the inherent resistance of the glow plug increases and will limit the current to approx. 8 amps.



a Current curve of pencil element glow plug

After a glow period of approx. 20 seconds a heater pencil element temperature of 900 °C/1652 °F will be attained, after approx. 50 seconds the max. temperature will be 1080 °C/1976 °F.



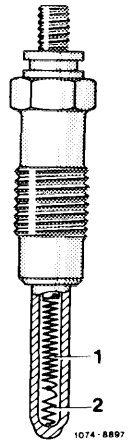
a Temperature curve of pencil element glow plug

Design of quick-start pencil element glow plugs

Except for heater element, the design of a quick-start pencil element glow plug is the same as that of a pencil element glow plug.

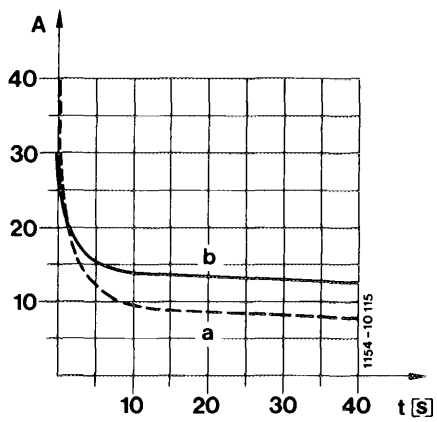
As an external identification, the connecting pin is screwed to the housing by means of a non-releasable round brass nut.

The heater element consists of a heater and control coil connected in series.



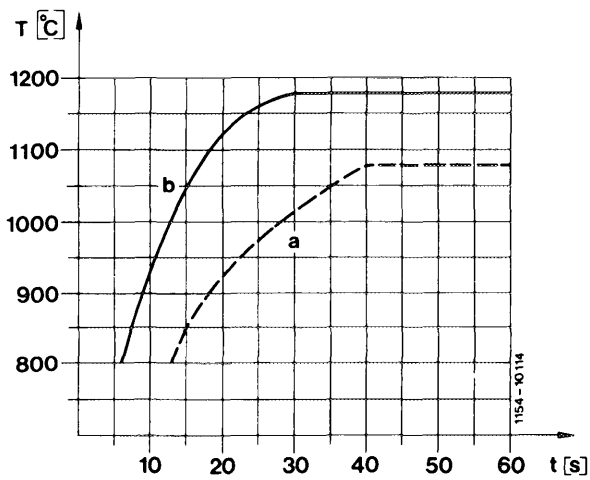
When the glow system is switched on, each glow plug will be subject to a current of approx. 30 amps.

The glow plug is heated very quickly by heater coil. With increasing temperature, the control coil increases its resistance and limits the current to approx. 8–15 amps. This will protect the glow plug against overloads.



b Current curve of quick-start pencil element glow plug

After a glow period of 9 seconds a pencil element temperature of approx. 900 °C/1652 °F is attained, after 30 seconds the max. temperature amounts to 1180 °C/1976 °F.

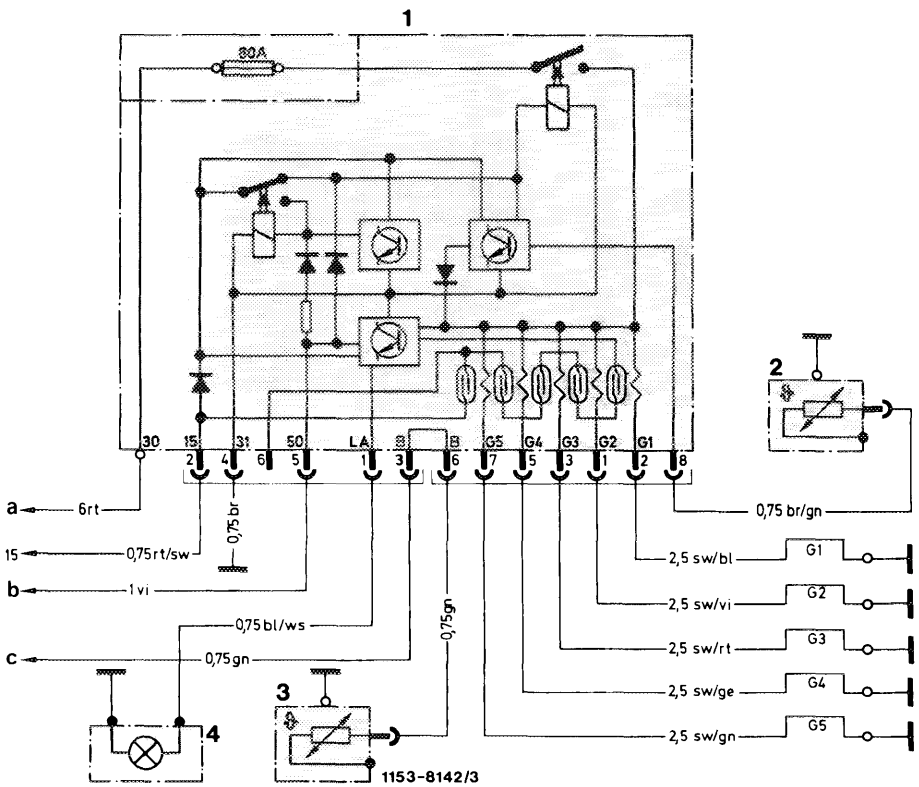


b Temperature curve of quick-start pencil element glow plug

B. Preglow system engine 617.950 (USA) 1978–1980

General information

The essential components of the preglow system are the pencil element glow plugs, model year 1980 quick-start pencil element glow plugs, preglow time relay, temperature sensor and preglow indicator lamp.



Wiring diagram

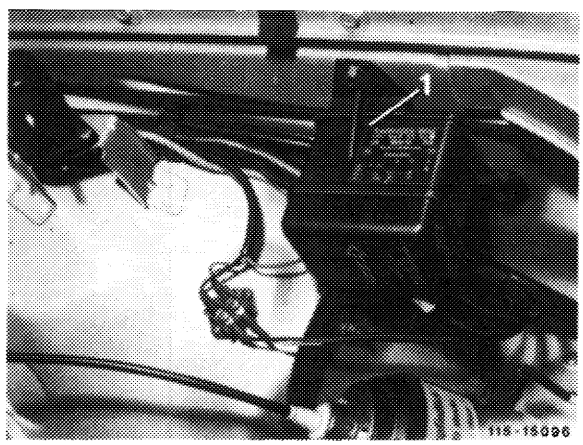
1 Preglow time relay
2 Temperature sensor preglow system
3 Temperature sensor coolant
4 Preglow indicator lamp

G 1 – G 5 Pencil element glow plugs
a Cable connector engine harness terminal 30
b Relay air conditioning/starter terminal 50
c Plug instrument cluster jack 3

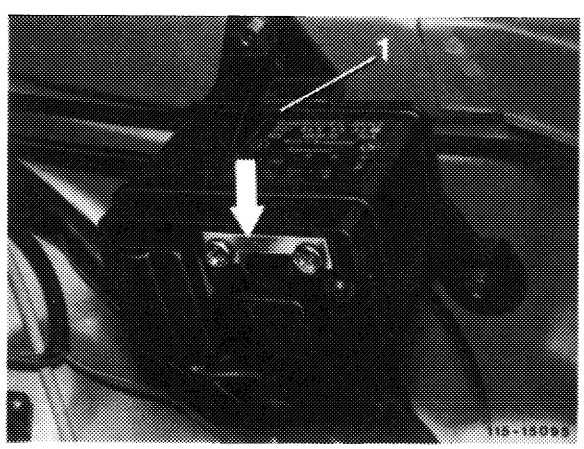
The pencil element glow plugs are designed for a current of 11 volts and connected in parallel. For this reason, preglowing will proceed even if one pencil element glow plug fails.

Preglow time relay

The preglow time relay is located in engine compartment at left of wheel house.



Upon removal of clipped-on cap on preglow time relay the 80-amps fuse and the electric connections will be accessible.



Functions of preglow time relay

The preglow time relay has the following functions:

- Switching of glow current
- Ready-to-start indicator
- Safety shutoff
- Fault indicator

Switching of glow current

When the preglow system is switched on in key position "2" (preglowing, driving) the preglow time relay is activated by terminal 15 of starter switch.

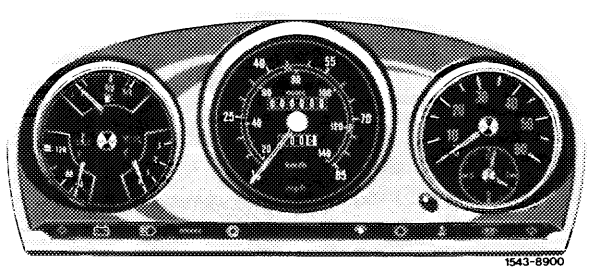
The power relay in preglow time relay closes the circuit of terminal 30 (battery +) via 80-amps fuse to pencil element glow plugs.

When the key is turned into position "3" (start) the power relay – activated by terminal 50 – remains in energized condition. The glow process continues until the key is turned to position "2".

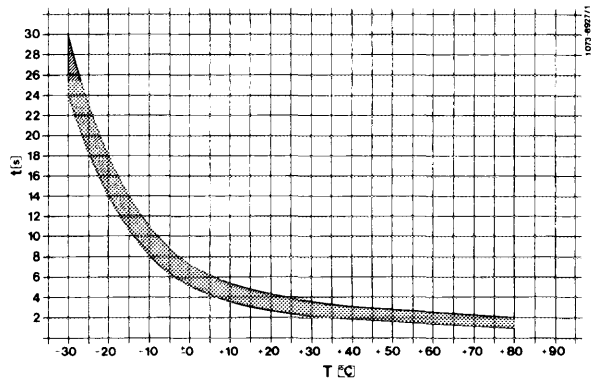
Ready-to-start indicator

A temperature sensor installed in coolant circuit determines the glow period in preglow time relay.

When the glow system is switched on, the preglow indicator lamp in instrument cluster lights up.



As soon as the required glow period, depending on coolant temperature, is attained, the preglow indicator lamp goes out and thereby indicates ready-to-start condition.



Safety shutoff

If there is no start following indication of ready-to-start condition, the glow current is interrupted by the safety shutoff, after 90 + 20 seconds for model year 1978/1979, after 50 + 10 seconds for model year 1980.

For subsequent starting, the glow system is again switched on via terminal 50 for the duration of the starting procedure.

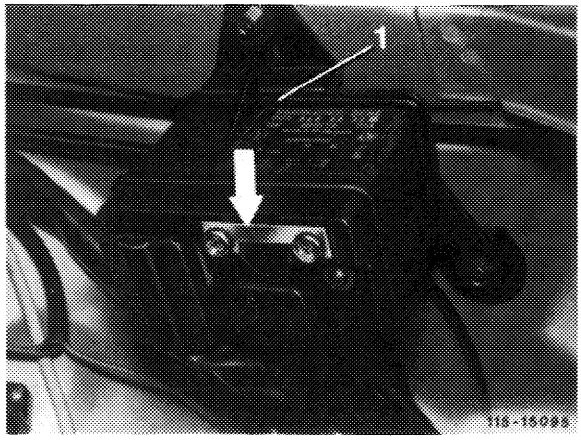
Fault indicator

A functional fault of the preglow system is indicated by the preglow indicator lamp during or after the preglowing has been completed.

The preglow indicator lamp is controlled by the electronic system in preglow time relay.

If the glow current circuit is interrupted, e.g. by a defective 80-amps fuse or power relay in preglow time relay, the electronic system receives no current from terminal 30 and the preglow indicator lamp will flash for approx. 30 seconds after the preglow system has been switched on.

If one or several pencil element glow plugs or lines are interrupted, the preglow indicator lamp will flash for approx. 30 seconds after starting.



For preglowing, the current flows through the Reed contact coils located in respective glow current circuits.

The resulting magnetic field will close the Reed contacts and a voltage from terminal 15 will be applied to electronic system.

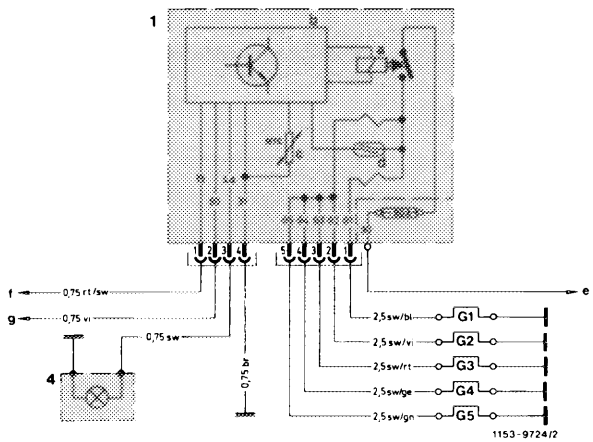
If this voltage is interrupted, for example by a failing pencil element glow plug (the respective Reed contact remains open) the preglow indicator lamp will flash for approx. 30 seconds after starting.

C. Preglow system engine 617.95 standard version and (USA) starting 1981

General information

The preglow system corresponds in principle to system of model year 1980.

The preglow time relay has been modified. In addition, the temperature sensor in coolant circuit is no longer installed.



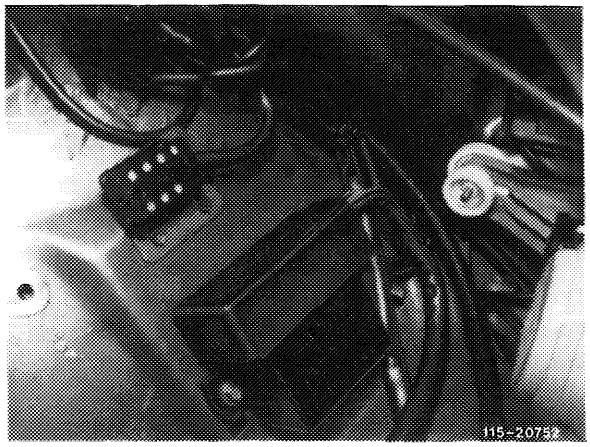
Wiring diagram

1 Preglow time relay
a Power relay
b Electronics
c Temperature sensor (NTC resistor)
d Reed relay
4 Preglow time relay
e To cable connector engine harness
Terminal 30 in model 123
To point of support in fuse box
Terminal 30 in model 126
f To fuse box terminal 15
g To plug connection starter lockout and backup lamp switch terminal 50
G 1 – G 5 Pencil element glow plugs

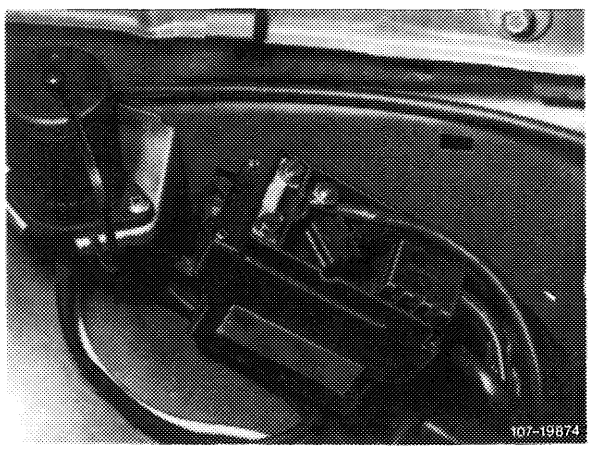
Preglow time relay

The preglow time relay is located in engine compartment at left on wheel house.

After removing plugged-on protective cap, the electrical connections as well as the fuse strip are accessible.



Relay layout on engine 617.951



Relay layout on engine 617.952

The temperature sensor installed up to now in coolant circuit is no longer installed. Instead, the relay or relay ambient temperature is obtained by means of an NTC resistor in preglow time relay.

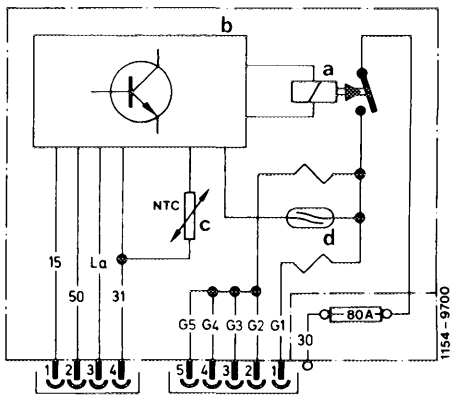
Functions of preglow time relay

The preglow time relay has the following functions:

- Switching of glow current
- Ready-to-start indicator
- Safety shutoff
- Fault indicator

Switching of glow current

When turning key into position "2" (preglowing, driving) the preglow time relay (current on terminal 15) is switched on. The power relay (a) closes the circuit of terminal 30 (plus) via fuse for pencil element glow plugs G 1 – G 5.



a Power relay
b Electronic unit
c Temperature sensor (NTC resistor)
d Reed relay

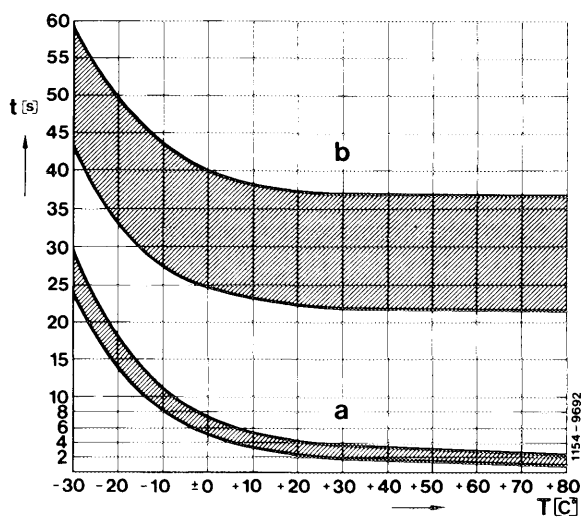
When the key is moved into position "3" (start) the power relay (a) remains in energized condition under influence of terminal 50. Glowing continues until key is again turned into position "2".

Ready-to-start indicator

A temperature sensor installed in preglow time relay determines the duration of the glow period.

When the glow system is switched on, the preglow indicator lamp in instrument cluster lights up.

As soon as the required glow period, depending on ambient temperature of preglow time relay, has been attained, the preglow indicator lamp will go out and thereby indicate ready-to-start condition.

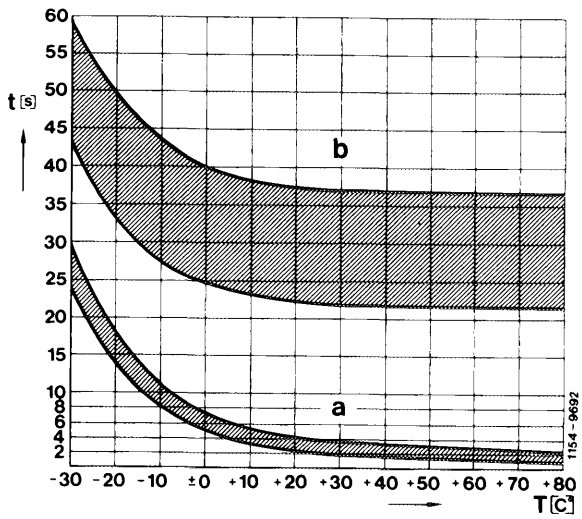


a Preglow period

Safety shutoff

If, upon indication of ready-to-start condition, there is no start within 20—35 seconds, the glow current is interrupted by the safety shutoff. For a subsequent start, the glow system is again switched on for the duration of the starting procedure.

The safety shutoff is no longer fixed, but is the result of the time up to ready-to-start condition (preglow indicator lamp goes out) plus 20 to 35 seconds.



a Preglow period
b Safety shutoff

Fault indicator

A fault in preglow system is indicated by the preglow indicator lamp **not lighting up** when key is actuated in position "2".

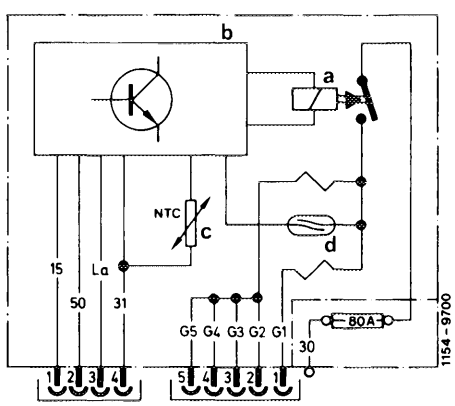
The following faults are recognized:

- Interruption of line to connection terminal 30.
- Fuse 80 Amps. defective.
- Power relay in preglow time relay defective.

– Interruption of one or several lines to pencil element glow plugs.
– Interruption of one or several pencil element glow plugs.

Note: In the event of unfavorable tolerances of pencil element glow plugs or of Reed relay (d), response of fault indicator only after two pencil element glow plugs are defective is allowed.

Faults (monitoring of pencil element glow plugs) are indicated by comparing the current of the pencil element glow plug G 1 with current of remaining pencil element glow plugs G 2 to G 5 connected in parallel.



a Power relay
b Electronic unit
c Temperature sensor (NTC resistor)
d Reed relay

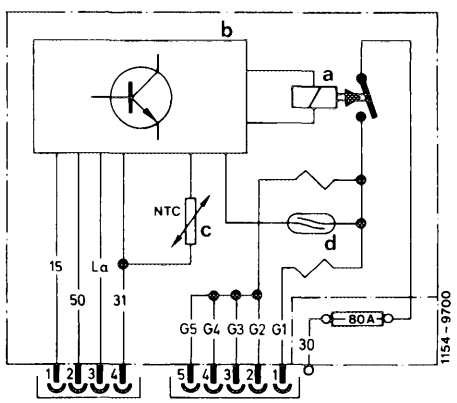
The currents of the two lines to pencil element glow plugs G 1 and G 2 to G 5 are flowing through two oppositely oriented Reed relay windings having a different number of turns in windings.

If the current flow in both windings is the same, the magnetic fields will cancel each other and the Reed contact will not respond.

If the balance of the magnetic fields is interrupted by the failure of one or several pencil element glow plugs, the Reed contact will close and the electronic unit (b) will be activated.

The preglow indicator lamp will switch off immediately and will therefore not light up when preglowing starts.

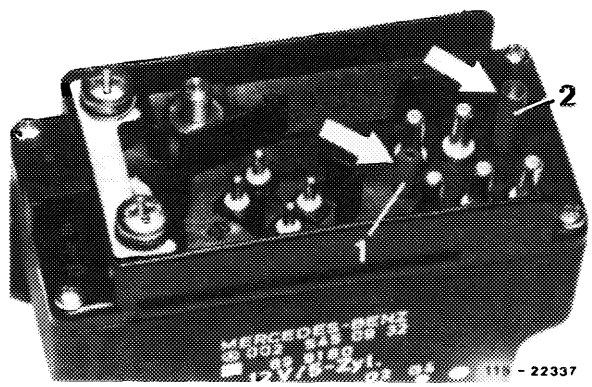
a Power relay
b Electronic unit
c Temperature sensor (NTC resistor)
d Reed relay



Note

Since September 1981 a preglow time relay with modified ventilation is installed for quick-start preglow system. The part number has not been changed.

In the modified version of the preglow time relay, ventilation proceeds via coding pin (1). The coding pin (2) is also longer as before and the 5-pole coupler has been designed in such a manner that the ventilation is covered. In the former preglow time relay ventilation proceeded through a bore in housing.



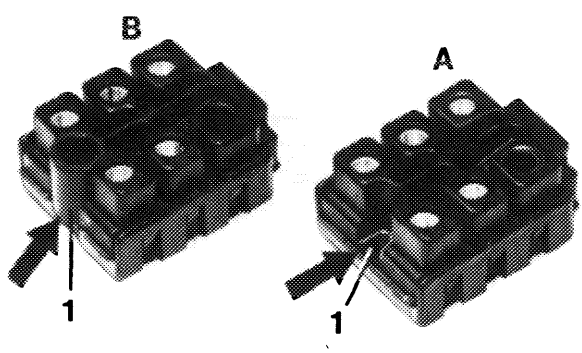
Modified preglow time relay
1 Ventilation
2 Higher coding pin

The modified preglow time relay can also be installed in vehicles prior to September 1981. In such a case, the modified 5-pole coupler must also be installed, since otherwise moisture may enter the relay.

Upon installation of the new relay, convert coupler of harness to new ventilation.

Layout of 5-pole coupler:

Jack 1 of coupler =
Pencil element glow plug cylinder 1—2.5 black/blue
Jack 2 of coupler =
Pencil element glow plug cylinder 2—2.5 black/purple
Jack 3 of coupler =
Pencil element glow plug cylinder 3—2.5 black/red
Jack 4 of coupler=
Pencil element glow plug cylinder 4—2.5 black/yellow
Jack 5 of coupler =
Pencil element glow plug cylinder 5—2.5 black/green



5-pole coupler
A 1st version
B 2nd version

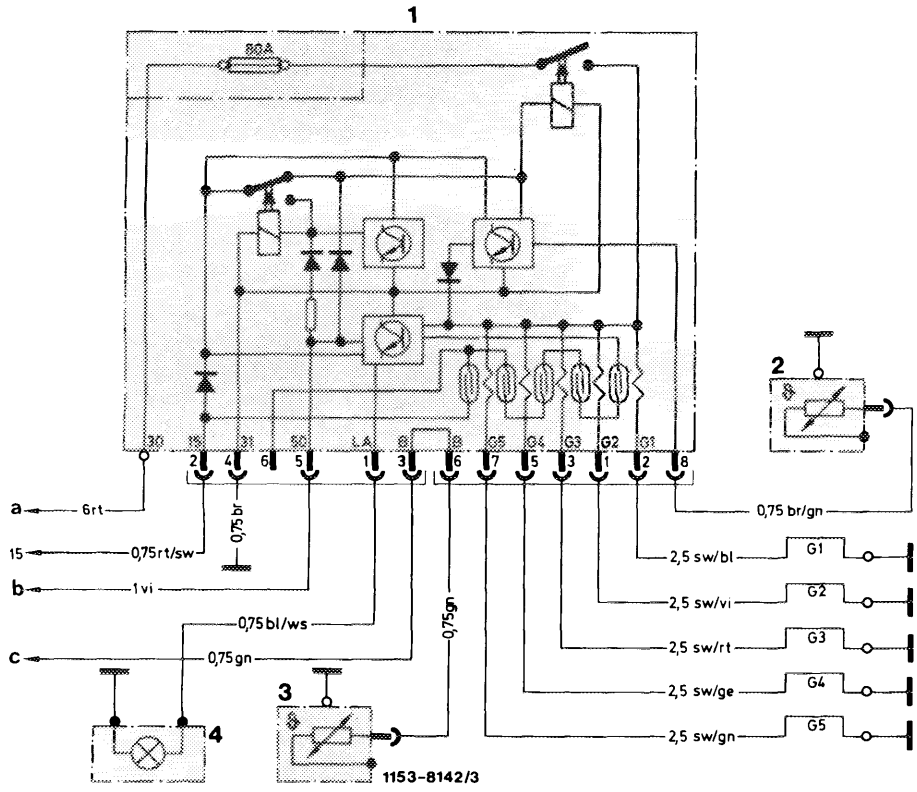
Conventional tools

Voltmeter (measuring range 0–3 volts/0–30 volts)

Note

Battery charged min. 60 % (acid density approx. 1.22 g/cc).

A. Engine 617.950 (USA) up to 1980



Wiring diagram

1 Preglow time relay
2 Temperature sensor preglow system
3 Temperature sensor, coolant
4 Preglow indicator lamp

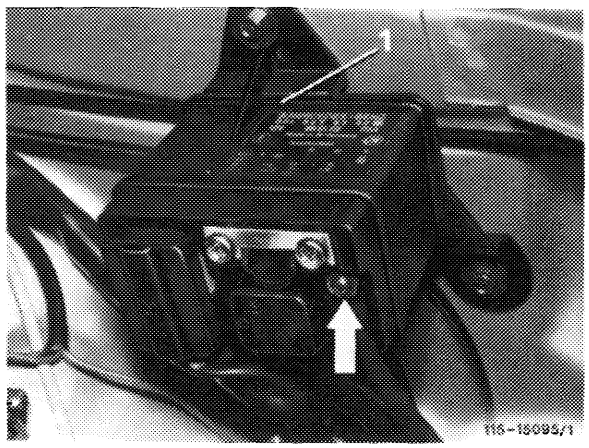
G 1 – G 5 Pencil element glow plugs
a To cable connector terminal 30
b Relay air conditioning/starter terminal 50
c Plug instrument cluster jack 3

Checking main circuit of preglow system for interruption

In the event of an interruption:

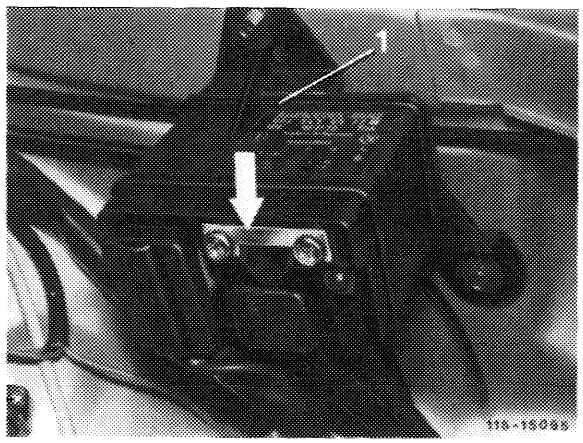
Preglow indicator lamp will flash for approx. 30 seconds in key position "2 preglowing".

Test voltage at terminal 30 of preglow time relay against ground by means of voltmeter. If no voltage is indicated (approx. 12 volts), check red line from cable connector engine harness to preglow relay terminal 30 for interruption and remove interruption, if applicable.



If voltage is indicated, check 80-amps fuse for tight seat or for interruption, replace fuse.

If no faults have been found during tests, replace preglow time relay.

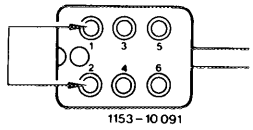


Testing glow bulb, temperature sensor of preglow system and their lines

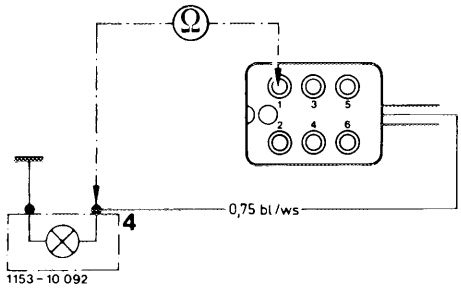
In the event of an interruption:

Preglow indicator lamp not lighting up in spite of ready-to-start condition.

Pull 6-point coupler from preglow relay, turn key to position "2", bridge jack 1 and 2 of coupler.

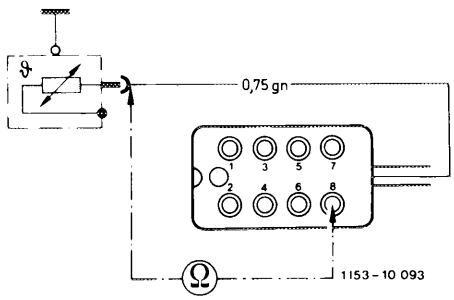


If preglow indicator lamp is not lighting up, check glow bulb or renew, if required. If glow bulb is in order, test blue/white line from coupler jack 1 of preglow time relay to preglow indicator lamp for interruption, remove interruption.



If preglow indicator lamp lights up, test green line from 8-point coupler jack 8 of preglow time relay to temperature sensor for interruption, remove interruption.

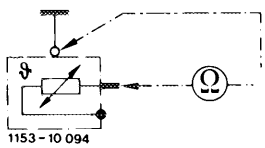
If no interruption is found, test temperature sensor or renew, if required.



Resistance values of temperature sensor at coolant temperature:

0 °C = 8200 Ω
+ 25 °C = 2440 Ω
+ 80 °C = 290 Ω

If temperature sensor is in order, replace preglow time relay.



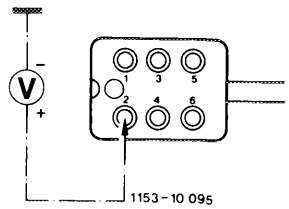
Testing activation of preglow time relay

In the event of an interruption:

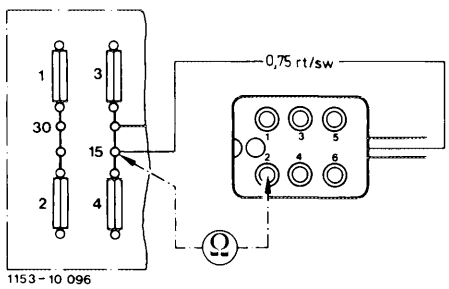
Preglow indicator lamp not lighting up, engine cannot be started.

Pull 6-point coupler from preglow time relay, turn key into position "2".

Test voltage at jack 2 (terminal 15) against ground by means of voltmeter.



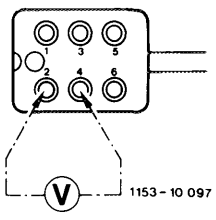
If there is no voltage (approx. 12 volts) on red/black line from fuse box (terminal 15, non-fused side) to coupler jack 2 of preglow time relay for interruption and remove interruption, if required.



If voltage is indicated, connect voltmeter to jack 2 (terminal 15) and jack 4 (terminal 31) and test voltage.

If no voltage (approx. 12 volts) is indicated, test brown line from jack 4 to ground for interruption and remove interruption, if applicable.

If voltage is indicated, preglow time relay is defective. Replace preglow time relay.



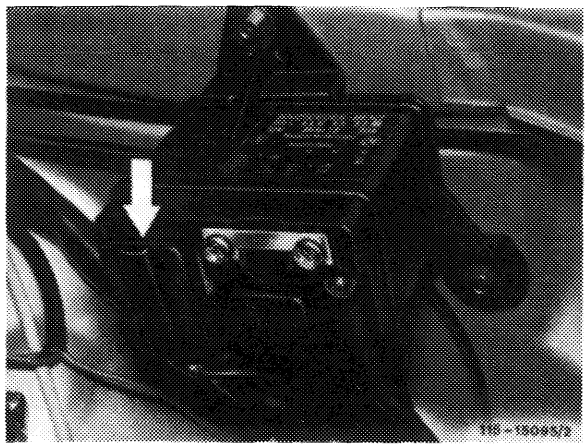
Testing pencil element glow plugs and their lines

In the event of a complaint:

Preglow indicator lamp flashes approx. 30 seconds after a completed start or start attempt, the cause may be an interruption of a pencil element glow plug or a line to pencil element glow plugs of cylinder 1–5, or by a wrong current input of the pencil element glow plugs in cylinders 1–5.

Measure current input of pencil element glow plugs with DC clip-on probe. For this purpose, place probe over the individual lines on pencil element glow plugs.

Move key in steering lock to position "2", the power input of each glow plug should then be 8–15 Amps. after 10–20 seconds.



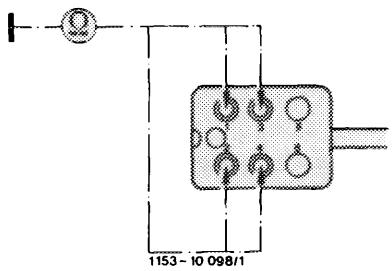
At a value above 15 Amps., renew glow plug.

At a value below 8 Amps., test electric line or glow plug with ohmmeter for interruption.

Test for interruption:
Pull 8-point coupler from preglow time relay.

Measure resistance against ground (engine block) by means of ohmmeter one after the other at

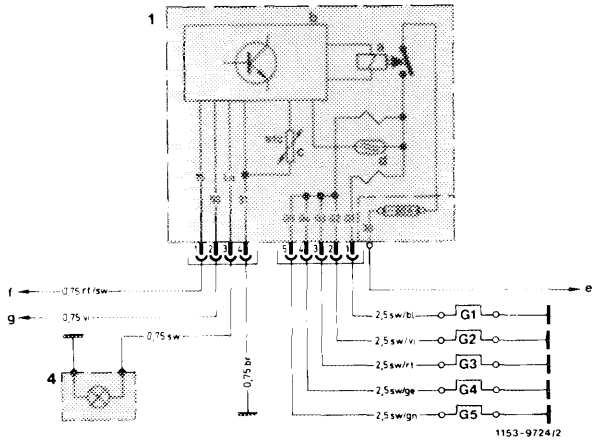
jack 1 of coupler = pencil element glow plug cylinder 2
jack 2 of coupler = pencil element glow plug cylinder 1
jack 3 of coupler = pencil element glow plug cylinder 3
jack 5 of coupler = pencil element glow plug cylinder 4
jack 7 of coupler = pencil element glow plug cylinder 5.



If resistance ∞ is measured, an interruption of respective pencil element glow plug or supply line or connection is indicated.

If a lower resistance (e.g. at 20 °C/68 °F < 1 Ω) is measured, the supply line and the pencil element glow plug are in order.

B. Engine 617.95 standard and (USA) version starting 1981 (quick-start system)



Wiring diagram

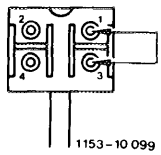
1	Preglow time relay
a	Power relay
b	Electronic unit
c	Temperature sensor (NTC resistor)
d	Reed relay
4	Preglow indicator lamp
e	To cable connector engine harness Terminal 30 in model 123 To point of support in fuse box Terminal 30 in model 126
f	To fuse box terminal 15
g	To plug connection starter lockout and backup lamp switch terminal 50
G 1 – G 5	Pencil element glow plugs

Testing glow bulb and its line

In the event of an interruption:

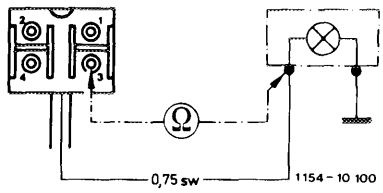
Preglow indicator lamp not lighting up when preglow system is switched on in spite of ready-to-start condition.

Pull 4-point coupler from preglow time relay, turn key into position "2", bridge jack 1 and 3 of coupler.



If preglow indicator lamp is not lighting up, test glow bulb and renew, if required.

If glow bulb is in order, test black line from coupler jack 3 of preglow time relay to preglow indicator lamp for interruption, remove interruption.



If preglow indicator lamp lights up, preglow time relay is defective, replace preglow time relay.

Installation not concerning preglow time relay

If a preglow time relay has been stored in spare parts sector for a considerable period (refer to production date), the specified preglow time may be below specification after the relay has been installed, so that the engine will not start.

By preglowing several times one upon the other (5 – 10 times) the capacitor in preglow time relay is again activated and the specified preglow time is attained.

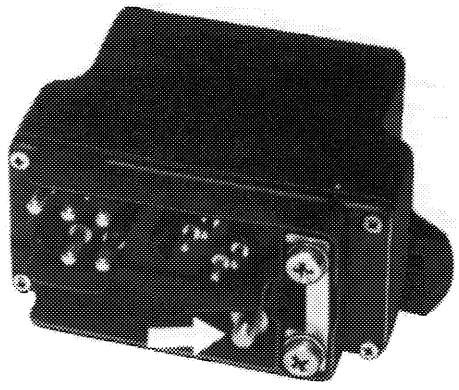
Testing main circuit of preglow system for interruption

In the event of an interruption:

Preglow indicator lamp not lighting up, engine cannot be started.

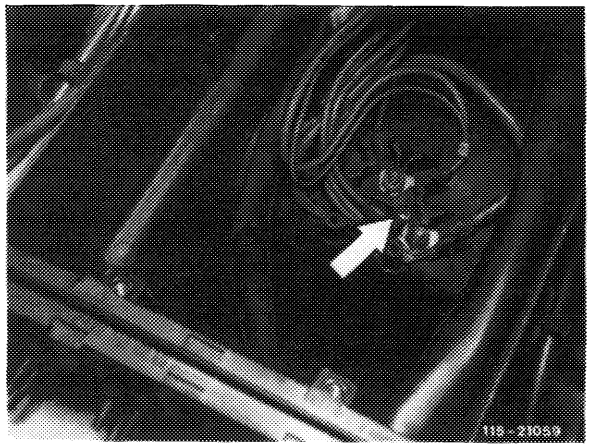
Test voltage at terminal 30 of preglow time relay against ground by means of voltmeter.

If no voltage (approx. 12 volts) is indicated, test red line for interruption and remove interruption, if required.



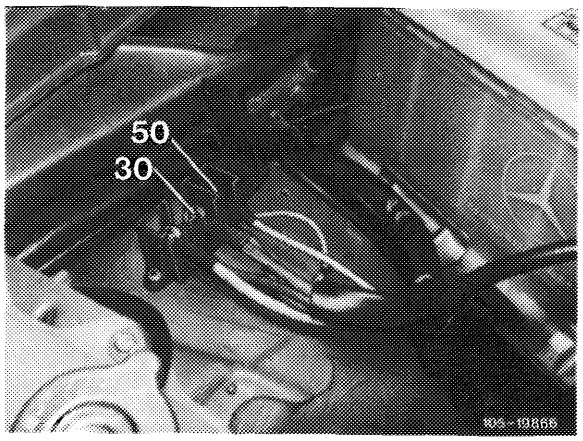
115-20011/1

On model 126 from point of support terminal 30 to preglow time relay connection terminal 30.

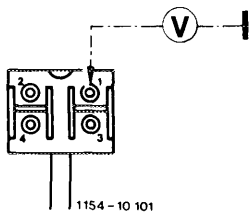


On model 123 from cable connector engine harness terminal 30 to preglow time relay connection terminal 30.

If voltage is indicated, check 80-amps fuse for tight seat or interruption and replace, if required.



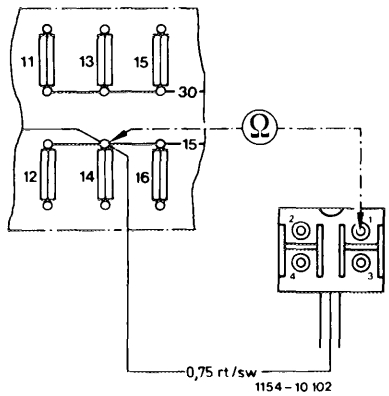
If no fault has been found up to now, test voltage on jack 1 of 4-point plug of preglow time relay against ground.



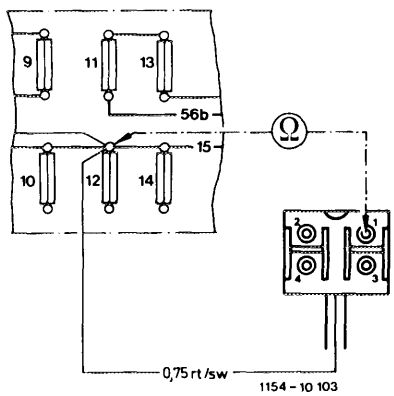
1154-10 101

If no voltage (approx. 12 volts) is indicated with preglow system switched on, test red/black line from fuse box terminal 15 to plug jack 1 of preglow time relay for interruption and remove interruption, if required.

On model 126 from input fuse No. 14 to plug jack 1 of preglow time relay.



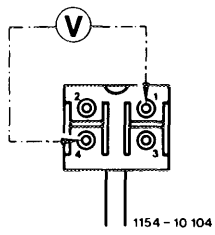
On model 123 from input fuse No. 12 to plug jack 1 of preglow time relay.



If voltage is indicated, connect voltmeter to jack 1 (terminal 15) and jack 4 (terminal 31) and test voltage.

If no voltage (approx. 12 volts) is indicated, test brown line from jack 4 to ground for interruption and remove interruption, if required.

If no fault has been found up to now, the preglow time relay is defective. Replace preglow time relay.



Testing pencil element glow plugs and their lines

In the event of an interruption:

Preglow indicator lamp not lighting up, engine fires poorly, an interruption of one or several pencil element glow plugs or lines to pencil element glow plugs may be indicated.

In the event of an interruption:

Preglow indicator lamp lights up, engine fires poorly after attaining ready-to-start condition, an interruption of a pencil element glow plug or a line to pencil element glow plugs of cylinder 2 to 5 or wrong current input of pencil element glow plugs in cylinder 1 to 5 may be indicated.

Measure power input of pencil element glow plugs with DC clip-on probe.

For this purpose, place probe over individual lines on pencil element glow plugs.

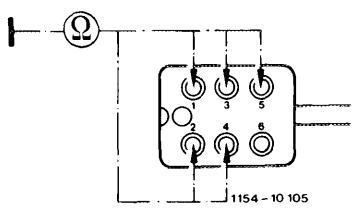
Move key in steering lock to position "2", the power input of each glow plug should then be 8–15 Amps. after 10–20 seconds.

If the value is higher than 15 Amps., renew glow plug.

At a value below 8 Amps., test electric line or glow plug with ohmmeter for interruption.

Test for interruption:

Pull 6-point coupler from preglow time relay.



Measure resistance against ground (engine block) with ohmmeter one after the other at

jack 1 of coupler = pencil element glow plug cylinder 1
jack 2 of coupler = pencil element glow plug cylinder 2
jack 3 of coupler = pencil element glow plug cylinder 3
jack 4 of coupler = pencil element glow plug cylinder 4
jack 5 of coupler = pencil element glow plug cylinder 5.

If resistance ∞ is measured, an interruption of the respective pencil element glow plug or supply line or connection is indicated.

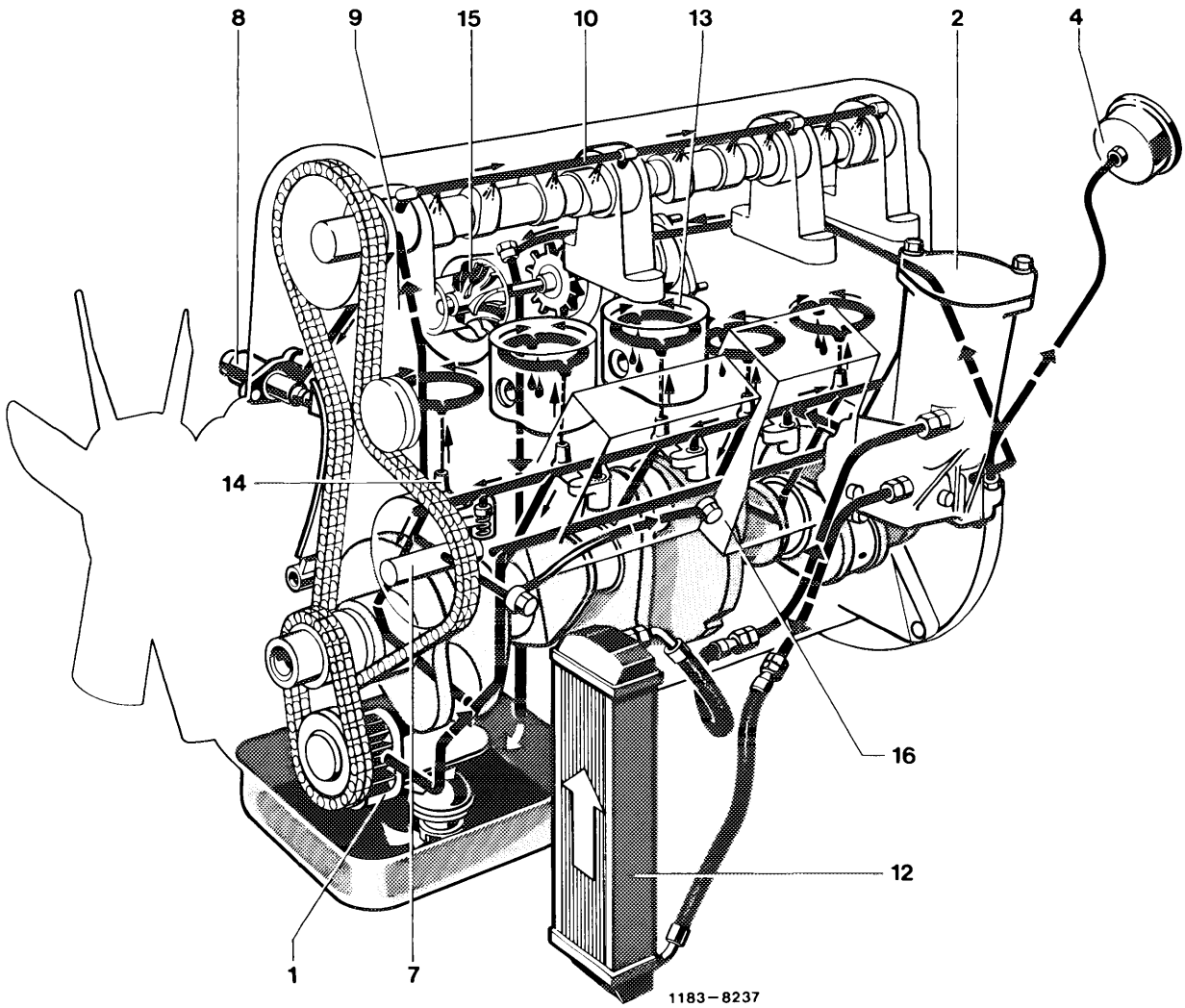
If a smaller resistance (e.g. at 20 °C/68 °F $< 1\ \Omega$) is measured, the supply line and the pencil element glow plug are in order.

Note: It is possible that an indicator lamp (as the result of unfavorable tolerances) will indicate a fault only after a failure of 2 pencil element glow plugs in cylinders 2 to 5.

To make sure that the fault indication in preglow time relay is not defective, disconnect 2 pencil element glow plugs of cylinders 2 to 5 in such a case and repeat preglow operation.

If the indicator lamp is now indicating a fault (not lighting up) the preglow time relay is in order.

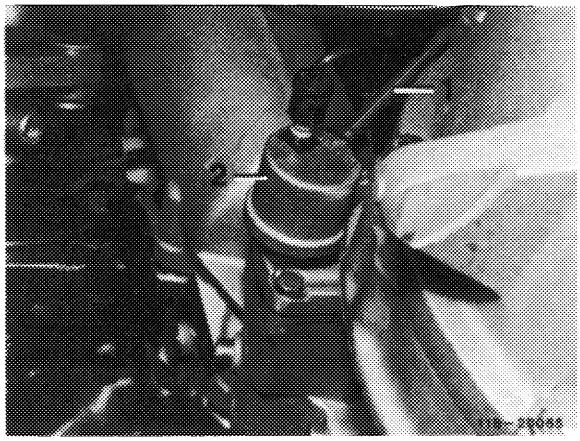
Oil circuit



1 Oil pump with integrated pressure relief valve
2 Oil filter
4 Oil pressure gage (readout)
7 Intermediate sprocket shaft
8 Chain tensioner
9 1st camshaft bearing
10 Oil pipe
12 Air-oil cooler
13 Piston
14 Oil spray nozzle
15 Exhaust gas turbocharger
16 Injection pump

Attention!
The oil circuit is controlled by a thermostat in oil filter (for operation, refer to section covering oil filter).

Oil pressure



At operating pressure, the oil pressure at idle should not drop to 0.3 bar gage pressure.

During acceleration, the oil pressure should rise again immediately and should attain at least 3 bar gage pressure at 3000/min.

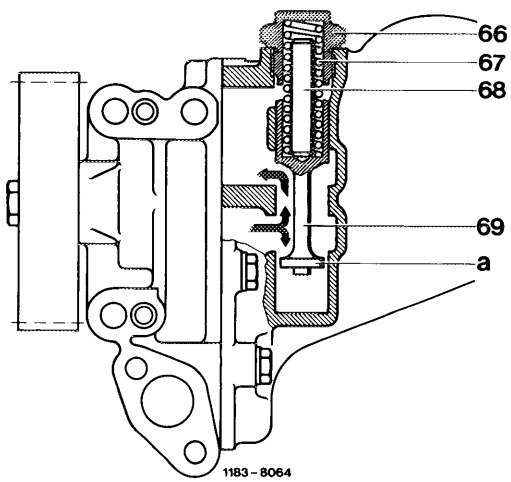
In model 126, the oil pressure is no longer transmitted to oil pressure gage (readout) in instrument cluster by way of a capillary tube as up to now, but the oil pressure gage is electrically activated by an oil pressure transmitter (2), which is screwed into oil filter.

Pressure relief valves

Opening pressure of pressure relief valves	bar gage pressure
Bypass valve in oil filter	3.5
Pressure relief valve in oil pump	7

Pressure relief valve in oil pump

The damped oil pressure relief valve (7 bar gage pressure) is integrated in oil pump.



66 Closing plug
67 Compression spring
68 Pin
69 Piston
a Washer

A damping device (washer "a") has been installed to make sure that the pulsating oil pressure generated by the oil pump is not transferred to piston (69) of pressure relief valve with subsequent de-activating noise.

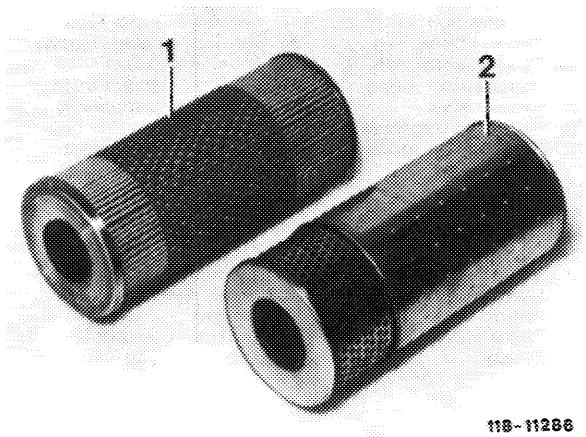
Starting at an oil pressure of 7 bar gage pressure the piston (69) is displaced against the pressure of compression spring (67) and clears the de-activation cross section.

Simultaneously some of the oil (arrow) flows into the area behind washer (a) by way of two control cross sections in washer (a). The oil flowing through the control cross sections opposes the piston movements initiated by the pulsating oil pressure and will thereby dampen the piston.

Oil filter

Main and bypass filter elements are contained in a cartridge.

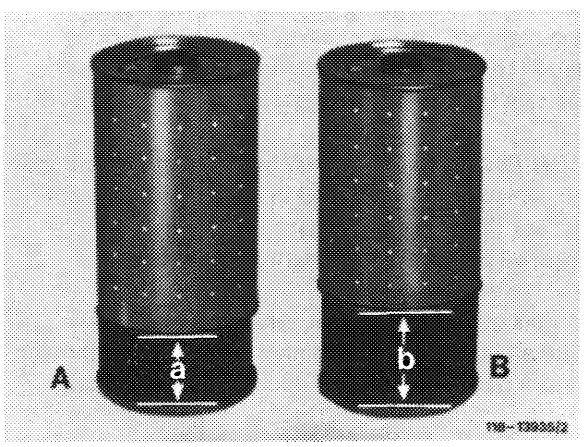
During first inspection (1000—1500 km or 800—1000 miles) the initial operation oil filter element (1) should be replaced by the combination filter element (2).



1 Initial operation filter element
2 Combination filter element

The combination filter element should then be replaced during oil change every 7500 km or 5000 miles.

Attention!
On this engine, install only the combination filter element (B), part No. 617 184 01 25 with the larger main flow filter component (dimension "b" = 55 mm).



A Combination filter element
Dimension A = 40 mm
B Combination filter element
Dimension B = 55 mm

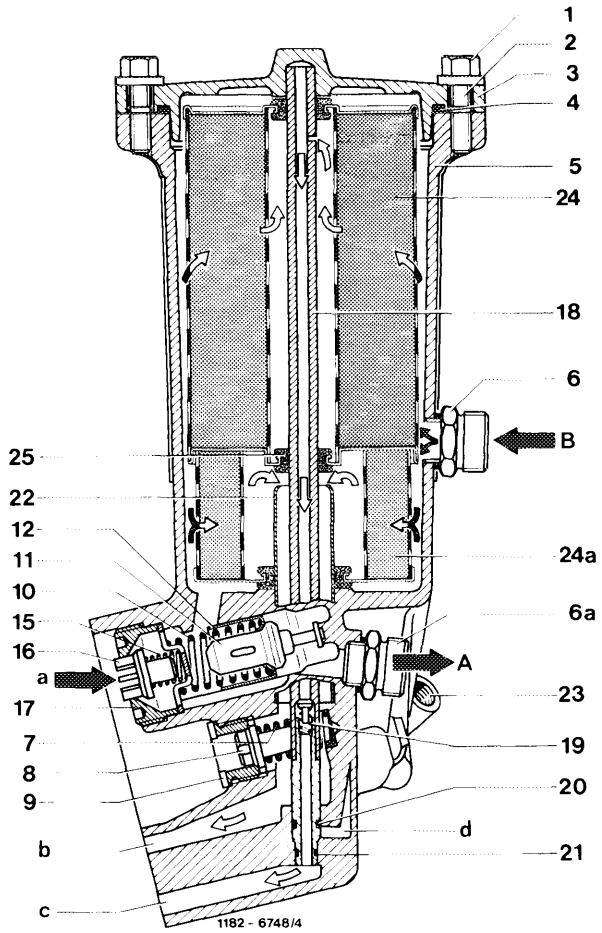
Operation

The oil filter comprises the following main components:

a) Oil filter housing with bypass, return flow locking valve and thermostat.

b) Cap with return flow pipe, check valve and sealing ring.

c) Combination filter element.



1 Nut
2 Stud
3 Cap
4 Sealing ring
5 Oil filter housing
6 Thread connection
6a Thread connection
7 Compression spring
8 Bypass valve
9 Valve seat bypass valve
10 Compression spring
11 Thermostat
12 Control valve
15 Compression spring
16 Return flow locking valve
17 Valve seat return flow locking valve
18 Return flow pipe
19 Check valve
20 O-ring
21 O-ring
22 Riser
23 Connection for oil pressure gage (model 116 and 123)
24 Oil filter element bypass filter component
24a Oil filter element main flow filter component
25 Rubber seal
A Uncleaned oil toward air-oil cooler
B Uncleaned oil from air-oil cooler

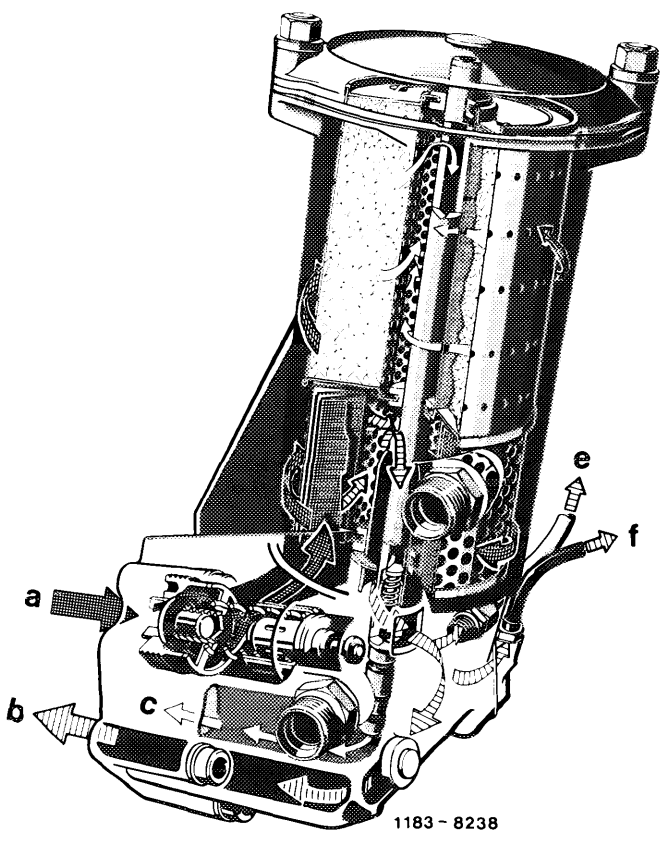
a From oil pump
b To bearing points
c Finely filtered oil for oil pan
d Oil return flow bore toward oil pan

Coming from oil pump via feed duct (a), the oil enters the oil filter housing at return flow locking valve (16) and flows directly to combination filter element up to an oil temperature of approx. 110 °C.

After flowing through combination filter element the oil, which has been cleaned in main flow filter component (24a), flows via riser (22) and duct (b) to main oil duct and on to bearing points.

On the other hand, the oil, which has been finely filtered in bypass filter component (24) flows through return flow pipe (18) and duct (c) toward oil pan.

To make sure that main flow and bypass flow remain separated from each other, the combination filter element is provided with a rubber seal (25).



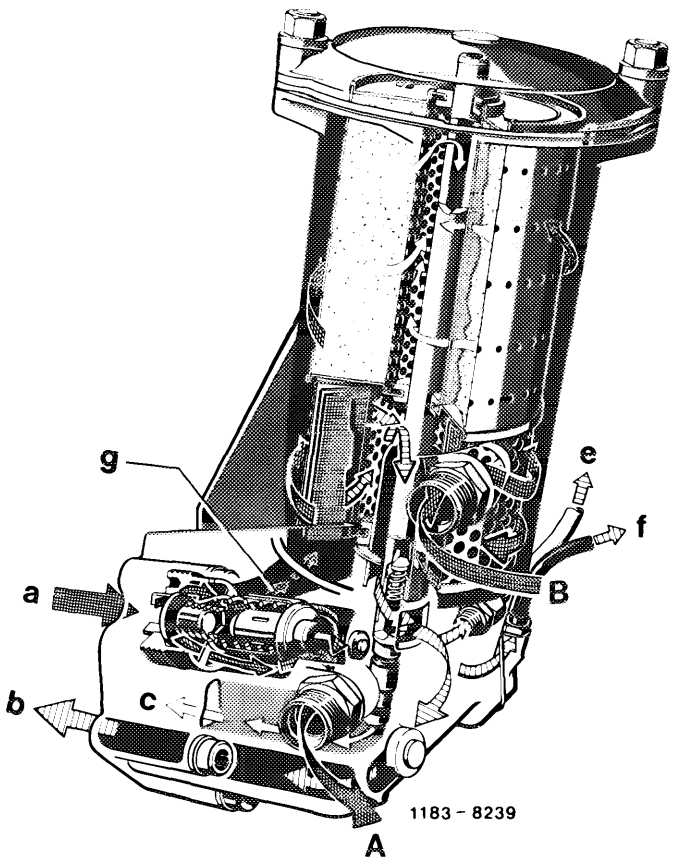
a From oil pump
b To bearing points
c Finely filtered oil toward oil pan
e To exhaust gas turbocharger
f To oil pressure gage (models 116 and 123)

Starting at an oil temperature of approx. 110 °C the thermostat (11) starts to displace control valve (12), which arrives at its end position at approx. 125 °C. In end position, the direct flow toward combination filter element is locked except for a given quantity of oil (g). This quantity of oil is enough to guarantee lubrication of engine at low outside temperatures, when continuous flow in oil cooler is widely obstructed by viscous oil.

The larger oil quantity flows to air-oil cooler and is cooled there, it will then flow back to oil filter housing and flows through oil filter element from outside in inward direction.

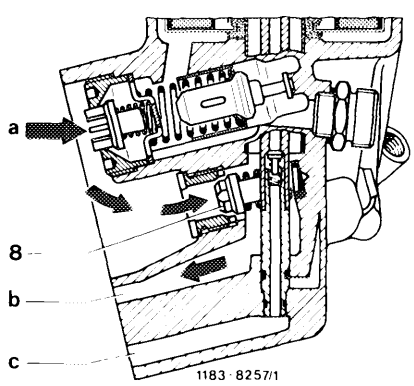
The cleaned oil flows through riser (22) or return flow pipe (18) to bearing points or to oil pan.

Attention!
On engine 617.950 (model 116) a 95 °C thermostat has been installed in oil filter up to engine end No. 019718. Here, thermostat control starts at approx. 95 °C and ends at approx. 110 °C.



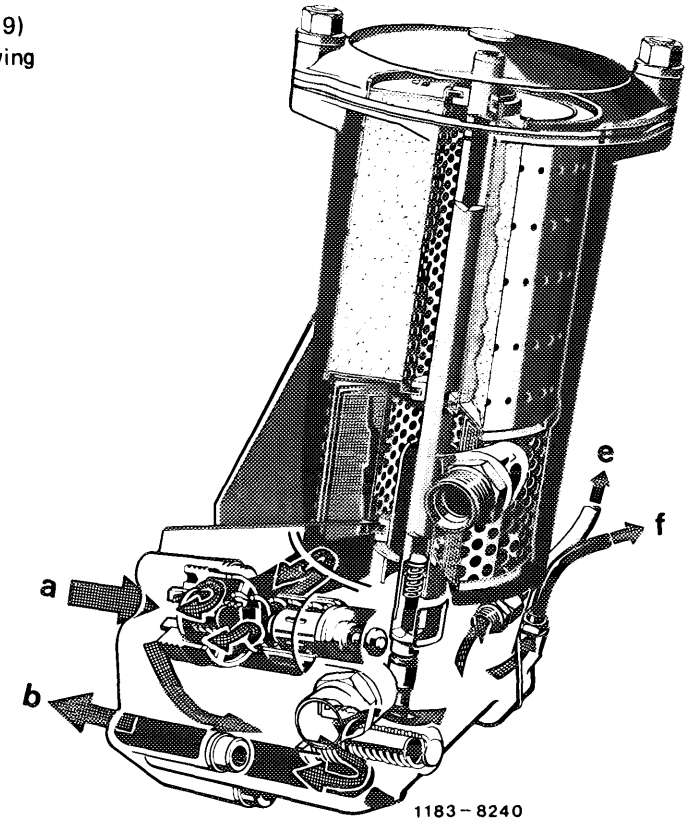
A Uncleaned oil toward air-oil cooler
B Uncleaned oil from air-oil cooler
a From oil pump
b To bearing points
c Finely filtered oil toward oil pan
e To exhaust gas turbocharger
f To oil pressure gage (models 116 and 123)
g Oil quantity directly to combination filter element

If the oil filter element is badly contaminated and the differential pressure between the contaminated side and the clean side of the filter exceeds 3.5 bar, bypass valve (8) will open. The oil will then flow uncleaned toward engine and exhaust gas turbocharger.



8 Bypass valve
a From oil pump
b To bearing points

Return flow locking valve (16) and check valve (19) in return flow pipe (18) prevent the oil from flowing out of oil filter back into oil pan with the engine stopped for an extended period.

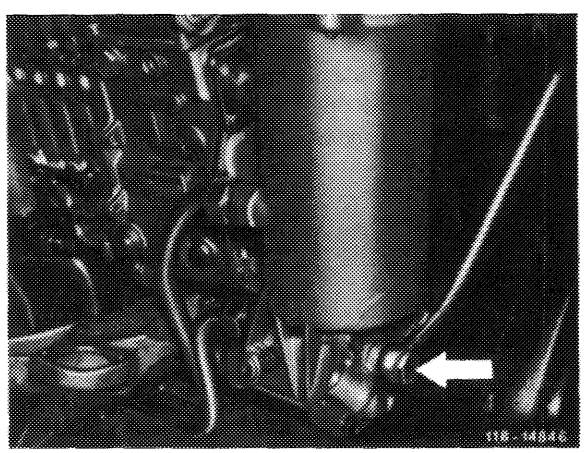


a From oil pump
b To bearing points
e To exhaust gas turbocharger
f To oil pressure gage (models 116 and 123)

When renewing oil filter element, unscrew cover (3) and pull up a bit.

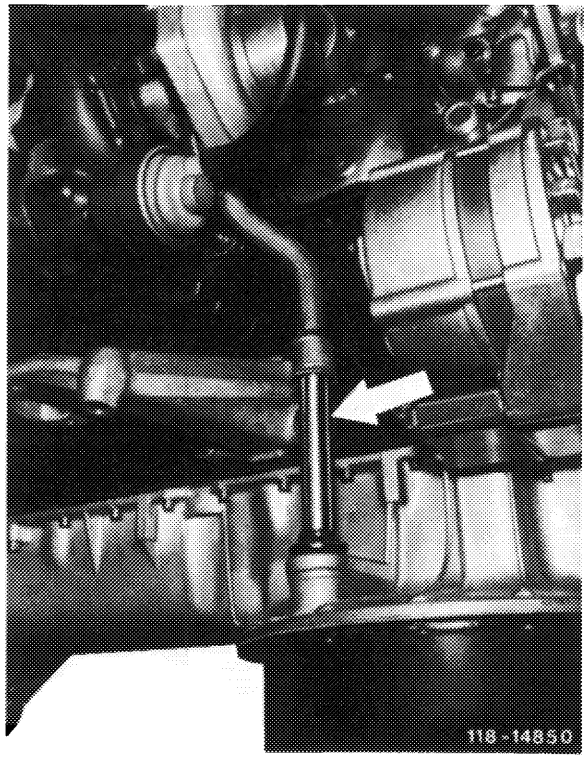
The return flow pipe (18) attached to cap will then expose a bore which connects ducts (a) and (b) to each other. The oil in oil filter will flow through duct (c) into oil pan.

The exhaust gas turbocharger is provided with the oil required for lubrication and cooling by way of a line (arrow) on rear oil filter cover.



Models 116 and 123
(engines 617.950/952)

The oil return flow from exhaust gas turbocharger to oil pan proceeds at outside of engine (arrow).

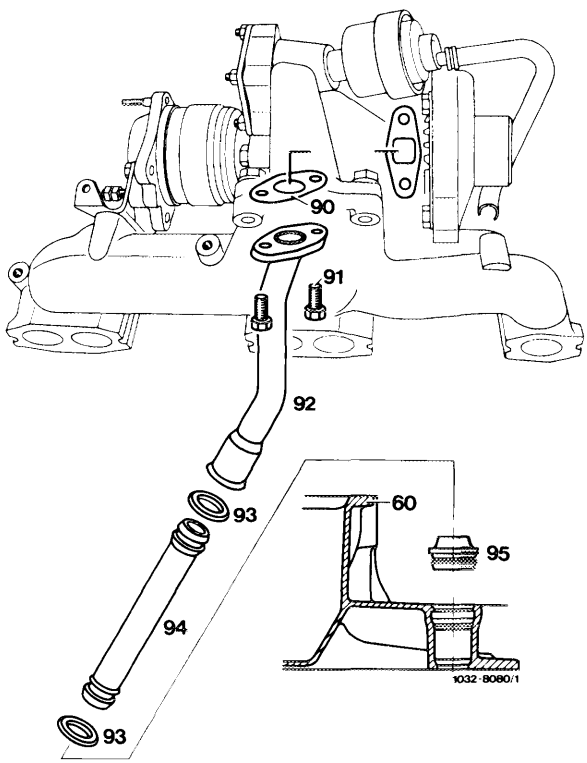


Note

The return flow line consists of two line sections.

The upper line section (92) is screwed to exhaust gas turbocharger.

This line section holds the lower line section (94) which is sealed by means of an O-ring (93), which in turn is sealed by an O-ring (93) in contoured sealing ring (95) and is inserted with the latter in oil pan upper half (60).



60 Oil pan upper half
90 Gasket
91 Hex. screws (2 each)
92 Upper line section
93 O-ring
94 Lower line section
95 Contoured sealing ring

Removal

1 Unscrew upper line section (92) from exhaust gas turbocharger.

2 Push upper line section down, pull outwards and remove.

3 Push lower line section (94) slightly down and force contoured sealing ring (95) out of oil pan.

4 Pull out lower line section (94) in upward direction together with contoured sealing ring (95).

5 Check contoured sealing ring (95) and O-ring (93) for damage and porousity and replace, if required.

Installation

6 Insert contoured sealing ring (95) into oil pan (60).

7 Slip lower line section (94) into contoured sealing ring (95).

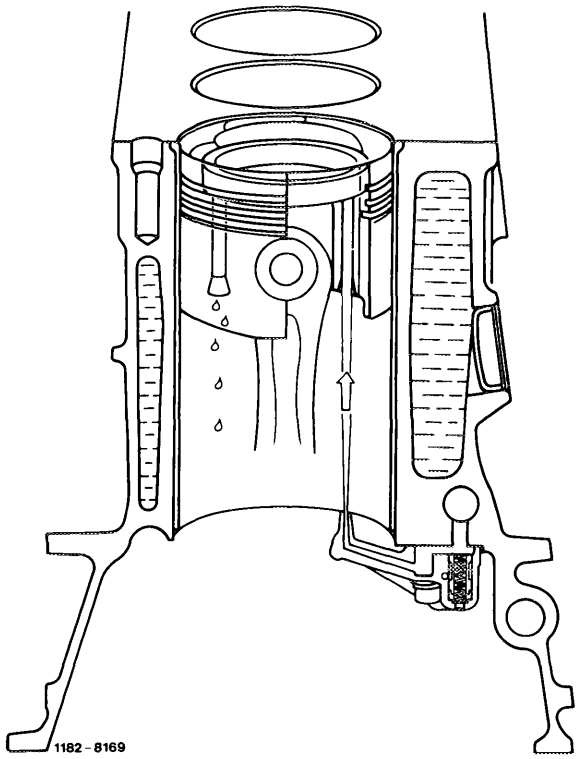
8 Insert upper line section (92) with a new gasket (90) and screw to exhaust gas turbocharger.

Note

Due to the higher thermic load, the pistons are cooled via a ring duct located in piston crowns.

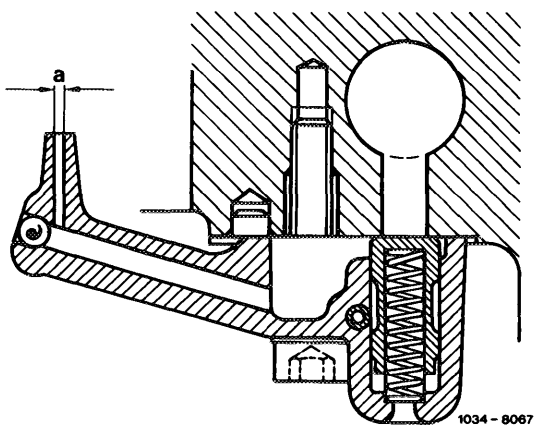
The required oil for the pistons is provided by oil spray nozzles located underneath cylinder bores at the left (driving direction).

The oil spray nozzles in turn are connected to engine oil circuit via the main oil duct in cylinder crankcase.



Starting at an engine oil pressure of 1.0—1.5 bar gage pressure, the valve located in oil spray nozzle opens.

An oil jet will come out of nozzle bore (a), aimed accurately into feed bore in piston.



a = 1.5 mm dia.

The ring duct (7 mm dia.) distributes the oil in piston crown, absorbs heat and flows back to oil pan through return flow bore.

Valve in oil spray nozzle closes at 1 bar gage pressure at the latest.

Since piston cooling is of considerable importance for life of engine, proper functioning of oil spray nozzles is extremely important.

It is also very important that in each piston position the oil jet sprays accurately into feed bore on piston.

To prevent plugging of nozzle bore (a) by particles of dirt, make sure that during assembly jobs no dirt will settle at clean oil end of oil circuit.

Remove oil spray nozzles for cleaning cylinder crankcase. **Do not mix up oil spray nozzles.**

Removal

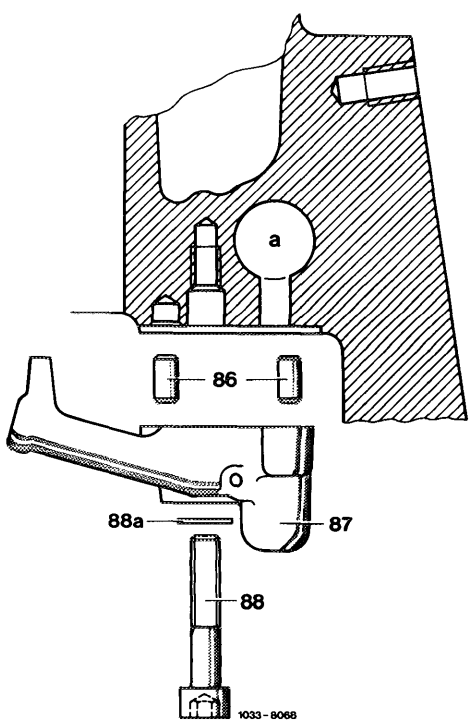
1 Completely remove oil pan (01–310).

2 Position crankshaft in such a manner that the respective oil spray nozzle is accessible.

3 Unscrew screw (88).

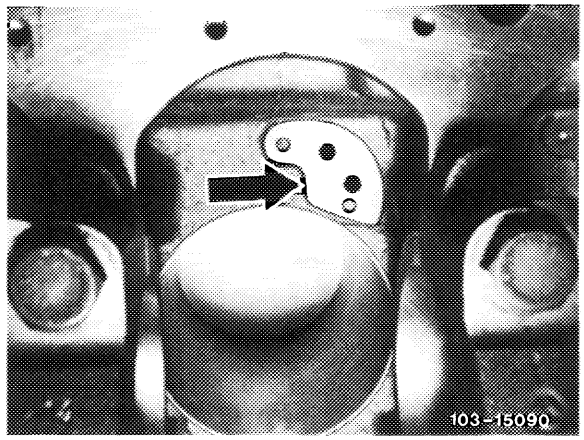
4 Pull out oil spray nozzle.

When pulling out oil spray nozzle, **do not cant nozzle and do not hold nozzle at nozzle neck.**



86 Cylindrical pin
87 Oil spray nozzle
88 Hex. socket screw
88a Washer
a Main oil duct

5 Cover or close oil feed bores in cylinder crankcase.



Installation

Attention!
The installation of oil spray nozzles with heavily out-of-round nozzle bore or with burr at nozzle outlet is no longer permitted.

6 Blow out oil spray nozzle with compressed air, with direction of air flow corresponding to direction of oil flow.

Do not position compressed air hose at nozzle bore.

Also do not use hard objects for cleaning nozzle bore.

7 Remove covers on oil feed bores in cylinder crankcase.

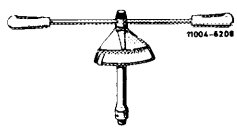
8 Position oil spray nozzle vertically to parting surface on cylinder crankcase and press on.

9 Screw-in screw (88) and tighten to 10 Nm.

10 Install oil pan (01–310).

Tightening torques	Nm
Nuts for oil filter cover (cap)	20–25
Screws for oil filter on cylinder crankcase	20–25

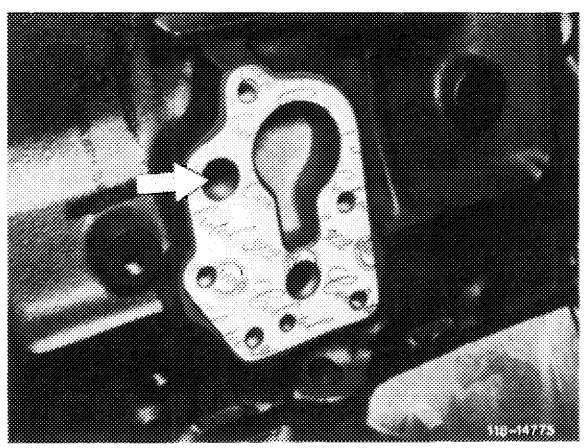
Special tool

Torque wrench 3/8" square head, 8–32 Nm		001 589 51 21 00

Note

When removing oil filter, residue from gasket may remain stuck to flange surface of cylinder crankcase.

To prevent such residue from entering the clean oil duct (arrow) of cylinder crankcase during removal (e.g. by scraping), make sure to cover or close bores first.

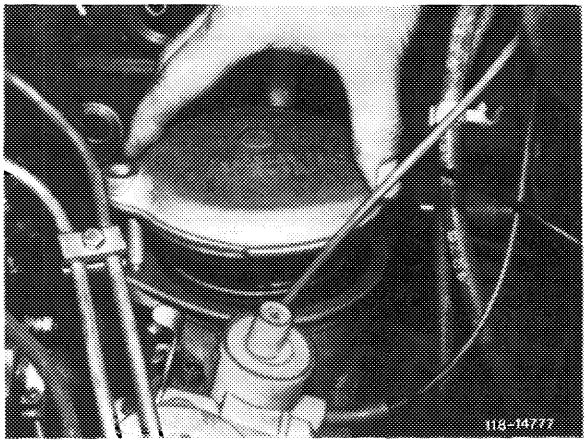


Residue from gasket dropping into clean oil duct may be flushed by the oil to the oil spray nozzles and plug the bore (1.5 mm dia.) there.

A plugged oil spray nozzle will definitely result in engine damage (seized pistons).

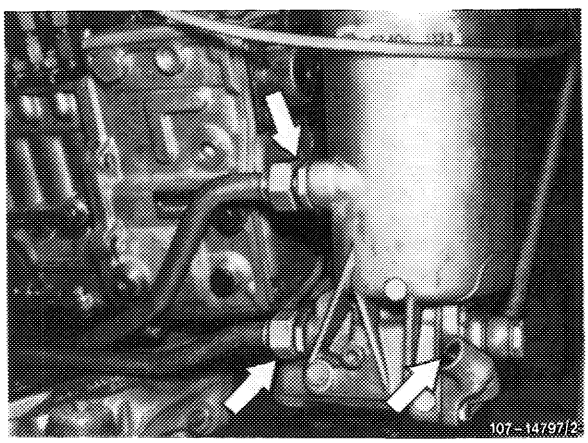
Removal

1 Unscrew oil filter cover (cap) and pull up for a short distance so that the oil flows back to oil pan.



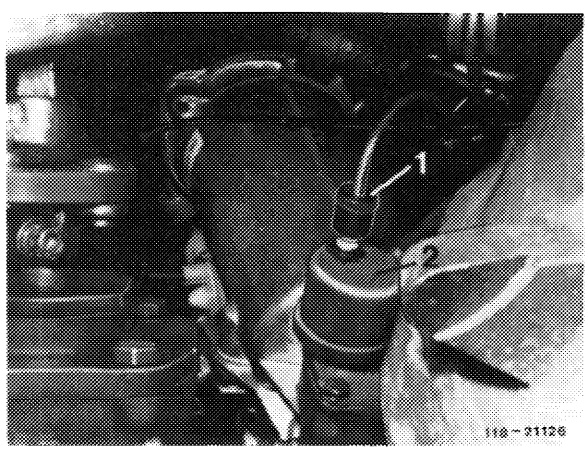
2 Unscrew oil cooler lines (arrows).

3 Unscrew line toward oil pressure gage on oil filter of models 116 and 123 (arrow).



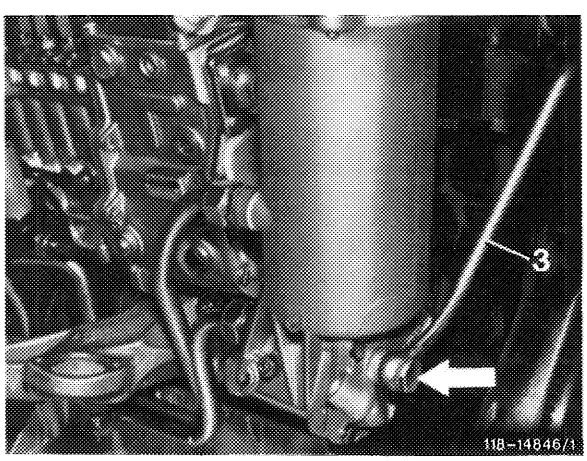
Models 116 and 123
(engines 617.950/952)

On model 126 pull off single plug connection (1) of electric line toward oil pressure gage on oil pressure transmitter (2).

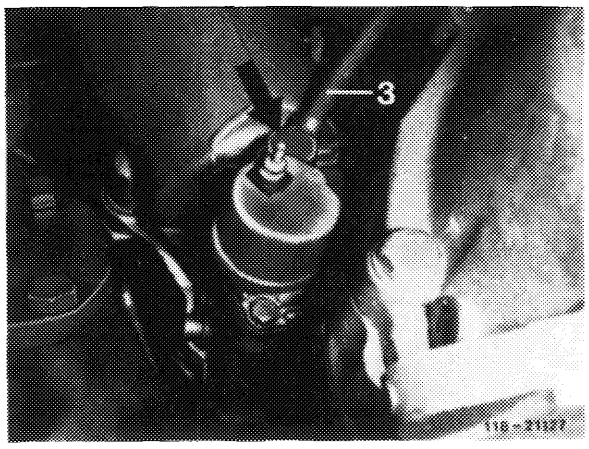


Model 126 (engine 617.951)

4 Unscrew oil feed line (3) toward exhaust gas turbocharger on oil filter (arrow).



Models 116 and 123
(engines 617.950/952)



Model 126 (engine 617.951)

5 Unscrew oil filter (5 hex. socket screws) and remove.

6 Thoroughly clean sealing surfaces on oil filter and cylinder crankcase.

For this purpose, close bores on cylinder crankcase.

Installation

7 Position oil filter with new gasket and screw down.

8 Screw on oil cooler lines.

9 Connect lines toward oil pressure gage on oil filter or on oil pressure transmitter.

10 Screw on oil feed line for exhaust gas turbo-charger on oil filter.

11 Mount oil filter cover (cap) and screw down.

12 Run engine at idle and check for leaks.

Special tool

Telethermometer for measuring engine oil temperature		116 589 27 21 00

Note

To obtain a favorable operating temperature of engine oil at a faster rate, a thermostat with an opening temperature of 110 °C (formerly 95 °C), part No. 117 180 00 75 has been installed in oil filter since December 1979.

The thermostat 110 °C can also be installed in engines manufactured at an earlier date as a spare part.

Start of series

Model	Engine	Engine end No.
116.120	617.950	019719

Checking

1 Exchange oil dipstick for flexible heat sensor.

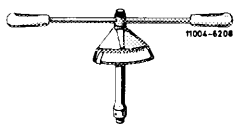
2 Run engine at increased speed and watch telethermometer.

3 At an oil temperature of 110 ± 4 °C or 95 ± 4 °C, depending on thermostat installed, a distinctive increase of oil temperature on oil cooler should be noticeable (manually).

If not, replace thermostat (18–125).

Tightening torques	Nm
Nuts for oil filter cover	20–25
Screws for oil filter on cylinder crankcase	20–25
Valve seat ring in oil filter housing	35–45

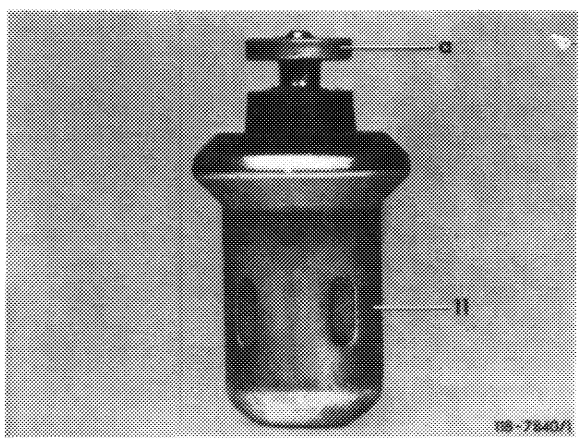
Special tools

Torque wrench 3/8" square, 8–32 Nm		001 589 51 21 00
Socket 1/2" square for valve seat ring		617 589 00 07 00

Note

Remove functioning thermostat only at temperatures below 60 °C, since otherwise the thrust pin (a) will be pushed out.

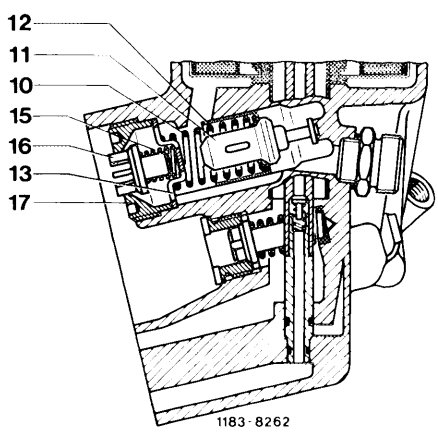
Never pull thrust pin (a) out of wax thermostat (11), since otherwise proper function cannot be guaranteed.



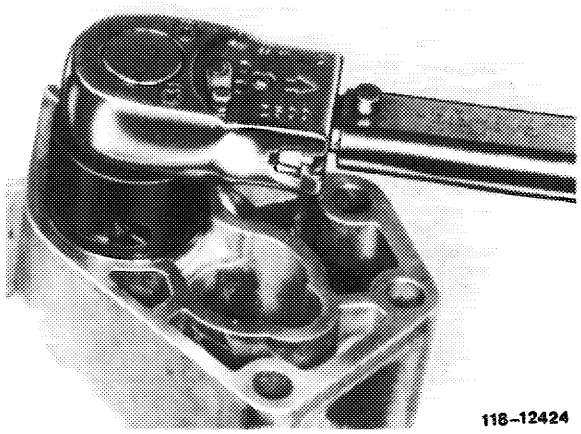
Removal

1 Remove oil filter (18–110).

2 Unscrew valve seat ring (17) by means of socket.

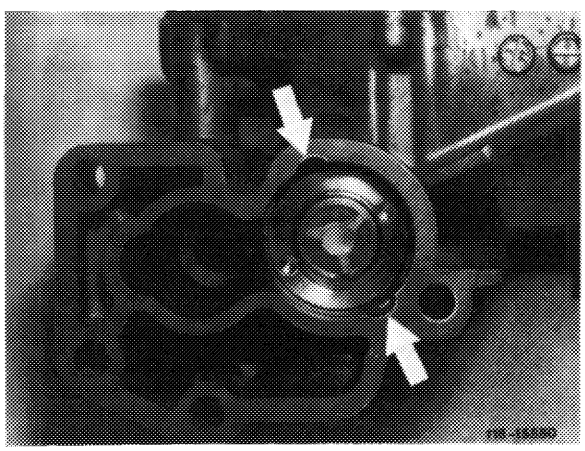


10 Compression spring
11 Thermostat
12 Control valve
13 Spring retainer
15 Compression spring
16 Return flow locking valve
17 Valve seat ring return flow locking valve



3 Remove return flow locking valve (16) with compression spring (15), spring retainer (13), compression spring (10) and thermostat (11) with control valve (12).

Installation



5 Insert thermostat (11) with control valve (12), compression spring (10), spring retainer (13) and return flow locking valve (16) with compression spring (15).

6 Tighten valve seat ring (17) by means of socket to 35–45 Nm.

7 Peen valve seat ring in both recesses on oil filter housing (arrows) by means of a cross chisel.

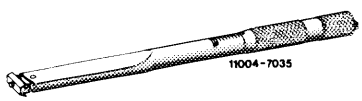
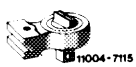
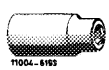
8 Install oil filter with new gasket (18–110).

9 Run engine at idle and check for leaks.

10 Correct oil level.

Tightening torques		Nm
Oil drain plug to oil pan		35–45
Oil pan upper half to cylinder crankcase	M 6	9–11
	M 8	20–25
Oil pan lower half to upper half		9–11
Engine carrier to engine mount front		70
Oil pump to crankcase		20–25
Oil pump to flange member		9–11
Sprocket on oil pump		30–35

Special tools

Torque wrench handle 20–100 Nm	 11004-7035	001 589 35 21 00
Torque wrench handle 50–200 Nm		001 589 44 21 00
Changeover ratchet for torque wrench	 11004-7115	001 589 42 09 00
Allen wrench 5 mm, 300 mm long	 11004-6187	116 589 02 07 00
Knock-out mandrel 9 mm dia.	 11004-6194	110 589 02 15 00
Socket 27 mm, 1/2" square for rotating engine	 11004-6193	001 589 65 09 00
Knock-in tool for oil dipstick guide tube	 11004-8254	117 589 00 31 00

Conventional tool

Engine hoist (Motordirigent) size 1.5	e.g. made by Bäcker, D–5630 Remscheid Order No. 3178

Note

Since a connecting link might wipe against timing chain or oil pan, do not open double roller chain during repairs and connect again by means of a connecting link.

To renew double roller chain and tensioning unit, completely remove oil pan (01–310) and front cylinder housing cover (01–107).

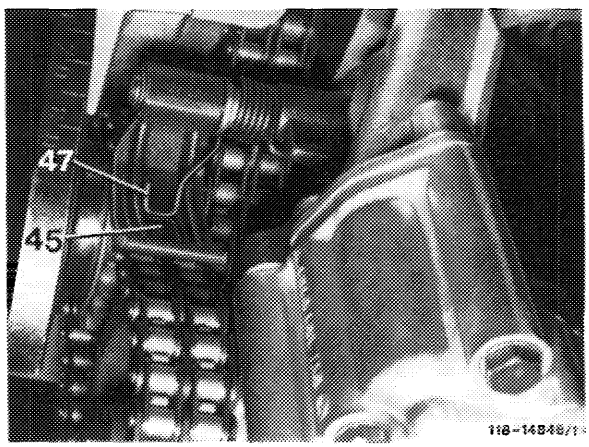
Removal

1 Completely remove oil pan (01–310).

2 Unscrew fastening screw (56) of sprocket.

3 Remove torsion spring (47) from clamp (45) in rearward direction.

4 Turn clamp in upward direction.



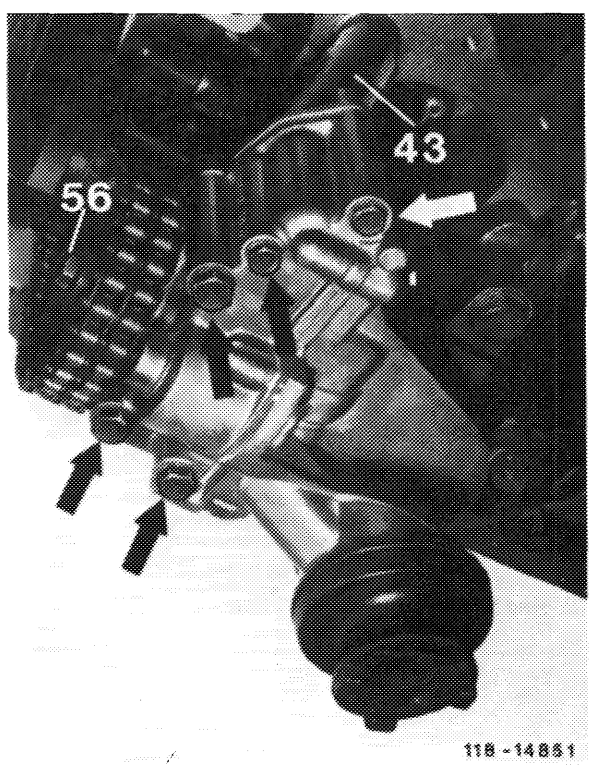
45 Clamp
47 Torsion spring

5 Remove sprocket by means of two screwdrivers.

6 Unscrew hex. screws (arrows) on oil pump and remove oil pump.

7 Remove sprocket.

8 Pull flange member (43) out of cylinder crankcase.



43 Flange member
56 Fastening screw

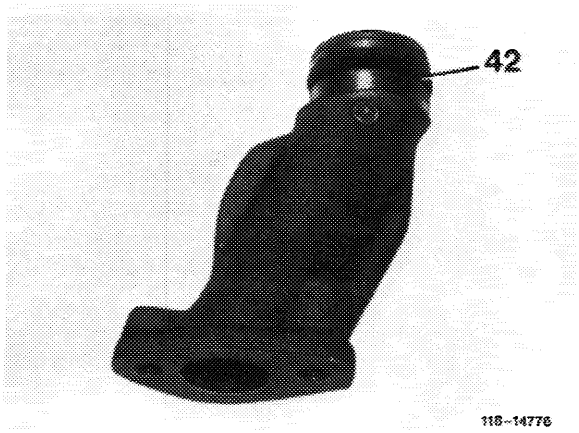
Installation

9 Renew O-ring (42) on flange member, if damaged.

10 Insert flange member.

11 Place sprocket into double roller chain.

12 Install oil pump and tighten fastening screws to 20–25 Nm on crankcase or 9–11 Nm on flange member.



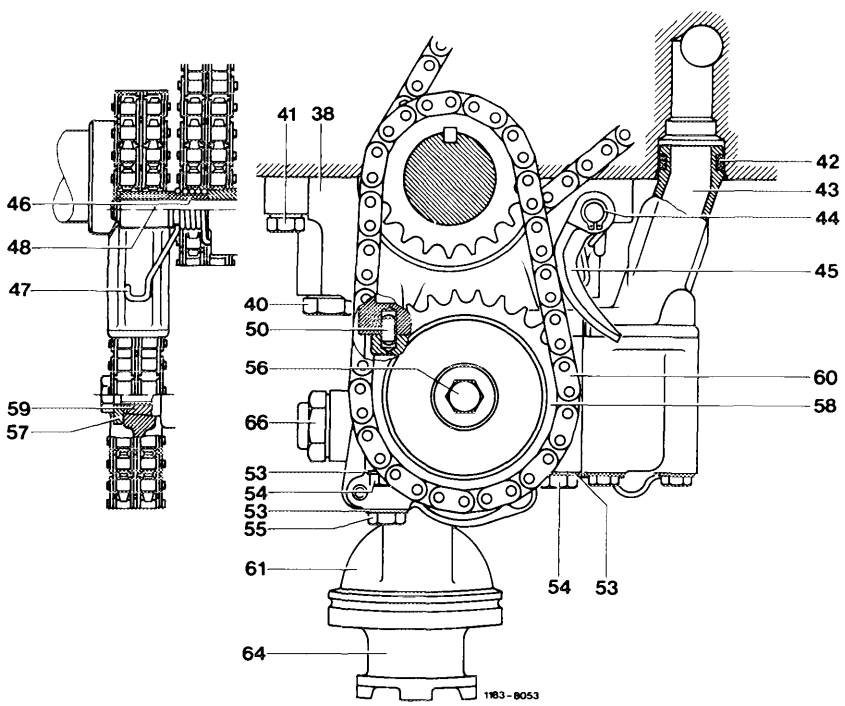
42 O-ring

13 Place sprocket on drive shaft and tighten fastening screw (56) to 30–35 Nm.

14 Set clamp on double roller chain and place torsion spring on clamp.

15 Completely install oil pan (01–310).

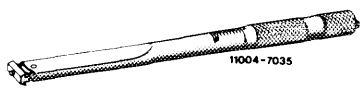
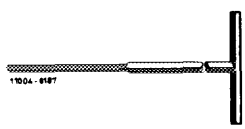
Layout of oil pump



38 Crankshaft bearing cover
40 Hex. screw
41 Hex. screw
42 O-ring
43 Flange member
44 Locking ring
45 Clamp
46 Bushing
47 Torsion spring
48 Bolt
50 Fitted pin
53 Spring washer
54 Hex. screw
55 Hex. screw
56 Hex. screw
57 Washer
58 Drive sprocket
59 Drive shaft
60 Double roller chain
61 Strainer
64 Adapter
66 Closing plug oil pressure relief valve

Tightening torques	Nm
Oil drain plug to oil pan	35–45
Oil pan lower half to upper half	9–11
Closing plug for oil pressure relief valve	35–45

Special tools

Torque wrench handle 20–100 Nm	 11004-7035	001 589 35 21 00
Changeover ratchet for torque wrench	 11004-7115	001 589 42 09 00
Allen wrench 5 mm, 300 mm long		116 589 02 07 00

Removal

1 Remove oil pan lower half.

2 Unscrew closing plug (66).

Attention!
Closing plug is under pressure of compression spring (67).

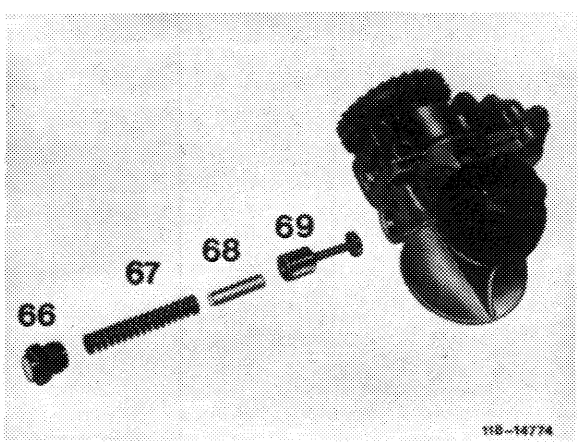
3 Remove compression spring (67), pin (68) and piston (69).

Installation

4 Install piston (69), pin (68) and compression spring (67).

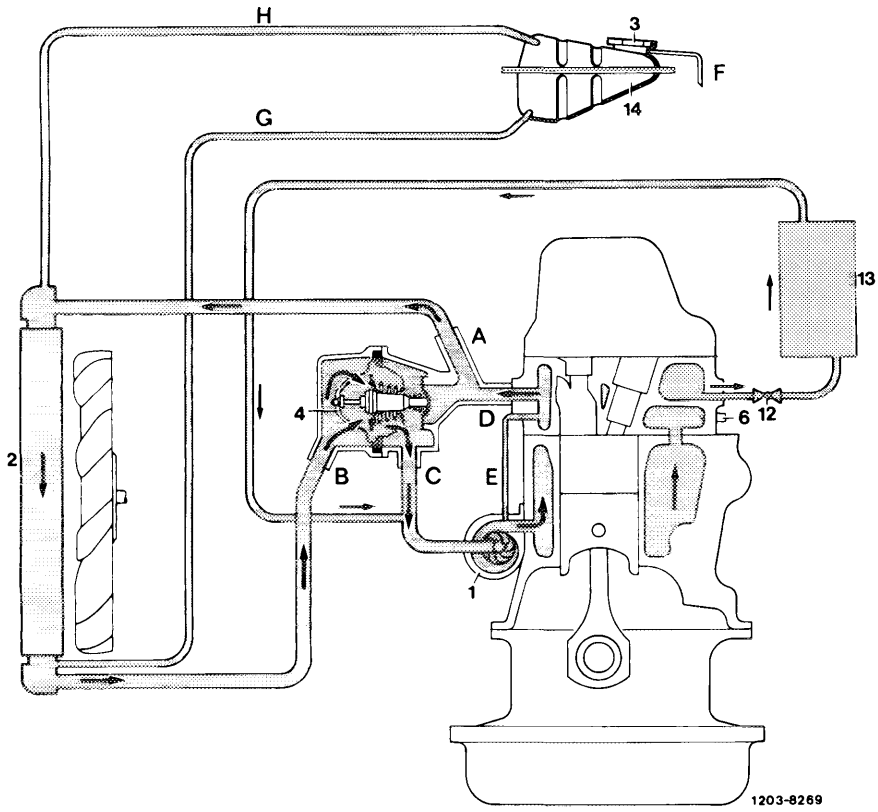
5 Screw in closing plug (66) with new sealing ring and tighten to 35–45 Nm.

6 Install oil pan lower half with new gasket and tighten screws to 9–11 Nm.



66 Closing plug
67 Compression spring
68 Pin
69 Piston

Coolant circuit

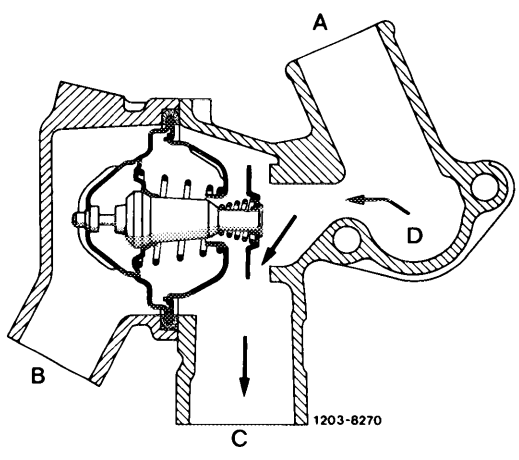


Circuit at coolant temperatures above approx. 94 °C

1 Coolant pump
2 Radiator
3 Closing plug, code number 100
4 Coolant thermostat
6 Temperature sensor for coolant temperature readout
12 Regulating valve for vehicle heater
13 Heat exchanger
14 Expansion tank

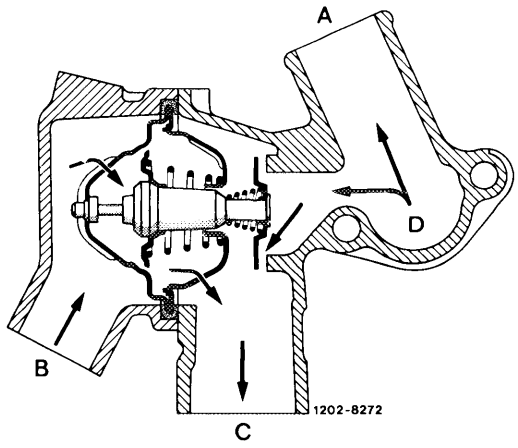
A To radiator
B From radiator
C To coolant pump (bypass line)
D From cylinder head
E Vent line
F Overflow
G Coolant line from expansion tank to radiator
H Vent line to expansion tank

The main valve is closed up to a coolant temperature of approx. 80 °C and the bypass valve is fully opened. Flow (B) from radiator is thereby interrupted and the coolant flows via bypass line (C) directly to coolant pump.



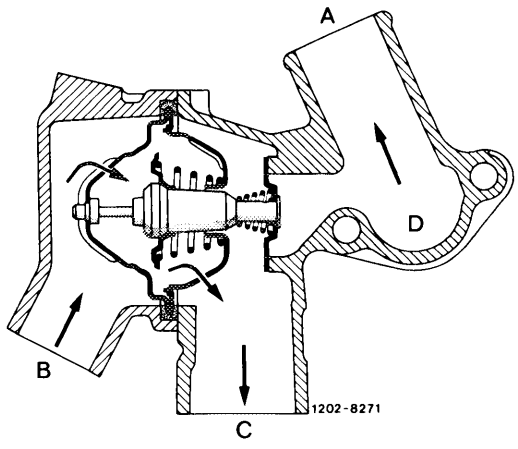
A To radiator
B From radiator
C Bypass line
D From cylinder head

At coolant temperatures of approx. 80 °C up to approx. 94 °C the main valve as well as the bypass valve are more or less open depending on engine load. The coolant flows via radiator (A) and bypass line (C) to coolant pump.



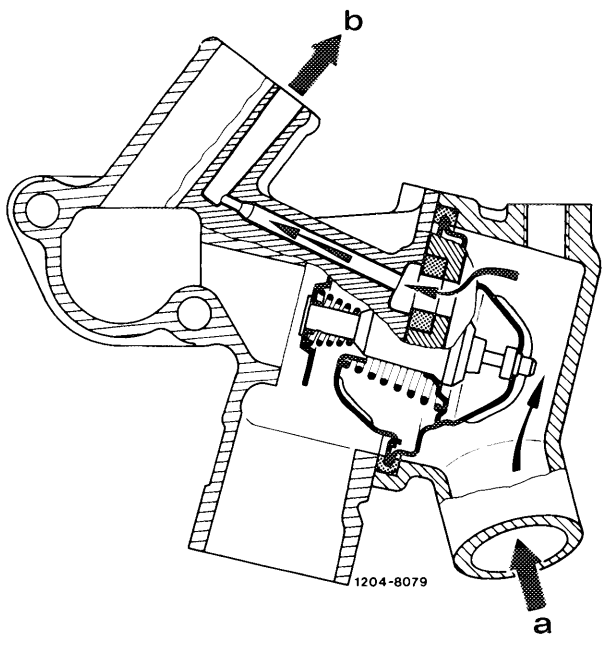
A To radiator
B From radiator
C Bypass line
D From cylinder head

At coolant temperatures above approx. 94 °C the bypass line (C) is closed by the bypass valve. The entire coolant volume should flow through radiator (refer to overall diagram). It is therefore wrong to remove the coolant thermostat for better cooling of the engine.



Venting of thermostat housing

The thermostat housing is suspended and has an integrated, independent venting system. The air will flow to radiator and expansion tank through a bore which bypasses the coolant thermostat.

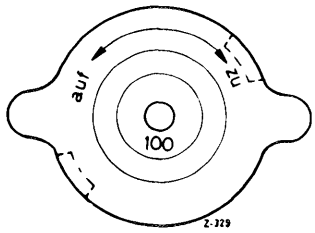


a From radiator
b To radiator

This venting method has the following advantages:

a) When filling-in the coolant, the coolant circuit will be automatically vented.

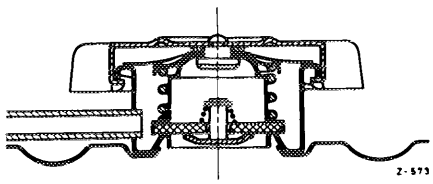
b) Better continuous venting of coolant circuit when engine is operating.



The spring-loaded closing cover (code number 100) on expansion tank establishes a gage pressure of approx. 1 bar in cooling system.

The cooling system is filled ex factory for use throughout a year with a coolant, which comprises approx. 55 % by volume of water and 45 % by volume of antifreeze.

The antifreeze provides protection down to –30 °C, and by means of additives in antifreeze prevents corrosion in cooling system. Since the additives are subject to aging, the coolant should be changed every two years.



To prevent corrosion, the concentration of the antifreeze should not drop below 30 % by volume (–20 °C antifreeze).

If no antifreeze is available and only water is filled in, be sure to add 1 % of treating compound (anticorrosion oil 10 cc/l water).

The antifreeze increases the boiling point, which amounts to approx. 118 °C for water at 1 bar gage pressure to approx. 125 °C as a result of the mixture filled in at the factory.

The red mark of coolant thermometer begins at 122 °C.

This must be specially observed when only water and treating agent are filled in. In such a case coolant may be thrown out before the indicator of the coolant thermometer is at the red mark.

When driving under full load, on mountain roads and bumper to bumper, or following a fast ride on an express highway with subsequent traffic congestion, or when driving in areas with high outside temperatures, the coolant temperature indicator may rise up to the red mark if an antifreeze of at least –30 °C is filled in, without any ejection of coolant or faulty running of engine.

When the engine is operated for an extended period with the vehicle stopped, e.g. during a vehicle congestion, it will be of advantage to move the selector lever into position "N". This will reduce the heat development in transmission and thereby prevent additional heating up of coolant by wax of the transmission oil cooler.

If coolant is lost by leaks in cooling system or by ejection as the result of overheating, add a pertinently prepared coolant. Losses caused by evaporation can be compensated by adding tap water.

Total capacities of cooling system with heater and mixing ratio Antifreeze[1])/water[2]) in liters

Model	Engine	Total capacity Cooling system with heater	Mixing ratio antifreeze/water for antifreeze protection up to –30 °C	–40 °C
116	617.950	12	5.50/6.50	6.25/5.75
123 126	617.952 617.951	11	5.00–6.00	5.75/5.25

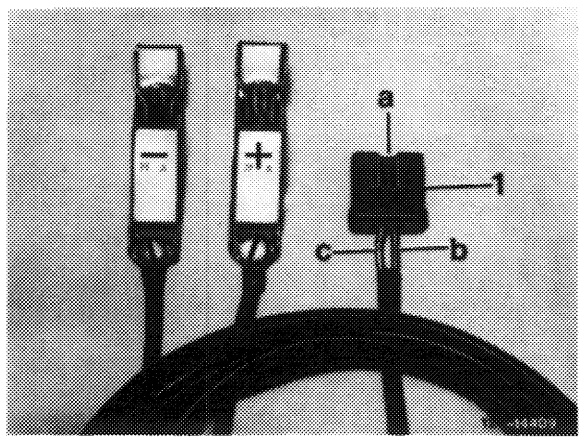
[1]) Refer to specifications for service products page 325.
[2]) Refer to specifications for service products page 310 and 311.

Tightening torques	Nm
Drain plug radiator model 116	6–10
Drain plug radiator models 123, 126	1.5–2[1])

[1]) This torque can be set by means of a washer or a coin.

Self-made tool

Coupling (1), part No. 002 545 49 28
approx. 1 m cable 1.5 mm² black (b) +
approx. 1 m cable 1.5 mm² brown (c) –
1 cable terminal +
1 cable terminal –



a = Locating groove

Note

For improved corrosion resistance, do not permit temperature of antifreeze concentration to drop below –20 °C (30 % by volume).

If no antifreeze is available and only water is filled in, be sure to add 1 % treating compound (anti-corrosion oil) (10 cc/l water).

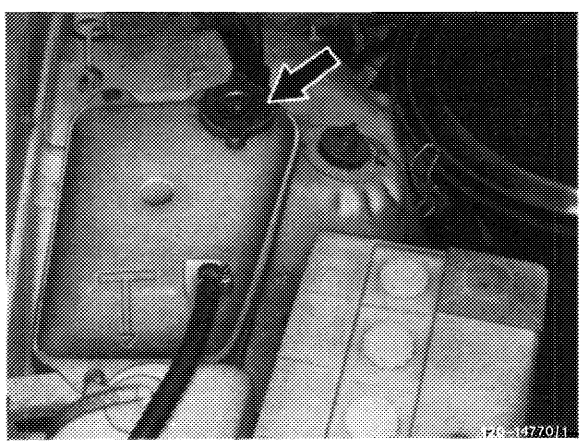
Attention!
Only approved antifreeze compounds (specifications for service products page 325) and treating compounds (specifications for service products page 311) may be used to prevent damage to light alloy components.

Vehicles provided with automatic climate control (models 116 and 126 as standard equipment) require given measures when filling in coolant.

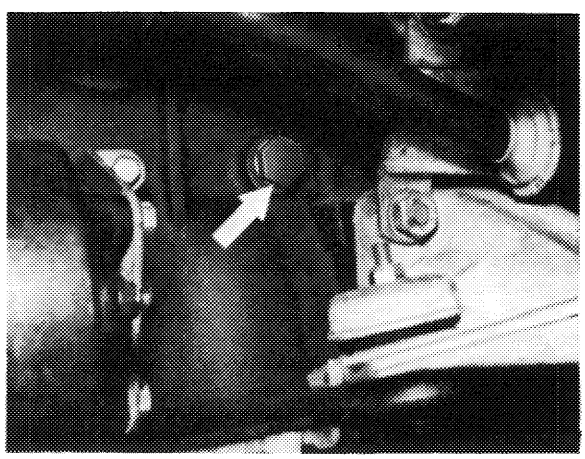
The thermostat housing has an automatic venting system.

Draining

1 Open closing cover (arrow) on expanding tank in steps (only below 90 °C).



2 Unscrew drain plug on radiator and cylinder crankcase.

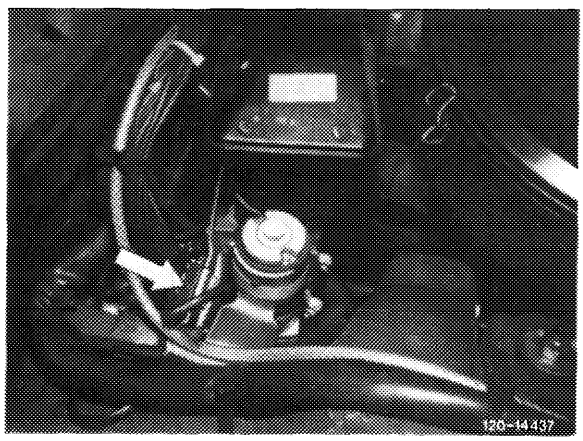


Drain plug on cylinder crankcase (arrow)

3 Slowly fill in coolant up to mark on expanding tank (Fig. item 1). Do not mount closing cover.

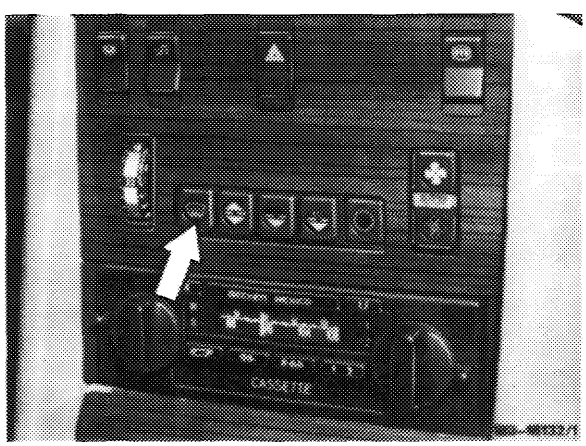
4 Start engine and warm up to approx. 40 °C.

5 On **model 116** pull plug of heating water pump (arrow) from supply line. Connect heating water pump to battery by means of self-made tool. Push "DEF" button.



On **model 123 with automatic climate control** and on **model 126,** push "DEF" button (arrow).

On **model 123 with and without air conditioning** set heater lever to max. heating capacity.



6 Run engine warm under **intermittent** operation until thermostat opens.

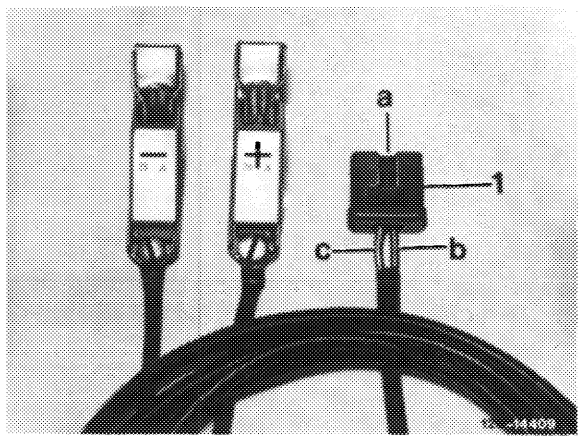
Note: Mount closing cover starting at a coolant temperature of approx. 60 °C.

7 On model 116, connect heating water pump again to supply line.

8 Check coolant level (below 90 °C) and fill up to specified level.

Self-made tool

Coupling (1), part No. 002 545 49 28
approx. 1 m cable 1.5 mm^2 black (b) +
approx. 1 m cable 1.5 mm^2 brown (c) –
1 cable terminal +
1 cable terminal –



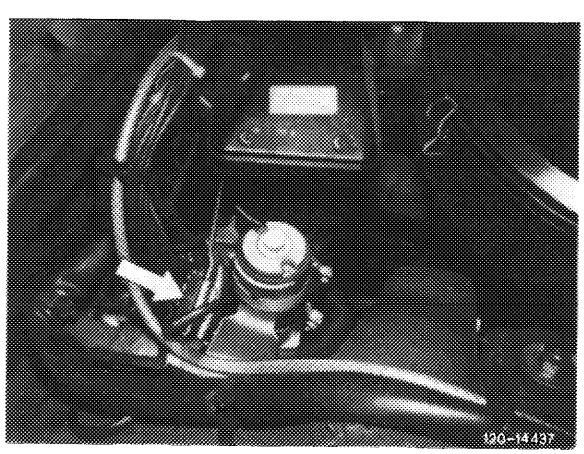
a = Locating groove

A. De-oiling

1 Completely drain coolant (20–010).

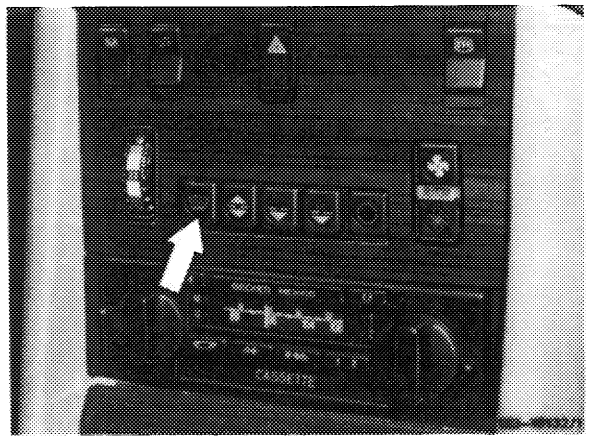
2 Remove coolant thermostat (20–110).

3 On **model 116** pull plug of heating water pump (arrow) from supply line. Connect heating water pump to battery by means of self-made tool. Push "DEF" button.



On **model 123 with automatic climate control** and on **model 126,** push "DEF" button (arrow).

On **model 123 with and without air conditioning,** set heater lever to max. heating capacity.



4 Fill cooling system with a 5 % solution of water and a neutral cleaner, or with a mildly alkaline cleaner such as P 3-Croni (supplier: Henkel) or Grisiron 7220 (supplier: Farbwerke Hoechst).

Attention!
On model 116 with heavy-metal radiator, a strongly alkaline cleaner, e.g. P 3-Standard (supplier: Henkel) may be used instead of a mildly alkaline cleaner. Strongly alkaline cleaners may **not be used** on **models 123** and **126** with **light alloy radiator.**

5 Run engine warm at medium speed up to approx. 80 °C (176 °F) and hold at this temperature for approx. 5 minutes.

6 Stop engine and permit cooling system to cool down to approx. 50 °C (122 °F).

7 Completely drain solution.

8 Immediately thereafter, fill cooling system twice with fresh water, run warm (approx. 5 minutes) and drain.

B. Decalcification, derusting

Attention!
Prior to decalcification, be sure to de-oil cooling system, even if there is no visible oiling up.

1 After second flushing job during de-oiling, fill cooling system with a 10 % (100 g/l) solution of water and citric acid, tartaric acid or oxalic acid (sold by the chemical trade) while giving preference to citric acid.

2 Run engine warm at medium speed up to approx. 80 °C (176 °F) and hold for approx. 10 minutes at this temperature. Proceed according to item 3 section A "De-oiling".

3 Stop engine and permit to cool down to approx. 50 °C (122 °F).

4 Completely drain decalcification solution.

5 Flush cooling system at least three times with fresh water while running engine for at least 5 minutes with each flushing charge.

Badly calcified cooling systems may require a repetition of the treatment. Always prepare a fresh decalcification solution and repeat flushing steps.

6 Install coolant thermostat with new sealing ring (20–110).

7 On model 116, connect heating water pump again to electric supply line.

8 Fill cooling system with specified coolant (20–010).

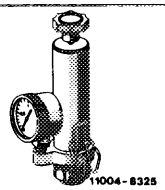
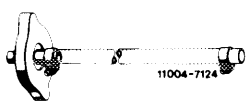
Note: For decalcification and derusting, commercial products made with the acids named above may also be used.

Chromic acid or products containing chromates are prohibited by sewage regulations.

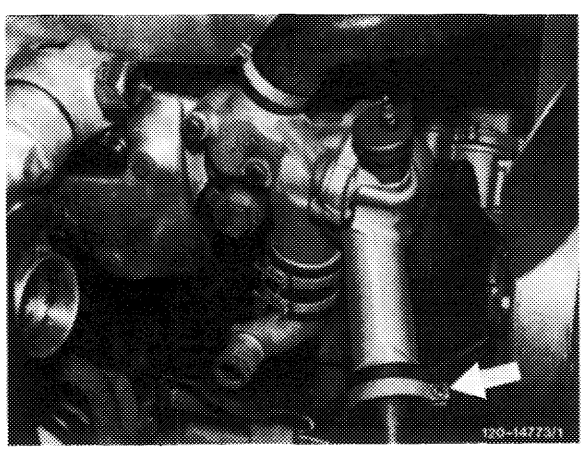
Tightening torques	Type	Nm
Screws for housing cover coolant thermostat		9–11
Drain plug for radiator	116	6–10
	123, 126	1.5–2[1])

[1]) This torque can be obtained by means of a washer or a coin.

Special tools

Tester for cooling system	 11004-8325	001 589 48 21 00
Radiator cap with hose for leak test	 11004-7124	605 589 00 25 00
7 mm socket on flexible shaft for hose clamps	 11004-8667	123 589 12 09 00

Removal



1 Drain coolant (20–010).

2 Disconnect hose on coolant thermostat housing cover (arrow).

3 Unscrew coolant thermostat housing cover.

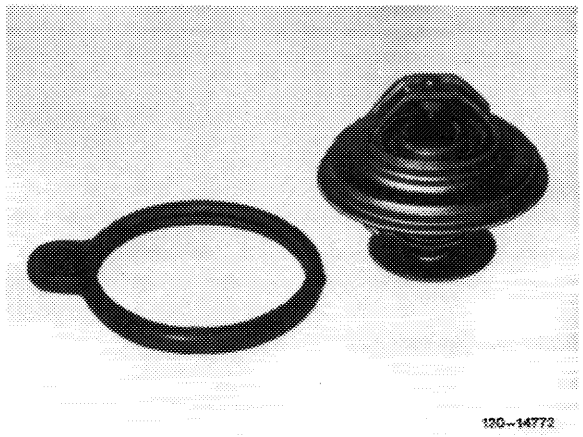
4 Remove coolant thermostat with seal out of cover.

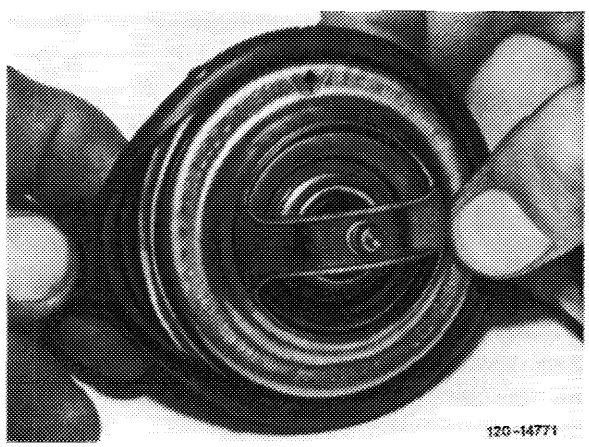
5 Check seal for damage and replace, if required.

Installation

Note: Replace damaged seal.

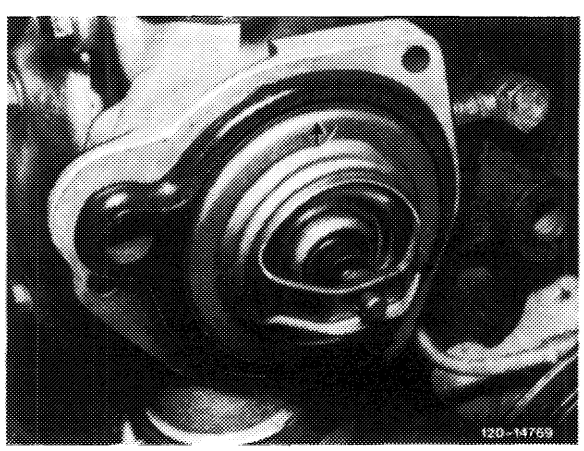
6 Place seal on coolant thermostat.





7 Install coolant thermostat with seal in such a manner that arrow on thermostat points upwards.

8 Screw on coolant thermostat housing cover, tighten to 9–11 Nm and connect hose.



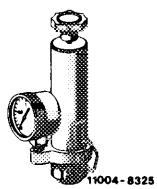
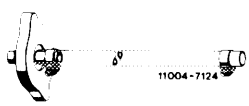
9 Add coolant (20–010).

10 Pressure-test cooling system with tester (approx. 1 bar gage pressure).

Tightening torques	Model	Nm
Drain plug of radiator	116	6–10
	123, 126	1.5–2[1])
Viscofan coupling to coolant pump		20–25
Coolant pump to coolant pump housing		10

[1]) This torque can be obtained by means of a washer or a coin.

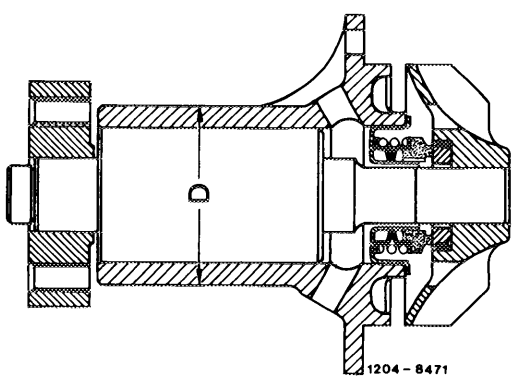
Special tools

Tester for cooling system	 11004-8325	001 589 48 21 00
Radiator cap with hose for leak test	 11004-7124	605 589 00 25 00
7 mm socket on flexible shaft for hose clamps	 11004-8667	123 589 12 09 00

Note

Since October 1979 coolant pump part No. 110 200 01 20 is replaced by coolant pump part No. 115 200 00 20 as standard equipment, identified by smaller OD (D) of bearing housing of 48 mm (formerly 52 mm).

Reason: standardized with engines 615 and 616.



Start of series

Model	Engine	Engine end No.	Chassis end No.
116.120	617.950	015494	015164

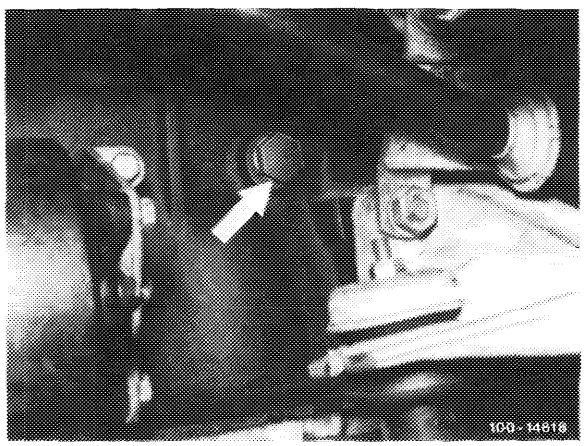
Attention!
Coolant pump 110 200 01 20 together with seal within scope of 110 200 09 20 are again available as a spare part.

Removal

1 Completely drain coolant (20–010).

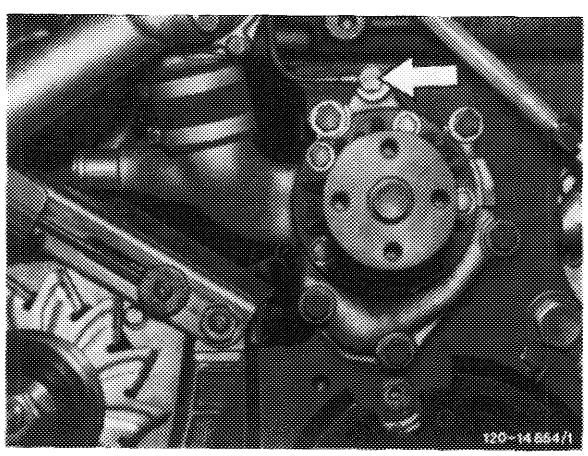
2 Remove fan with viscofan coupling.

3 Remove alternator V-belt and coolant pump pulley.



Drain plug on cylinder crankcase (arrow)

4 Unscrew coolant pump and remove.



Installation

5 Position coolant pump with new gasket and tighten fastening screws to 10 Nm.

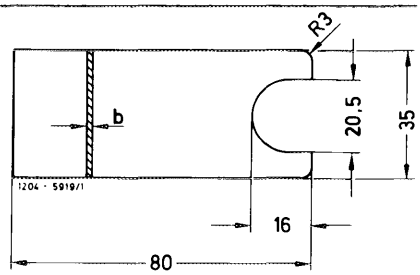
6 For further installation proceed vice versa to removal.

7 Tension alternator V-belt (13–340).

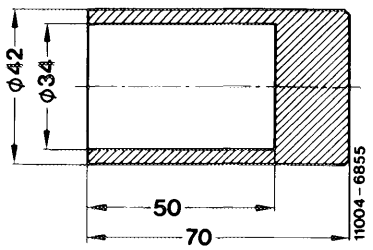
8 Pressure-test cooling system with tester (approx. 1 bar gage pressure).

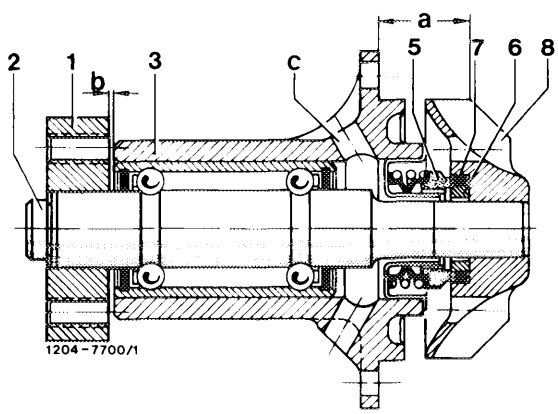
Self-made tools

Spacing plate
b = 2 mm



Pressing-in sleeve



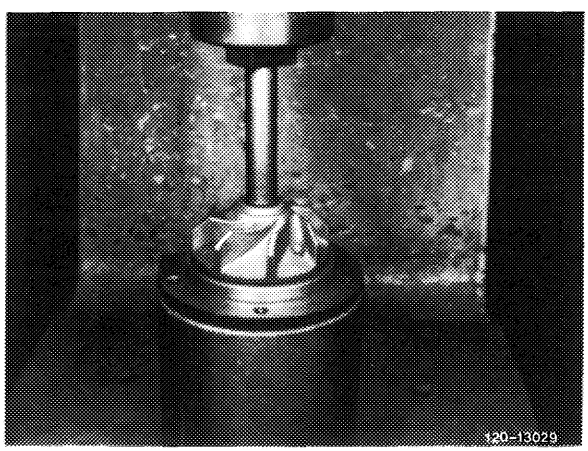


1 Fan hub
2 Coolant pump shaft with compact bearing
3 Bearing housing
5 Slide ring seal
6 Counterring
7 O-ring
8 Impeller
a 22.8–23.2 mm
b 2 mm
c Vent holes

Disassembly

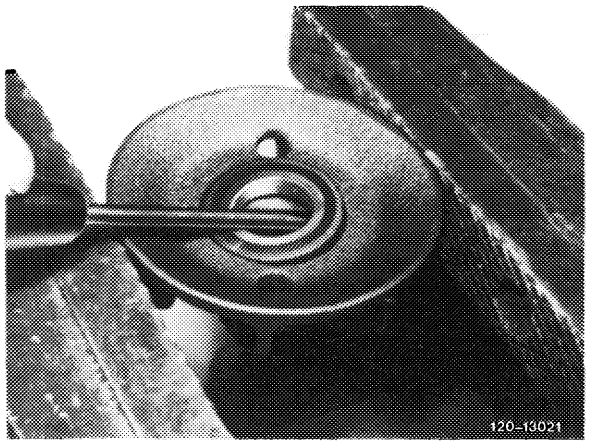
1 Support bearing housing with pertinent tubing and press out coolant pump shaft by means of a mandrel.

2 Knock sliding ring seal out of bearing housing.



3 Remove counterring from impeller.

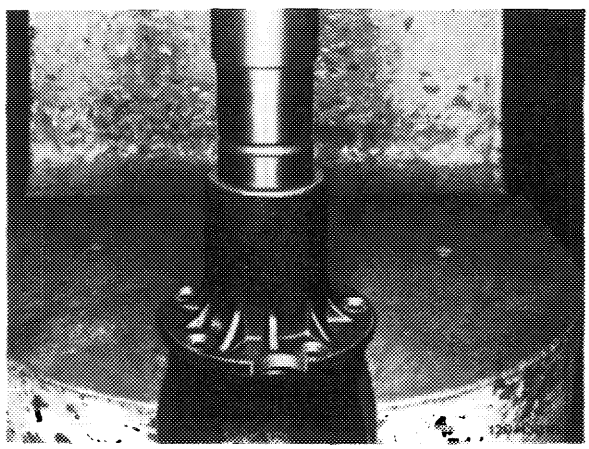
Note: Always replace compact bearing and fan hub following disassembly.



Assembly

4 Press in new compact bearing flush with bearing housing by means of a tube positioned against outer race.

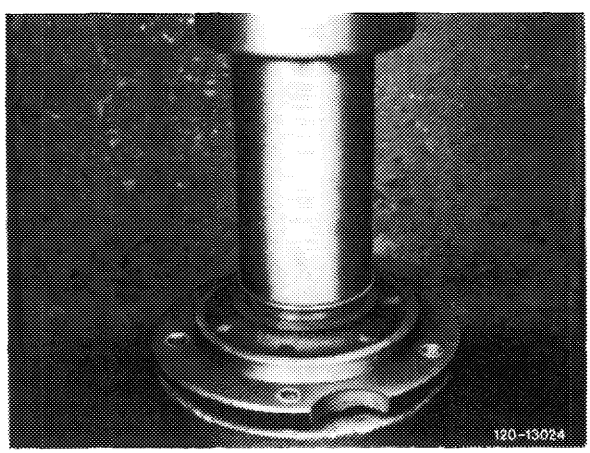
Do not press against coolant pump shaft.



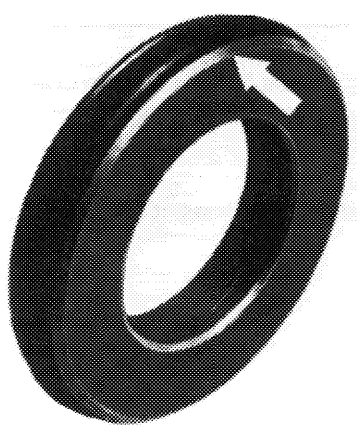
5 Coat mounting bore of sliding ring seal in bearing housing slightly with sealing compound (part No. 001 989 25 20).

Press-in or knock-in sliding ring seal with pressing-in sleeve.

Attention!
Support only against bearing housing and not against coolant pump shaft.



6 Coat O-ring on counterring with brake cylinder paste and push with chamfered side (arrow) into thoroughly cleaned impeller.

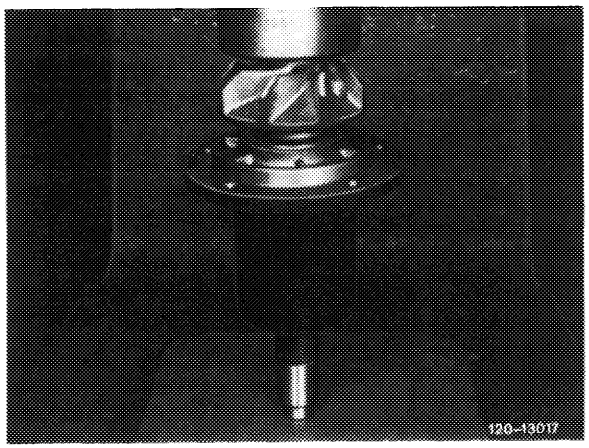


120 - 10863

7 Clean sealing surfaces of counterring and sliding ring seal free of dust by means of a chamois cloth.

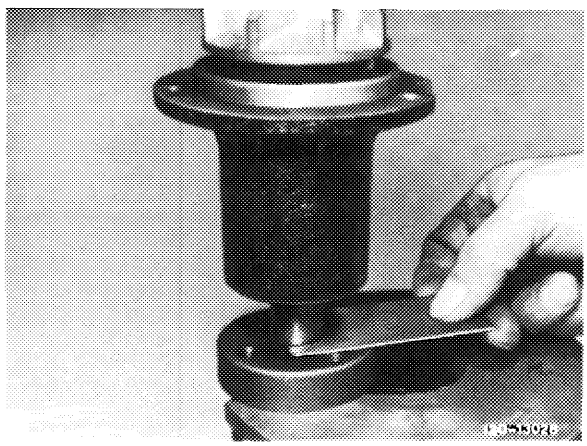
8 Degrease both shaft stubs and impeller in bore.

9 Press-on impeller flush with shaft while supporting coolant pump shaft.



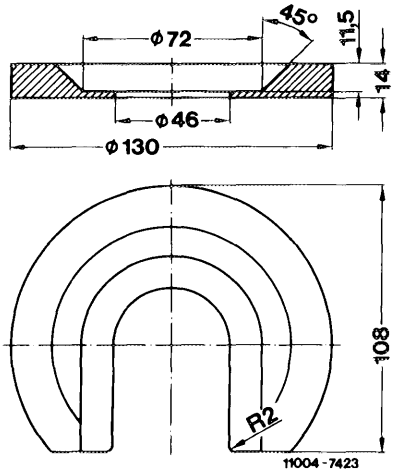
10 Heat fan hub on a hot plate to approx. 300 °C (annealing color dark – up to light blue).

Place heated fan hub on a recessed base. Hold spacing plate on coolant pump shaft, slip coolant pump shaft on fan hub and apply a blast of compressed air against hub. Wait for a few seconds until fan hub is firm and then cool immediately in water bath.

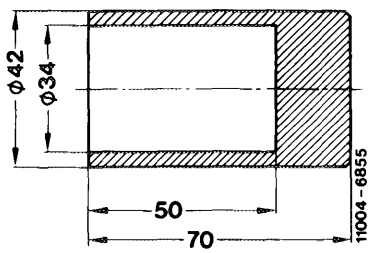


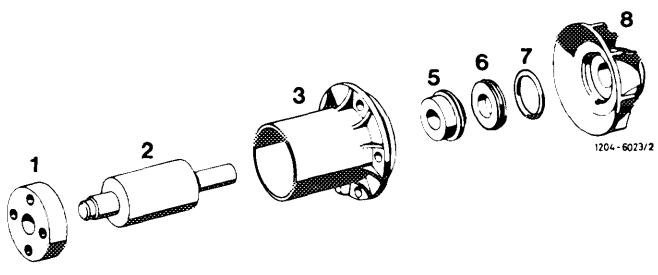
Self-made tools

Pressing-off disk for impeller



Pressing-in sleeve

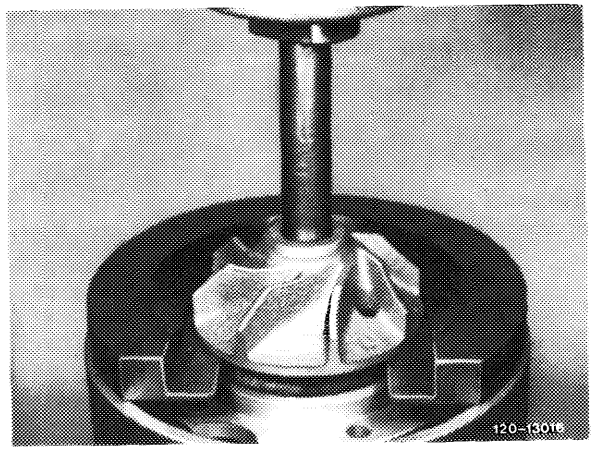




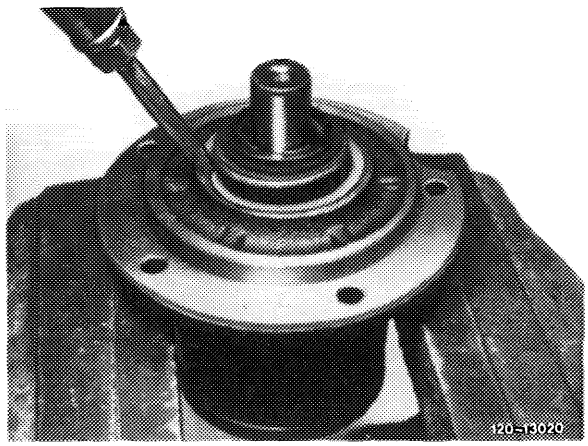
1 Fan hub
2 Coolant pump shaft with compact bearing
3 Bearing housing
5 Slide ring seal
6 Counterring
7 O-ring
8 Impeller

Disassembly

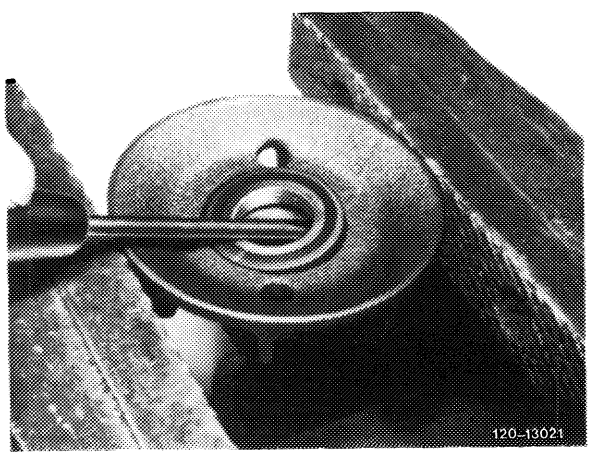
1 Press off impeller. For this purpose, place pressing-off disk between impeller and bearing housing.



2 Apply light hammer blows at several points between bearing housing and sliding ring seal to cancel the preload and force sliding ring seal out.



3 Force counterring out of impeller.

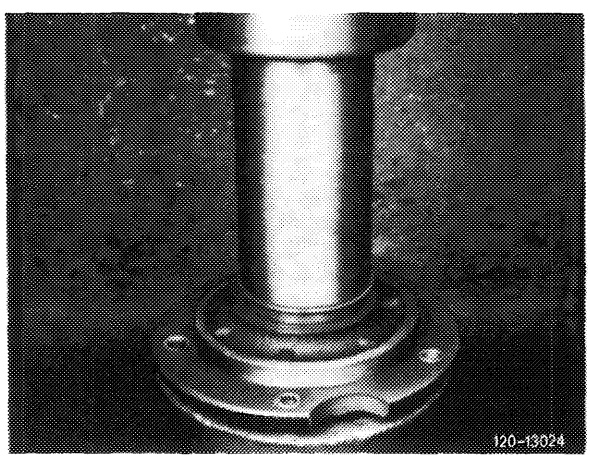


Assembly

4 Slightly coat mounting bores of sliding ring seal in bearing housing with sealing compound (part No. 001 989 25 20).

Press-in or knock-in sliding ring seal by means of pressing-in sleeve.

Attention!
Support at bearing housing only and not at coolant pump shaft.



5 Coat O-ring on counterring with brake cylinder paste and push with chamfered side (arrow) into thoroughly cleaned impeller.

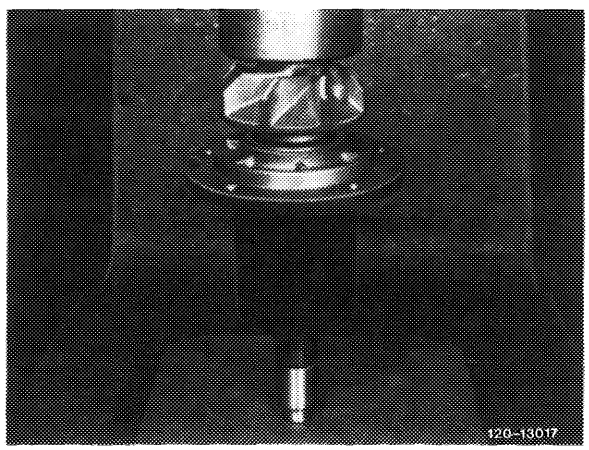


120 - 10863

6 Clean sealing surfaces of counterring and sliding ring seal free ob dust by means of chamois cloth.

7 Degrease shaft stub of coolant pump shaft and impeller bore.

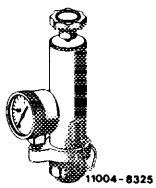
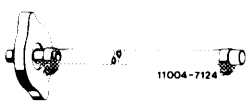
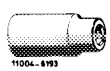
8 Press-on impeller flush with shaft while supporting coolant pump shaft.



Tightening torques		Nm
Radiator drain plug	Model 116	6–10
	Model 123, 126	1.5–2[1])
Coolant pump housing to cylinder crankcase		27–33
Viscofan coupling to coolant pump		20–25

[1]) This torque can be obtained by means of a washer or a coin.

Special tools

Tester for cooling system	 11004-8325	001 589 48 21 00
Radiator cap with hose for leak test	 11004-7124	605 589 00 25 00
Socket 27 mm, 1/2" square	 11004-8193	001 589 65 09 00
7 mm socket on flexible shaft for hose clamps with worm drive	 11004-8867	123 589 12 09 00

Removal

1 Completely drain coolant (20–010).

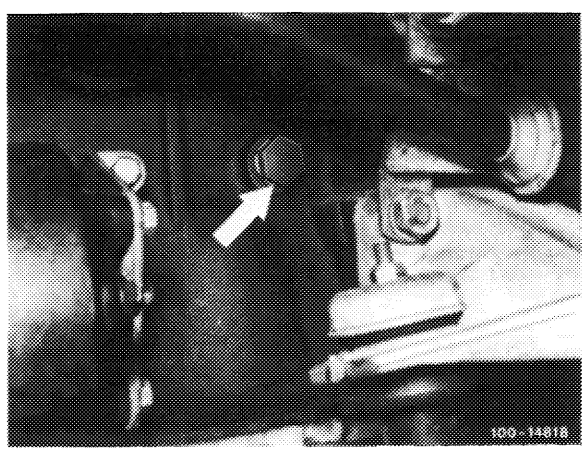
2 Remove radiator (20–420).

3 Remove fan with viscofan coupling.

4 Slacken all V-belts and remove (13–340).

5 Remove coolant pump pulley.

6 Remove crankshaft pulley and vibration damper (03–340).

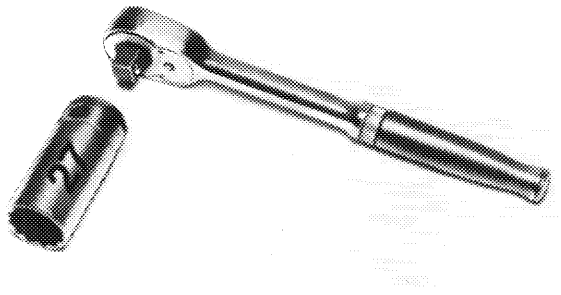


Drain plug on cylinder crankcase

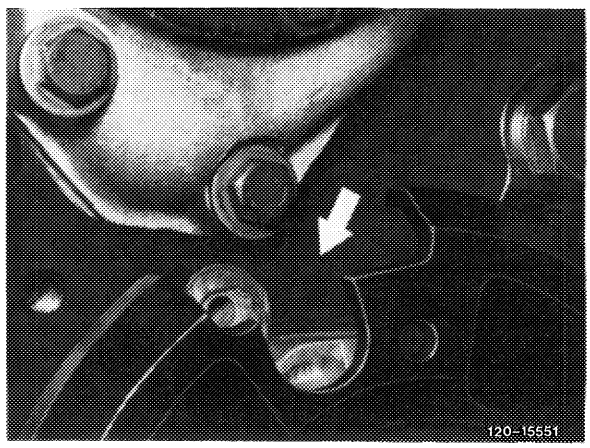
7 Disconnect hot water return hose on coolant pump housing.

8 Disconnect hose between coolant thermostat housing and coolant pump housing.

9 Rotate crankshaft with tool combination until the recess in balancing disk is in front of lower fastening screw of coolant pump housing (arrow).



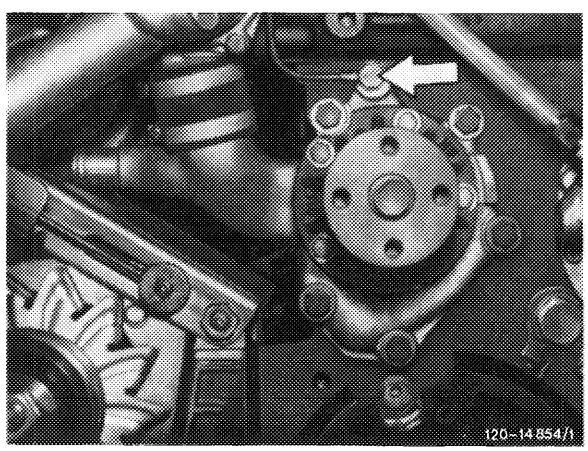
1100-6438/1



120-15551

10 Unscrew vent line on coolant pump housing (arrow).

11 Unscrew coolant pump housing and remove together with coolant pump.



120-14854/1

Installation

12 Install coolant pump housing with new gasket and tighten fastening screws to 27–33 Nm.

13 For further installation proceed vice versa to removal.

14 Add coolant (20–010).

15 Pressure-test cooling system with tester (approx. 1 bar gage pressure).

Operation

The viscofan coupling is a service-free, hydraulic coupling which operates in dependence of temperature as well as infinitely variable.

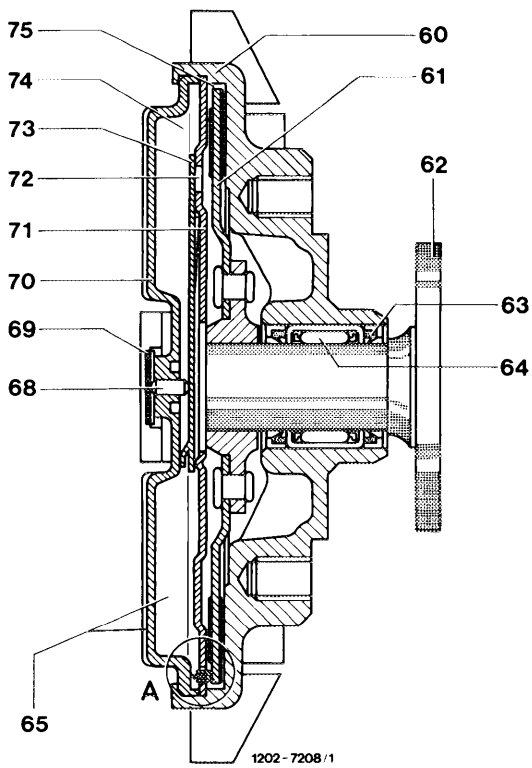
When the engine is started (cold start) the fan will initially run at higher speed until the oil has flown back from the working chamber (75) to the reservoir (74) (approx. 1–3 minutes). The fan coupling will then switch off. The fan speed in disconnected condition depends on engine speed, but a fan speed of approx. 2100/min should not be exceeded.

This condition remains in force as long as the engine maintains its normal operating temperature.

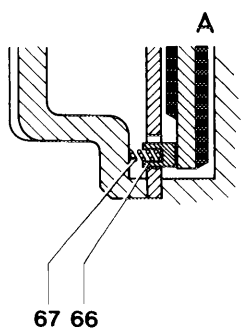
If the coolant temperature increases as the result of the higher load or higher outside temperatures, the air which flows through the radiator and actuates the bimetallic strip will become warmer. The bimetallic strip (69) changes its shape under the increasing heat and opens at approx. 73 °C a valve by means of a control pin (68) and thereby the path of the oil from reservoir (74) into working chamber (75), so that the fan will be additionally engaged.

During this control operation, the coolant temperature is between 90 and 95 °C.

With the clutch engaged, the fan speed in lower speed range will increase approximately proportional with increasing engine speed, but will not exceed 3500/min in upper speed range.



60 Coupling body (secondary member)
61 Pulley (primary member)
62 Flange shaft
63 Sealing ring
64 Needle bearing
65 Cooling fins
66 Oil scraper
67 Compression spring
68 Control pin
69 Bimetallic strip
70 Cover with holding clip
71 Intermediate washer
72 Feed hole
73 Valve lever
74 Reservoir
75 Working chamber



Checking connecting temperature

Run engine at 4000—4500/min. As soon as a coolant temperature of 90 to 95 °C is attained, the fan speed should increase by approx. 1000/min, which can be clearly noticed acoustically.

Reconditioning

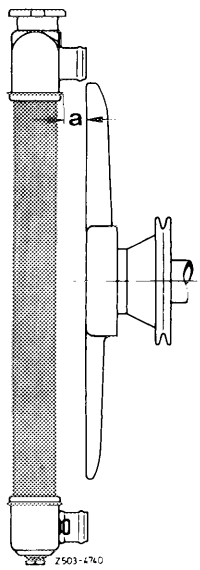
A defective coupling cannot be repaired with workshop equipment and a new coupling should therefore be installed.

Transportation and storage

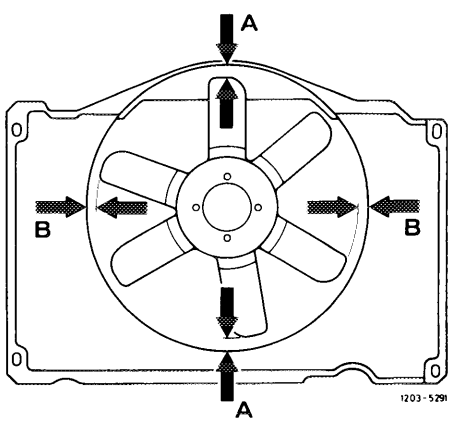
Temperature-controlled viscofan couplings should be transported and stored vertically. For short periods – e.g. during assembly – the coupling may rest on its flange, but never on front end.

Installation dimensions for cooler — fan and fan — fan cover

Model	Fan distance "a" for cooler approx. mm	Fan distance to fan cover approx. mm A	B
116.120	45	25	20
123	49		25
126.120			



Radiator/fan

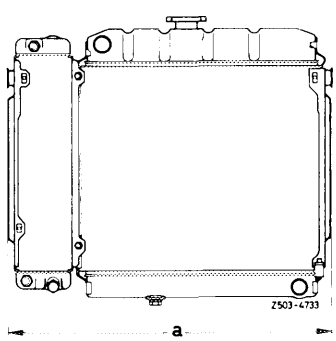


Fan cover/fan

Installation dimensions for radiator with air-oil cooler

Model	Installation dimension "a" in mm
116.120	685 ± 1
123	673.5 ± 4[1])
126.120	

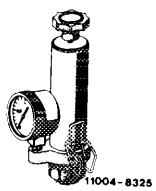
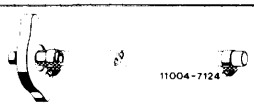
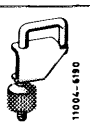
[1]) Model 123.193 with air conditioning installation dimension "a" 681 ± 4 mm.



Tightening torques		Nm
Drain plug radiator	Model 116	6–10
	Models 123, 126	1.5–2[1])
Lube oil hose to air-oil cooler		20–25
Transmission fluid hose to transmission fluid cooler		15–20

[1]) This torque can be obtained by means of a washer or a coin.

Special tools

Tester for cooling system	 11004-8325	001 589 48 21 00
Radiator cap with hose for leak tester	 11004-7124	605 589 00 25 00
7 mm socket on flexible shaft for hose clamps with worm drive	 11004-8667	123 589 12 09 00
Clamp	 11004-6190	000 589 40 37 00

Removal

1 Drain coolant from radiator (20–010), loosen coolant hoses on radiator and pull off.

2 Disconnect transmission fluid and lube oil hoses and unscrew on radiator or air-oil cooler.

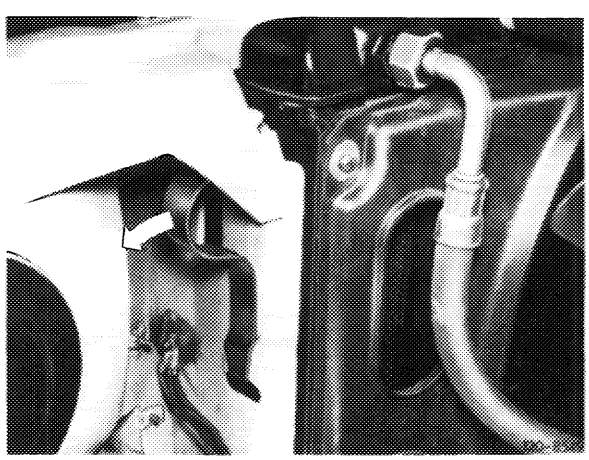
The open connections of oil hoses and connections on radiators and coolers can be closed with plastic plugs.

Model 116

3 Unscrew fan cover at top, pull out of holding clips at bottom and place over fan.

4 Push holder (arrow) in outward direction.

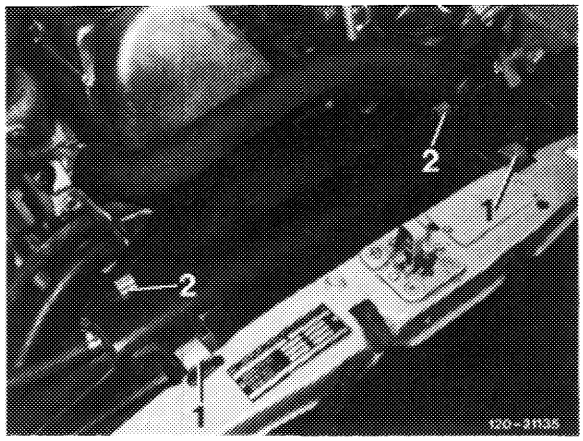
5 Lift out radiator together with air-oil cooler in upward direction.



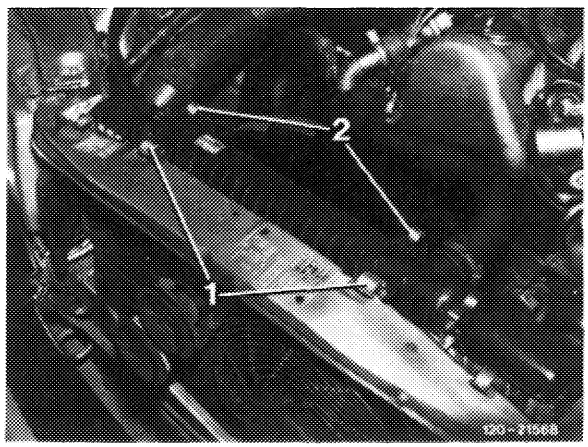
Model 116

Models 123 and 126

6 Pull out both holding clamps (2) in upward direction.

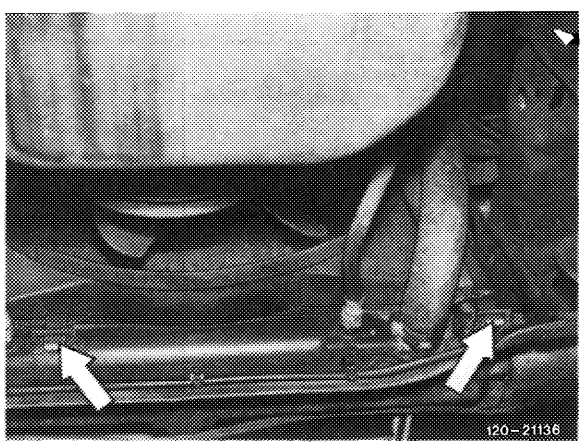


Model 123

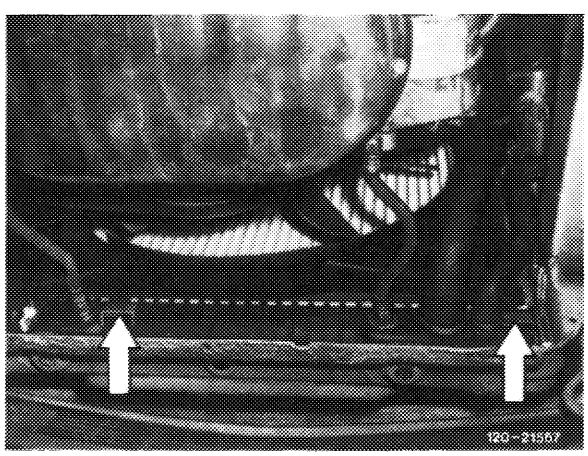


Model 126

7 Lift fan cover out of lower holders (arrow) and place behind fan.

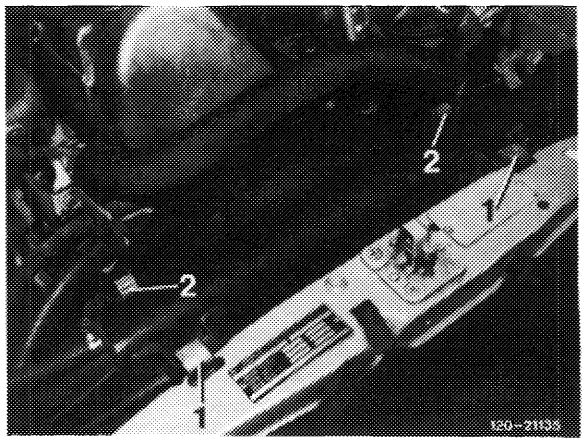


Model 123

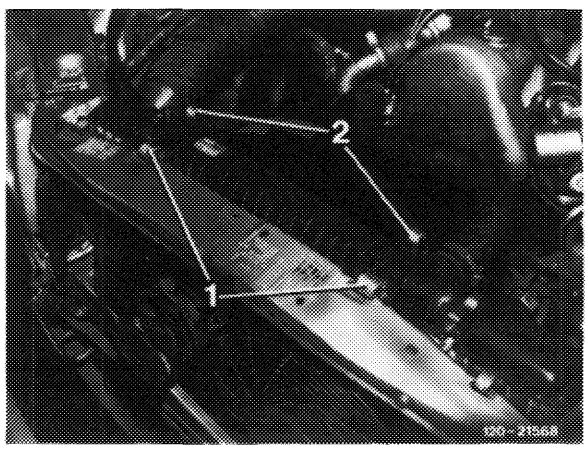


Model 126

8 Pull out both holding clamps (1) in upward direction and lift out radiator together with air-oil cooler.



Model 123

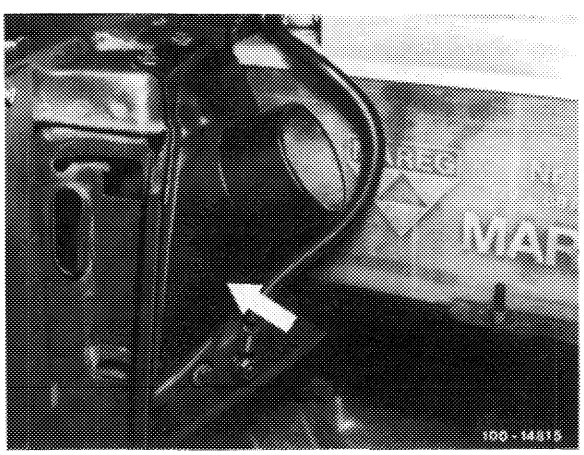


Model 126

Installation

9 Insert radiator with air-coil cooler.

Note: On model 116, for positioning righthand holder (driving direction), unscrew intake scoop (arrow) and screw on again after fastening radiator.

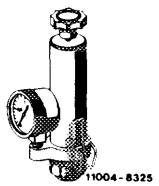
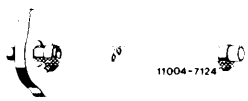


10 For additional installation proceed vice versa to removal.

Pay attention to distance of fan in relation to radiator and to fan cover.

11 Pressure-test cooling system with tester (approx. 1 bar gage pressure).

Special tools

Tester for cooling system	 11004-8325	001 589 48 21 00
Radiator cap with hose for leak test	 11004-7124	605 589 00 25 00
7 mm socket on flexible shaft for hose clamps	 11004-8667	123 589 12 09 00

Note

Since light alloy radiators with plastic coolant tanks cannot be repaired by soldering, a sealing compound has been developed.

This compound can also be applied to seal heavy-metal radiators (non-ferrous metal radiators).

The sealing compound is a product on a silicon rubber base which remains permanently elastic in its end condition. Temperature resistance extends from −50 °C to + 200 °C.

Because of the different accessibility on radiator (e.g. in core more difficult than on coolant tank) the sealing compound is available in diluted and non-diluted condition.

The different sealing compound versions and the priming fluid are combined in a repair kit, part No. 123 989 00 20.

Designation	Purpose
Priming fluid	Preparation of primer
Sealing compound non-diluted	For sealing easily accessible areas
Sealing compound diluted	For sealing poorly accessible areas (e.g. laterally on cooling tubes)

Sealing compound and primer have a service life of approx. 1 year provided they are always closed air-tight upon use.

Cloudy primer fluid can no longer be used.

Individually, the sealing compound can be used to seal the following parts or areas in coolant circuit:

a) Plastic coolant tanks (3 and 4).

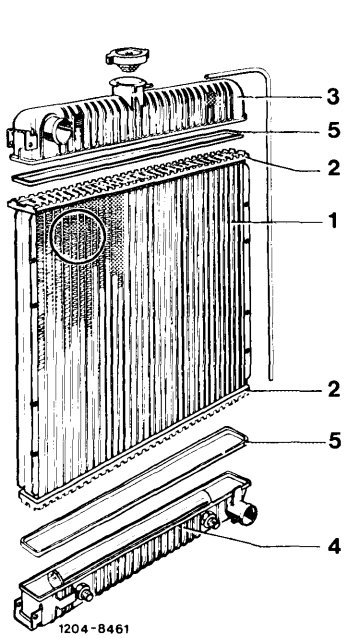
b) Heavy-metal coolant tanks (holes up to 1.5 mm dia.).

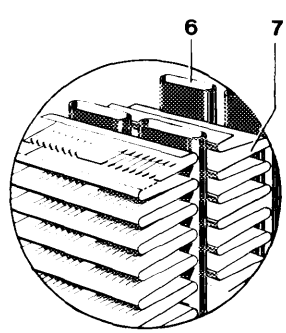
c) Light and heavy-metal cooling tubes (6).

d) Tube plate (2).

e) Bead connection (connection between radiator core and coolant tank).

f) Heat exchanger of heating system.





1 Radiator core
2 Tube plate
3 Coolant tank top
4 Coolant tank bottom
5 Sealing
6 Cooling tubes
7 Radiator ribs

Damaged areas on coolant tanks which are subject to higher loads, such as cracked or broken fastening elements, cracked in fillet radius to fittings, fractured spots and very long or large cracks at top should not be repaired, since the sealing compound can take only a very low load.

Plastic coolant tanks of radiators made by Behr can be exchanged with the assistance of special tools or fixtures in Behr radiator repair shops or in Inter-Radia service stations. If required, the nearest Behr repair shop or Inter-Radia service station should be consulted concerning such an exchange and information as to whether such repairs can be made should be requested.

If there is not such a possibility, the radiator should be replaced.

On heavy-metal radiators with plastic coolant tanks soldering (brazing) should be performed only up to a distance of 20 mm from coolant tank, since otherwise the high soldering (brazing) temperature will damage the sealing (5) and the coolant tank (3 or 4). Leaks which are closer to coolant tank should be sealed with sealing compound only.

If the leaking spot can be clearly located in installed condition, the radiator need not be removed. In such a case it will be enough to drain the coolant and to pressure-test the cooling system upon sealing.

When handling priming fluid and sealing compound, observe the following:

The priming fluid is easily inflammable (observe safety rules dangerous materials class A 1).

Acetic acid will be released up to complete setting of sealing compound. For this reason, prevent skin contact. Clean involved spots immediately with water and soap. Rinse eyes with water or see a doctor.

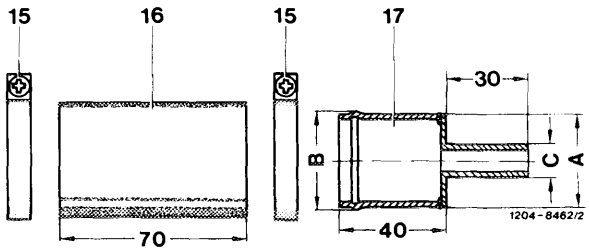
1 If the leaking spot cannot be perfectly located in installed condition, remove radiator (20–420). Unscrew air-oil cooler from radiator.

2 Clean radiator.

3 Close hose connections with self-made caps.

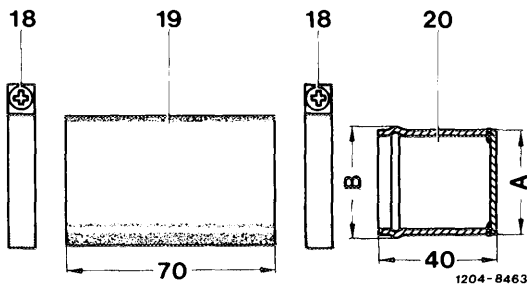
Required parts for upper hose connection:

15 2 clamps L 40–50, part No. 916026 040000
16 Individual piece from hose, part No. 126 501 02 82
17 Reduction element made of two tubes
A 38 mm dia.
B 39 mm dia.
C 12 mm dia.



Required parts for lower hose connection:

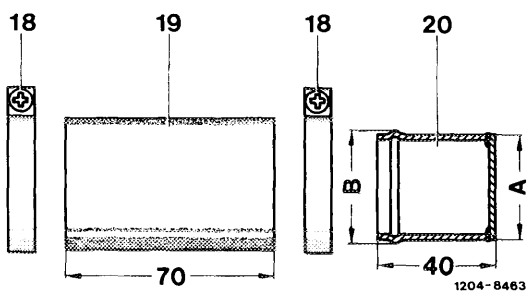
18 2 clamps L 40–50, part No. 9126026 040000
19 Individual piece from hose, part No. 126 501 02 82
20 Cap made from tubing
A 38 mm dia.
B 39 mm dia.



Overflow connection on upper coolant tank must be closed.

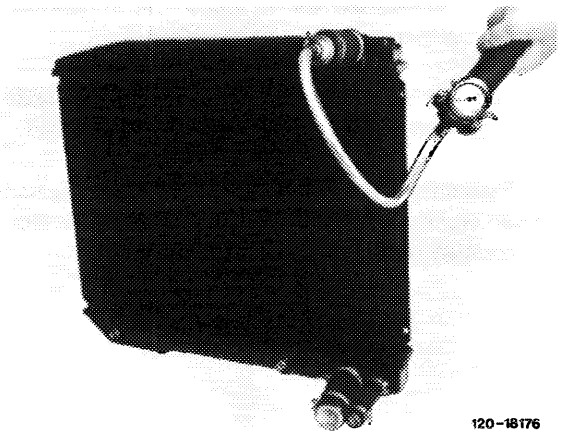
Required parts for inflow from expanding tank:

18 2 clamps L 28–35, part No. 916026 028000
19 Individual piece from hose, part No. 126 501 10 82
20 Cap made from tubing
A 21 mm dia.
B 22 mm dia.



4 Close transmission fluid cooler connections with plastic caps or plugs made from old oil cooler lines. For this purpose, saw off oil cooler lines shortly behind nipple and close by soldering.

5 Connect tester to radiator.
For leak test, pull hose from radiator cap and attach to reduction at upper hose connection of radiator.



6 Place radiator into a water bath.

7 Put radiator under pressure by means of tester and watch where air bubbles are rising.

8 Mark leaking spot.

9 Remove radiator and evacuate pressure.

10 Blow radiator dry with compressed air.

11 Clean spot about to be sealed with a conventional cleaning compound (e.g. Tri or benzine). Always clean area slightly larger than spot to be sealed (e.g. in the event of cracks approx. 20–30 mm beyond ends of cracks).

Paint removal is not required. Then blow radiator dry with compressed air at pertinent area.

No dust and grease residue should remain.

12 Apply very thin layer of priming fluid uniformly with a brush.

Similar to cleaning, apply priming fluid beyond area or spot to be sealed. To make sure that the priming fluid is not getting dirty in tank, pour quantity required for repairs into a separate vessel.

Attention!
When handling priming fluid, pay attention to safety rules. Dangerous materials class A 1, inflammable.

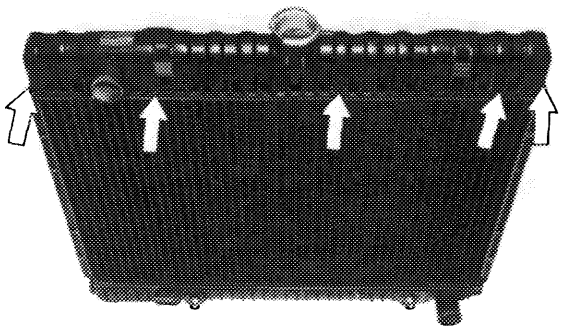
13 Let priming fluid dry for approx. 10 minutes at ambient temperature.

14 Position radiator in such a manner that the sealing compound cannot run off the spot to be sealed.

15 Depending on accessibility, apply diluted or non-diluted sealing compound. Use brush, spatula or the like for distributing sealing compound.

Attention!
During application and distribution, make sure that no air bubbles will be included.

Apply sealing compound beyond spot about to be sealed, similar to cleaning and priming. In the event of several leaking spots on bead flange (arrows) it will be of advantage to seal the bead flange all-around.



120-15953

Seal leaks in core from both sides.

At end of sealing procedure, close tube immediately. Acetic acids will be released up to full linking of sealing compound. Prevent skin contact. Clean respective spots immediately with water and soap, rinse eyes with water and see doctor, if required.

16 Leave radiator alone for at least 3 hours until sealing compound is dry. Depending on quantity of applied sealing compound and size of spot or area to be sealed, complete linking of sealing compound into a permanent, elastic connection will take max. 24 hours.

17 Pressure-test radiator in water bath for approx. 5 minutes at 1.5 bar gage pressure.

If there should still be leaks, repeat sealing procedure starting at item 8.

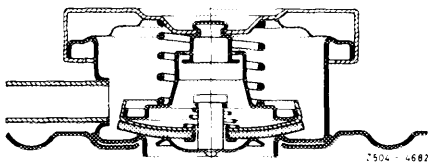
18 Remove tester and closures.

19 Attach air-oil cooler to radiator and tighten fastening screws to 5—7 Nm.

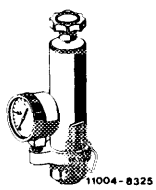
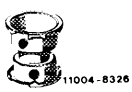
20 Install radiator (20—420).

21 Pressure-test cooling system with tester (approx. 1 bar gage pressure).

Expansion tank closing cover

Pressure relief valve opens at	new closing cover $1.0 \pm^{0.15}_{0.1}$ bar gage pressure	
	used closing cover 1.0–0.2 bar gage pressure	
Vacuum valve starts opening at	0.1 bar vacuum	

Special tools

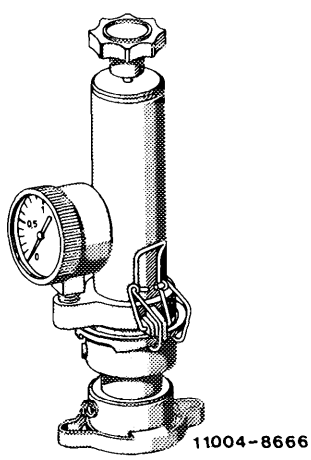
Tester for cooling system		001 589 48 21 00
Double connection for expansion tank closing cover for cooling system tester		000 589 73 63 00

Checking pressure relief valve

1 Attach double connection on tester for cooling system by means of holders.

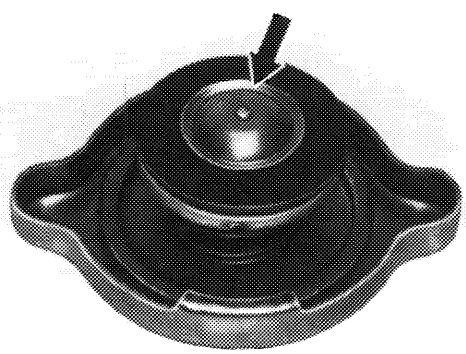
2 Place expansion tank closing cover on double connection.

3 Check by pumping opening pressure.

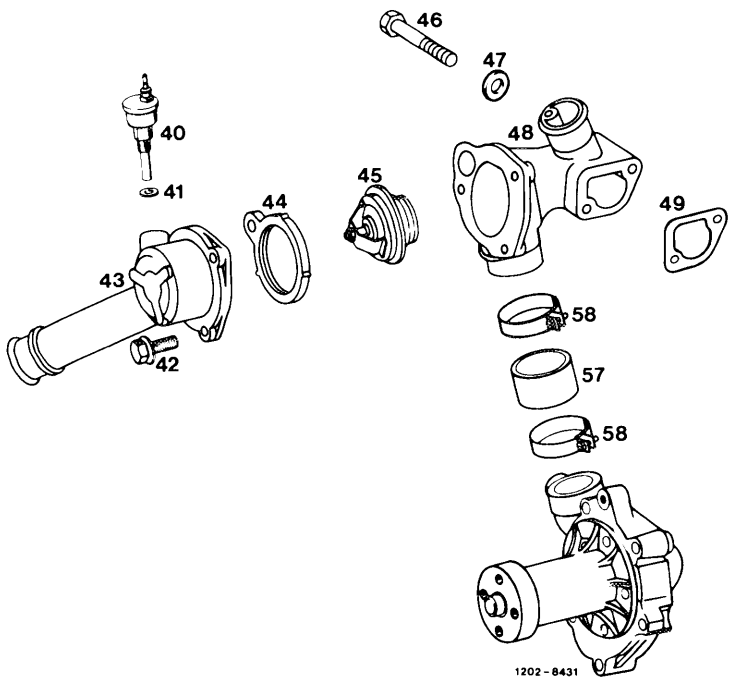


Checking vacuum valve

The vacuum valve (arrow) should rest against rubber seal, valve should lift easily and snap back upon release.



120-14497



40 Temperature switch 100 °C (model 116, engine 617.950 only)
41 Sealing ring
42 Combination screw (3 each)
43 Cap coolant thermostat housing
44 Sealing ring
45 Coolant thermostat
46 Hex. screw (2 each)
47 Spring plate (2 each)
48 Coolant thermostat housing
49 Gasket
57 Coolant hose
58 Hose clamp

Tightening torques	Nm
Screws for engine carrier on engine mount front	70
Screws for engine mount on front axle carrier	30
Screws for engine mount on engine carrier rear	30

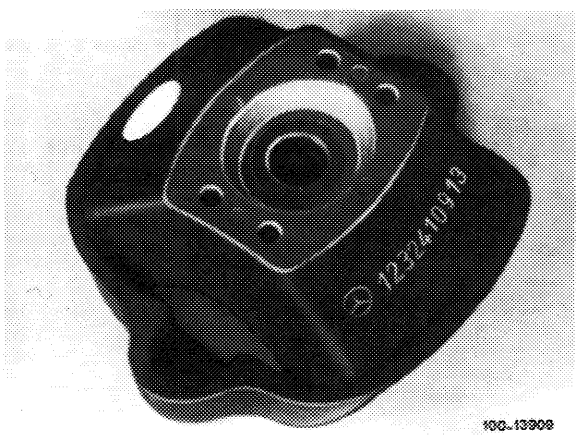
Special tools

Torque wrench with plug-type ratchet, 1/2" square, 25–130 Nm		001 589 66 21 00
Torque wrench with plug-type ratchet, 1/2" square, 40–220 Nm		001 589 67 21 00

Note

Engine mounts differ with regard to shore hardness.

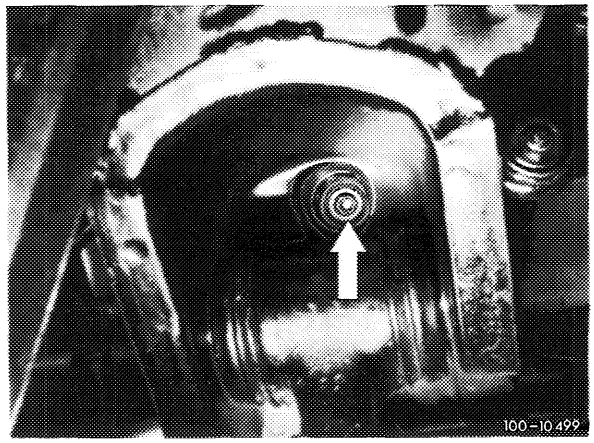
For identification, a color dot is applied on engine mount in addition to part number.

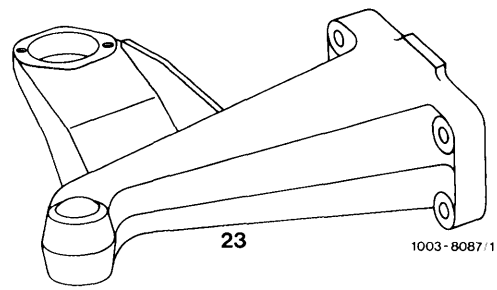


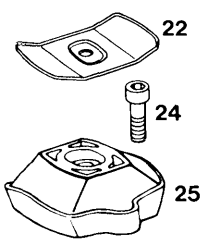
Model	Engine mount left Part No.	Engine mount right Part No.	Shielding plate
116.120	123 241 30 13 (two blue dots)	123 241 27 13 (blue dot)	left and right
123	123 241 30 13 (two blue dots)		left and right
126.120	123 241 30 13 (two blue dots)	123 241 27 13 blue dot)	left

Removal

1 Unscrew screws (20) for engine carrier on engine mount from below (arrow).

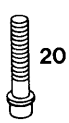


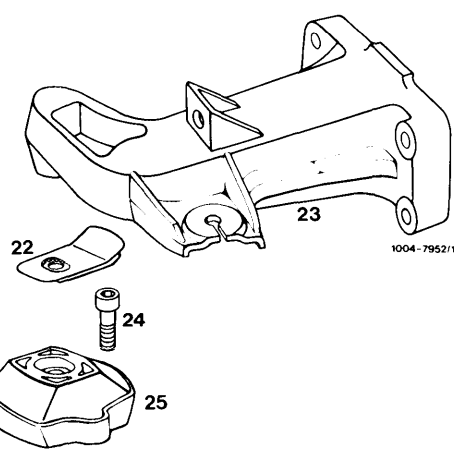




Engine carrier right in model 116.120

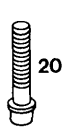
20 Screw M 12 x 40
22 Shielding plate
23 Engine carrier
24 Combination screw M 8 x 18
25 Engine mount





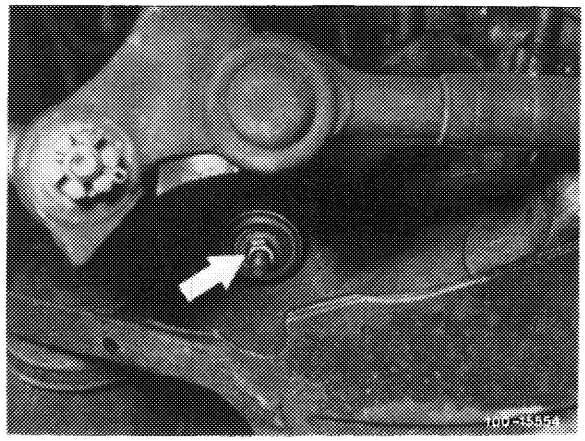
Engine carrier right in model 123

20 Screw M 12 x 40
22 Shielding plate
23 Engine carrier
24 Combination screw M 8 x 18
25 Engine mount

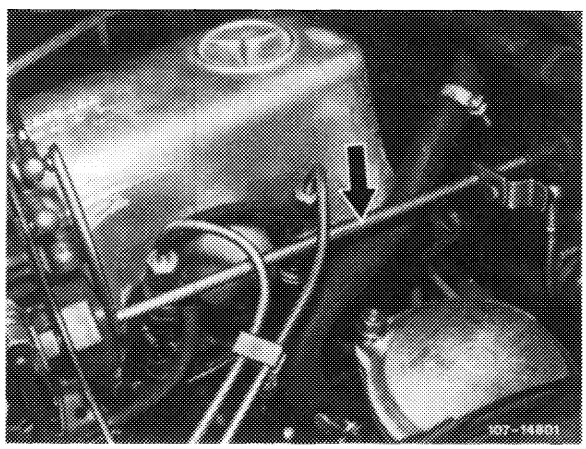


2 Unscrew nuts on engine shock absorbers below (arrow) and remove rubber buffer together with disk washers.

For loosening nuts, apply counterhold to piston rod at spot provided for this purpose (Fig. item 10).

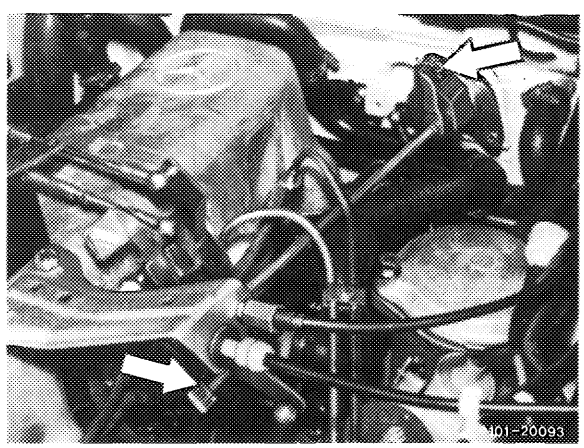


3 Remove longitudinal regulating shaft. For this purpose, disconnect regulating linkage and pull out locking eye (arrow).



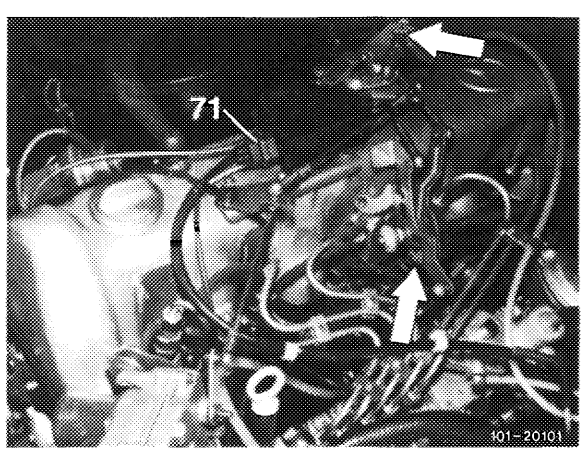
Model 116.120

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



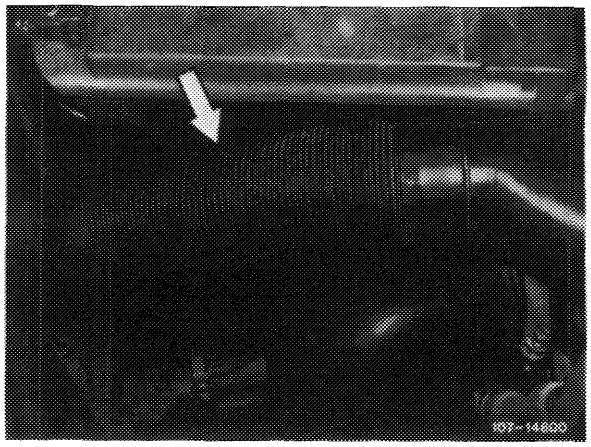
Model 123

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



Model 126.120

4 Remove intermediate piece on air cleaner.

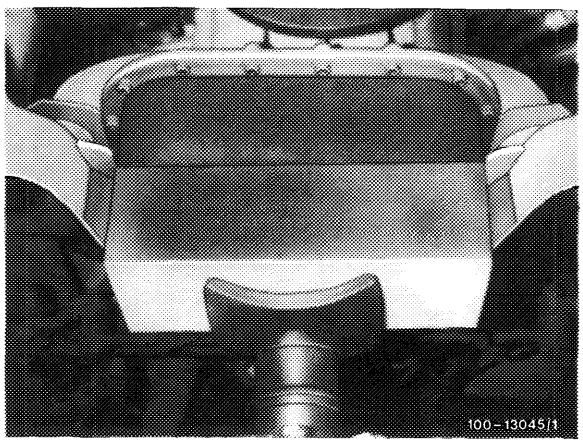


5 Lift engine at oil pan by means of pit lift.

Note: To prevent damage to oil pan, use a wooden base.

The engine can also be lifted be means of a crane and engine hoist attached to front suspension eye.

When lifting, make sure that the fan is not abutting against radiator shell.



6 Remove shielding plate (22).

7 Unscrew screws (24) and remove engine mount.

Installation

8 Position new engine mount and screw down.

9 Insert shielding plates.

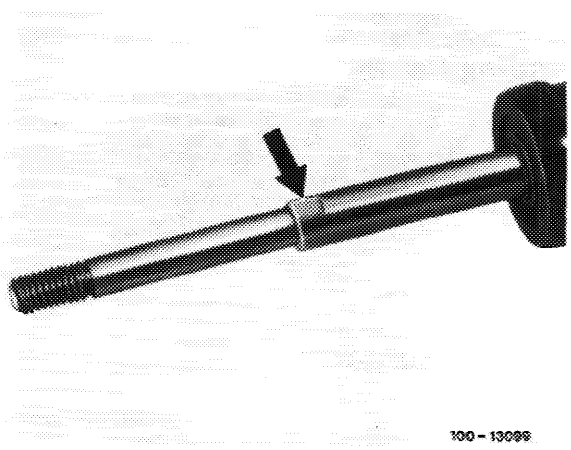
Note: Pay attention to installation position.

10 Lower engine, while fitting piston rods of engine shock absorbers on frame cross member.

11 Position screws (20) and tighten to 70 Nm.

12 Position rubber buffers and disk washers on engine shock absorbers.

Screw down engine shock absorbers. For this purpose, apply counterhold to piston rod at spot provided for this purpose (arrow).



Tightening torques	Nm
Screws for engine mount on engine carrier	30
Adjusting screw for engine mount (model 123.193)	40

Special tools

Torque wrench with plug-type ratchet, 1/2" square, 25–130 Nm		001 589 66 21 00

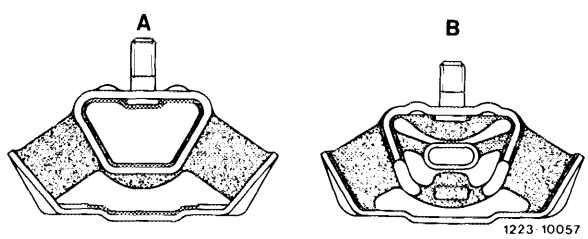
Note

Models 116.120, 123.133/153, 123.193 (USA) (J) version and 126.120 are provided with an engine mount **without stop** since start of series.

Model 123.193 standard version has been provided with an engine mount **with stop** up to July 1981.

Starting July 1981 likewise **without stop.**

For this purpose, vehicles with automatic transmission W 4 B 025 (722.120) had to be provided with a rubber buffer on transmission tunnel to prevent transmission vent from knocking against tunnel.



A Engine mount without stop
B Engine mount with stop

If a new engine mount with stop is installed, the stop requires adjustment after 1000–1500 km and 7500 km (22–220).

Model	Engine mount Part No.	Version
116.120	116 240 04 18	without stop
123.193[1])	123 242 04 13	with stop
123.133 123.153 123.193[2])	123 240 25 18	without stop
126.120	116 240 04 18	without stop

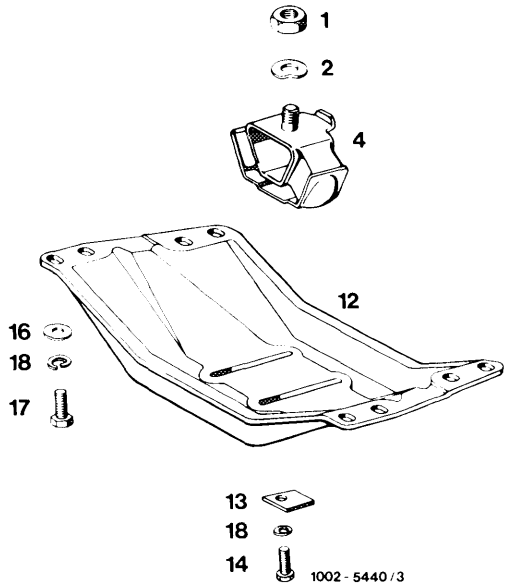
[1]) Standard version up to July 1981.
[2]) Standard version starting July 1981, (J) (USA) version from start of series.

Removal

1 Unscrew nuts (1).

2 Unscrew screws (14).

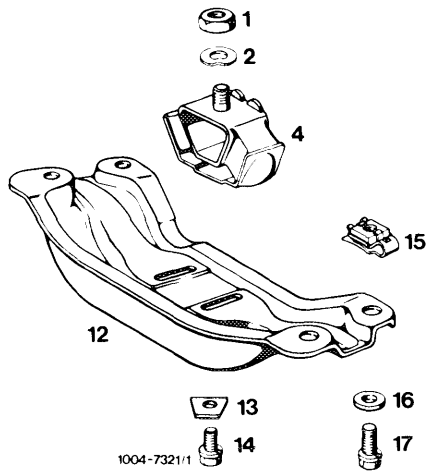
3 Push transmission in upward direction by means of a pit lift at intermediate flange and remove engine mount (4).



Model 116.120

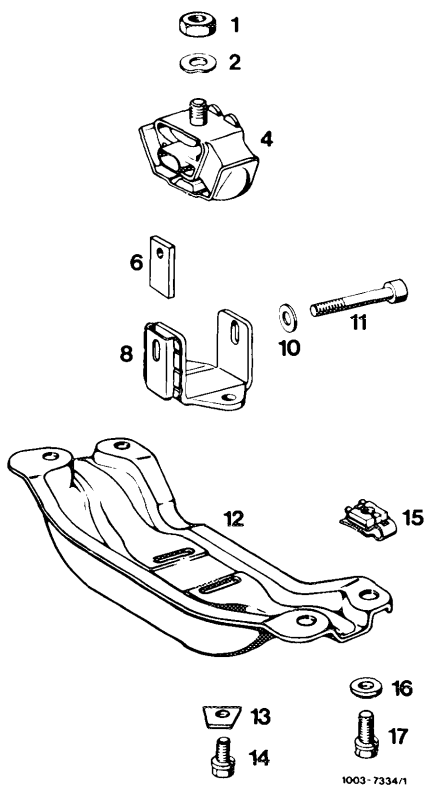
1	Nut M 12 x 1.5	14	2 screws M 8 x 15
2	Spring washer B 12	16	4 washers 8.4
4	Engine mount	17	4 screws M 8 x 20
12	Engine carrier	18	2 snap rings A 8
13	2 washers		

4 On model 123.193 standard version up to July 1981, unscrew adjusting screw (11) and take engine mount (4) out of holder.



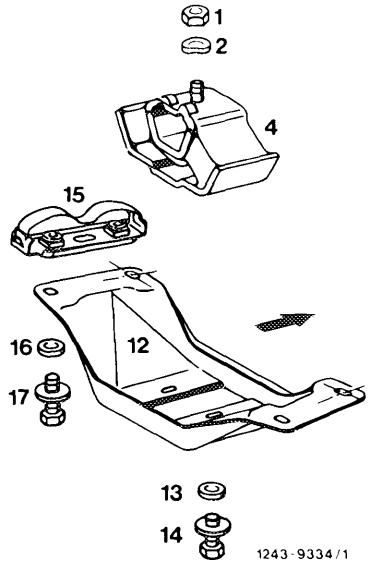
Models 123.133/153 and 123.193 standard version starting July 1981, (J) (USA) version from start of series

1	Nut M 12 x 1.5	14	Combination screw
2	Spring washer B 12	15	Cage nut
4	Engine mount	16	Washer
12	Engine carrier	17	Combination screw
13	Washer		



Model 123.193 standard version up to July 1981

1	Nut M 12 x 1.5	12	Engine carrier
2	Spring washer B 12	13	2 washers
4	Engine mount	14	2 screws M 8 x 18
6	Threaded plate	15	4 cage nuts
8	Holder	16	4 washers
10	Washer 8.4	17	4 screws M 10 x 22
11	Adjusting screw M 8 x 75		



Model 126.120

1	Nut M 12 x 1.5	17	Combination screw M 10 x 22
2	Spring washer	13	Washer
4	Engine mount	14	Combination screw M 8 x 15
12	Engine carrier	15	Nut holder
16	Washer 10.5		

Installation

5 On model 123.193 standard version up to July 1981, place new engine mount into holder (8).

6 Place new engine mount with or without holder (depending on model) on engine carrier (12).

7 On model 123.193 screw-in adjusting screw (11) (do not tighten).

8 Lower transmission.

9 Position screws (14) and tighten to 30 Nm.

10 Screw-on nut (1). Torque reference value 70 Nm.

11 On model 123.193, adjust engine stop (22–220).

Tightening torque	Nm
Adjusting screw (11) on rear engine mount	40

Special tool

Torque wrench with plug-in ratchet, 1/2" square, 25–130 Nm		001 589 66 21 00

Note

On standard version vehicles up to July 1981, adjust engine stop during inspection (1000–1500 km) and during first service (7500 km).

If a new rear engine mount is installed, also adjust engine stop after 1000–1500 km and 7500 km.

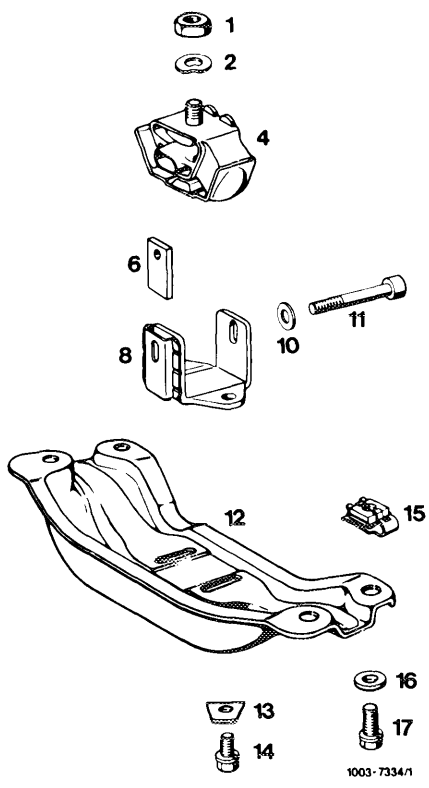
Vehicle should rest on its wheels ready-to-drive.

Adjustment

1 Completely loosen adjusting screw (11) on rear engine mount.

2 Move engine by light manual crosswise shaking.

3 Tighten adjusting screw (11) to 40 Nm.



Note

Model 116.120

The engine has two engine shock absorbers, which are mounted at the left and right between engine carrier and frame cross member.

Model 123

The engine has two engine shock absorbers, of which the left one is mounted between engine carrier and frame cross member and the right one between engine carrier and console for lower control arm.

The lefthand engine shock absorber is located behind, and the right one in front of engine carrier.

Model 126.120

The engine has two engine shock absorbers, which are located at the left and right between engine carrier and frame cross member.

The lefthand engine shock absorber is located behind and the right one in front of engine carrier.

On all models, the engine shock absorbers are fastened to engine carriers by means of an engine damper bearing (42) and to frame cross member or console by means of rubber buffers and disk washers.

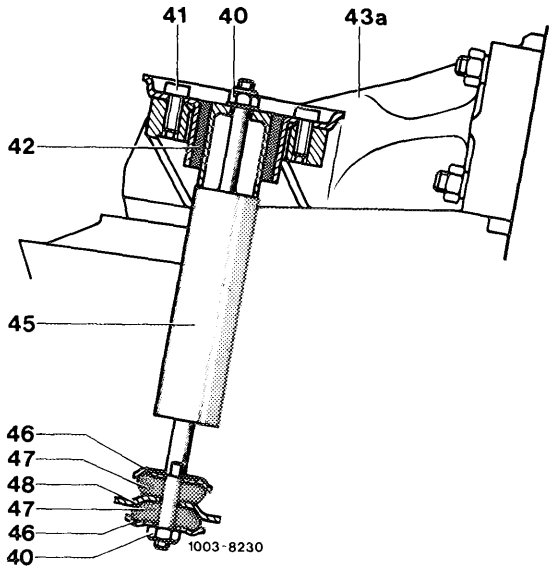
On model 123, from start of series, rubber buffers with disk washers were temporarily installed on right-hand engine shock absorber instead of damper bearing.

Removal

1 Unscrew nuts (40). For unscrewing lower nut, apply counterhold to piston rod at spot provided for this purpose (refer to Fig. item 6).

2 Remove lower disk washer (46) and lower rubber buffer (47).

3 Unscrew engine damper bearing (42).

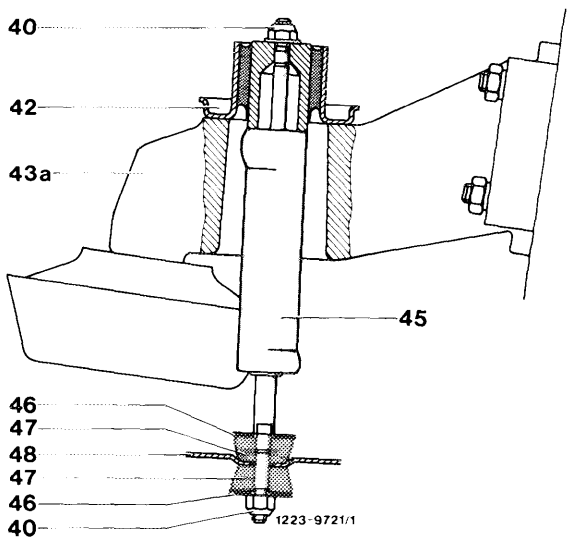


Engine shock absorber left and right in model 116.120

40 Nut M 6
41 Combination screw M 6 x 15
42 Engine damper bearing
43a Engine carrier
45 Engine shock absorber
46 Disk washer
47 Rubber buffer
48 Frame cross member

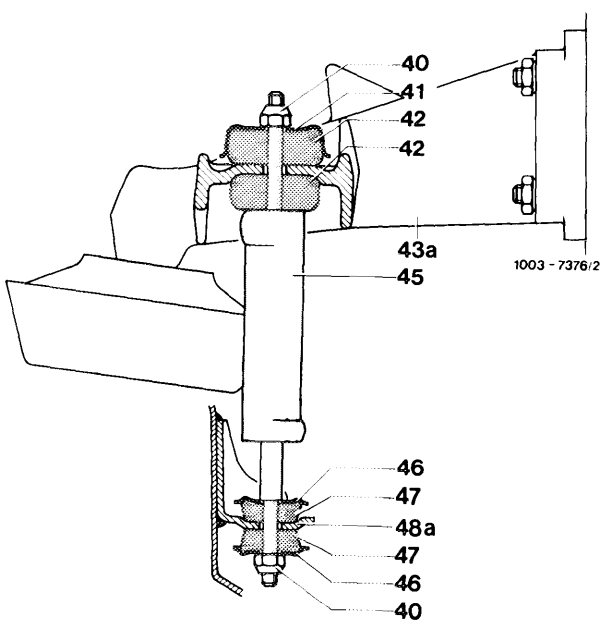
4 Remove engine shock absorber.

For this purpose, on model 123, pull righthand engine shock absorber (1st version) out of holder on engine carrier in forward direction.



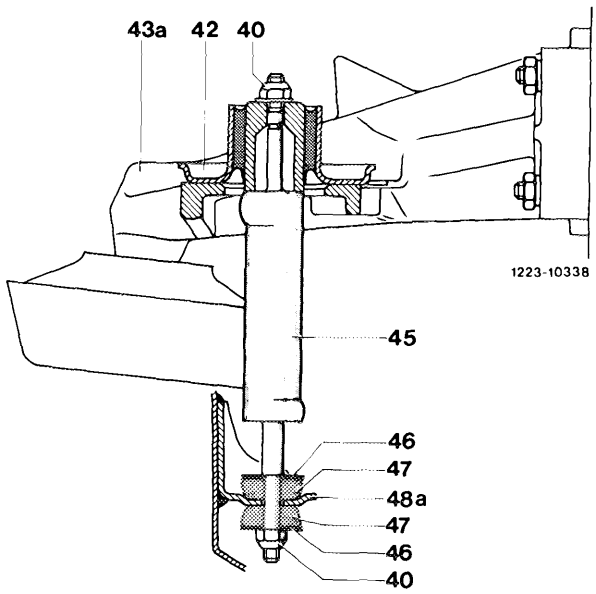
Engine shock absorber left in model 123

40 Nut M 6
42 Engine damper bearing
43a Engine carrier
45 Engine shock absorber
46 Disk washer
47 Rubber buffer
48 Frame cross member



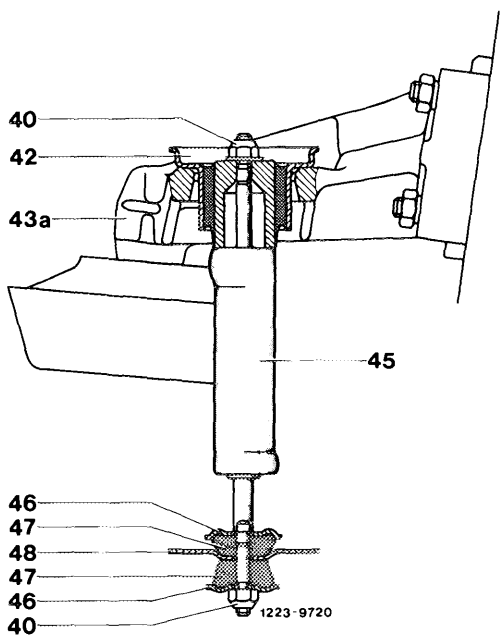
Engine shock absorber right in model 123 (1st version)

40 Nut M 6
41 Disk washer
42 Rubber buffer
43a Engine carrier
45 Engine shock absorber
46 Disk washer
47 Rubber buffer
48a Holder on console for lower control arm



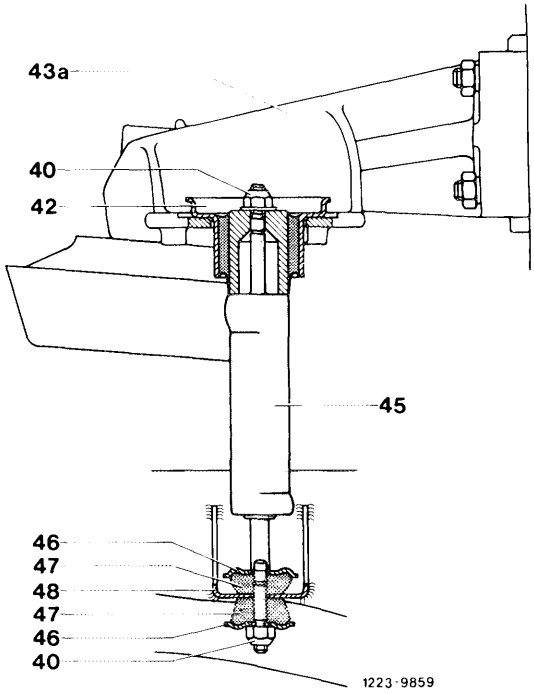
Engine shock absorber right in model 123
(2nd version)

40 Nut M 6
42 Engine damper bearing
43a Engine carrier
45 Engine shock absorber
46 Disk washer
47 Rubber buffer
48a Holder on console for lower control arm



Engine shock absorber left in model 126.120

40 Nut M 6
42 Engine damper bearing
43a Engine carrier
45 Engine shock absorber
46 Disk washer
47 Rubber buffer
48 Frame cross member



Engine shock absorber right in model 126.120

40 Nut M 6
42 Engine damper bearing
43a Engine carrier
45 Engine shock absorber
46 Disk washer
47 Rubber buffer
48 Frame cross member

Installation

5 Insert engine shock absorber with piston rod in downward direction, with upper disk washer (46) and rubber buffer (47).

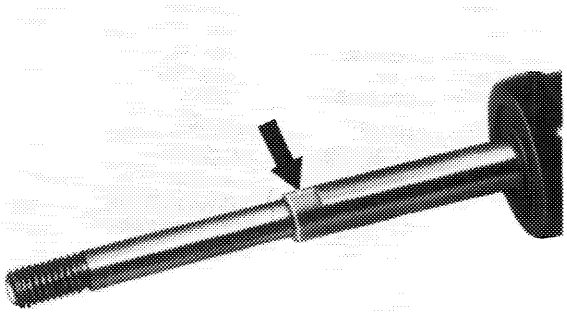
On model 123 slip righthand engine shock absorber (1st version) from the front on holder on engine carrier. Rubber buffer (42) should be under holder.

6 Slip lower rubber buffer (47) and disk washer (46) on piston rod.

7 Screw-on engine damper bearing (42).

8 Position nuts (40) and tighten.

For tightening lower nuts (40), apply counterhold to piston rod at spot provided for this purpose (arrow).



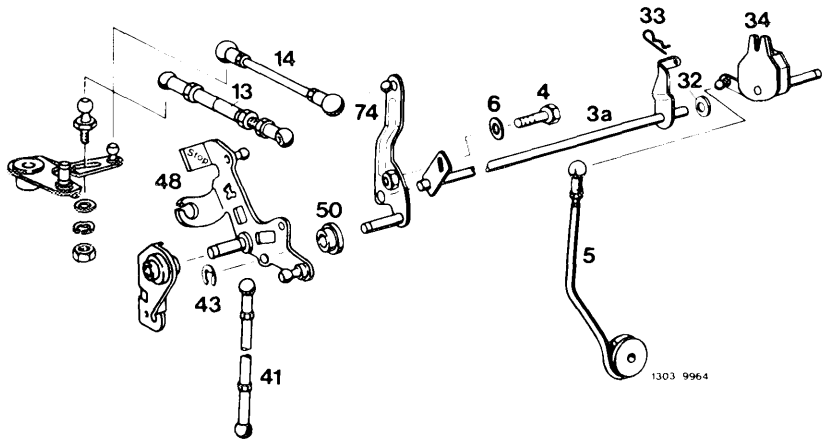
100-13089

A. Model 123.193 standard version

1st version

Length of regulating rods in mm

Free travel rod (13) in pulled out condition	154
Connecting rod (14)	140
Pushrod (41)	190
Pushrod (5)	200



Connecting rod (5 in Fig. item 4)	118

Auxiliary tool (spare part)

Adjusting sleeve (5 in Fig. item 5)		180 072 03 93

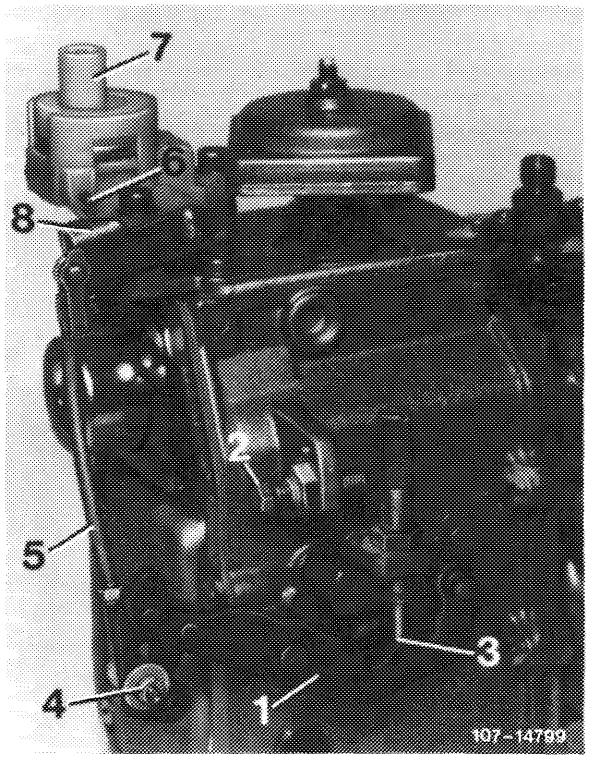
Adjustment

1 Check throttle linkage for easy operation and bends. Replace damaged parts, if any.

2 Disconnect all regulating rods.

3 Check whether regulating lever (1) of injection pump rests against idle speed stop (3).

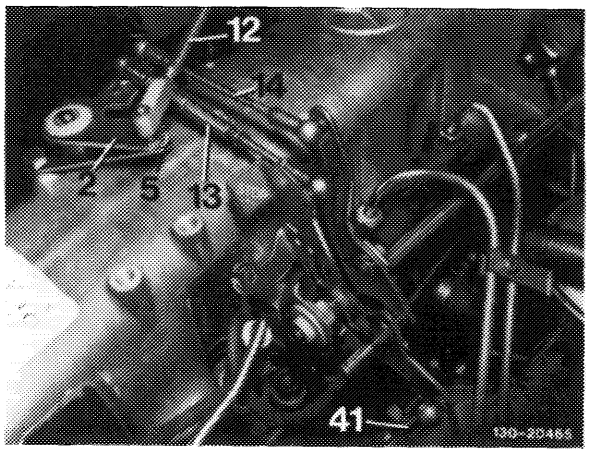
4 Check whether connecting rod (5) is correctly set. For this purpose, push regulating lever (1) against full load stop (2). Actuating lever (8) should have a max. play of 0.5 mm up to full load stop (6). If required, adjust connecting rod (5) by means of adjustable ball head (4).
Connecting rod (5) should be set to 122 mm, measured from center of ball socket to center of linkage.



1 Regulating lever
2 Full load stop
3 Idle speed stop
4 Adjustable ball head
5 Connecting rod
6 Full load stop on vacuum control valve
7 Vacuum control valve
8 Actuating lever for vacuum control valve

5 Plug-on adjusting sleeve (5). Guide lever should rest against sleeve.

6 Set free travel rod (13) in completely pulled out condition to 154 mm, measured from center to center of ball head and connect.



2 Guide lever
5 Adjusting sleeve
12 Control pressure rod
13 Free travel rod
14 Connecting rod
41 Pushrod

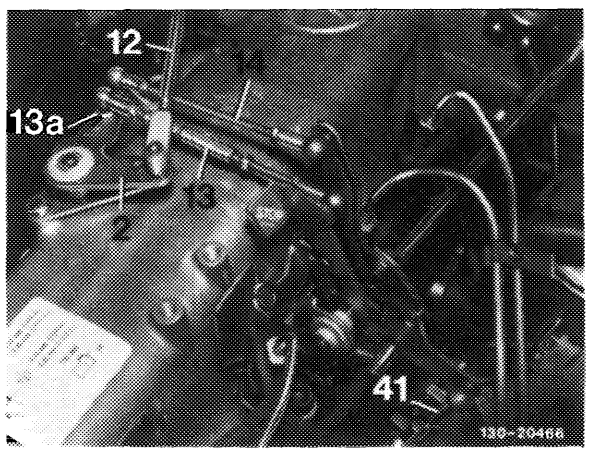
7 Push guide lever (2) against idle speed stop.

8 Adjust pushrod (41) in such a manner that rod can be connected free of tension.

9 Set connecting rod (14) to 140 mm, measured from center to center of ball head and connect.

10 Set regulating lever on injection pump to full load.

Adjust adjustable ball head (13a) in slot, if required.

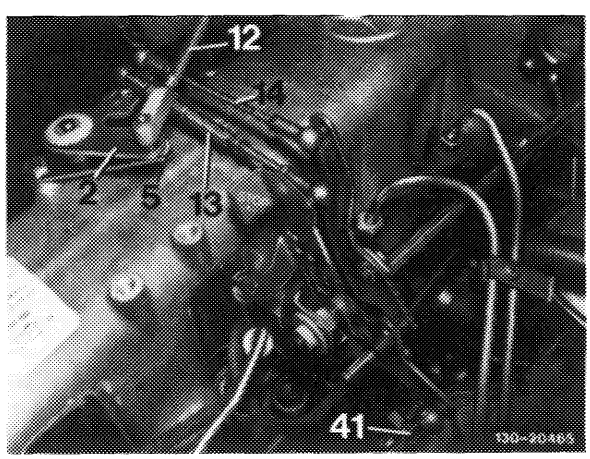


11 Adjust control pressure rod (12). Guide lever (2) should rest against idle speed stop. Push control pressure rod carefully against idle speed stop on transmission, set to tension-free length, connect and secure.

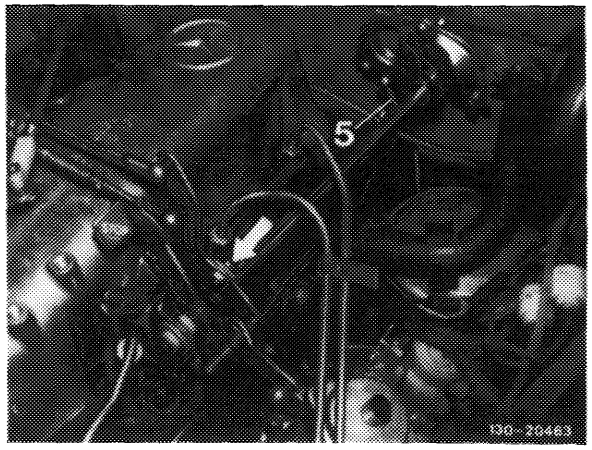
Note: To facilitate assembly, make sure that trademark faces in upward direction when end piece is connected.

During longitudinal checkup, hold control pressure rod above test bore adjacent to bolt.

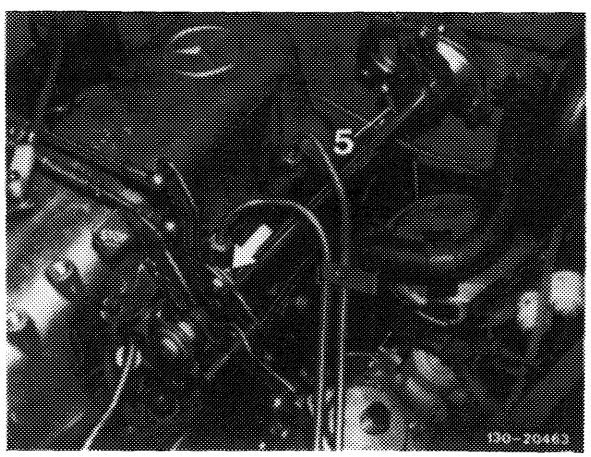
12 Remove adjusting sleeve (5).



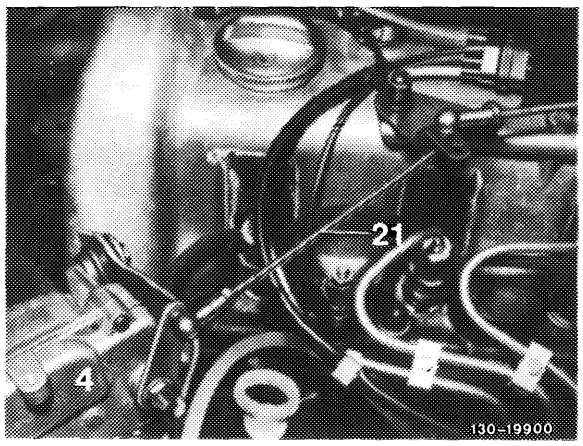
13 Check full load stop. With engine stopped, push accelerator pedal from inside vehicle up to stop on kickdown switch. Accelerator pedal and regulating lever on injection pump should rest against full load stop. If required, loosen adjusting screw (arrow). Adjust throttle linkage in such a manner that the regulating lever rests against full load stop.



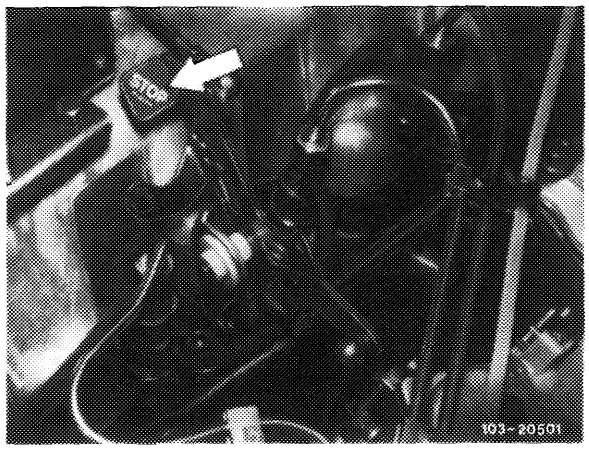
If this adjustment is not enough to attain full load or idle speed stop, set pushrod (5) from longitudinal regulating shaft to accelerator pedal to 200 mm, measured from center of ball socket to center of damping ring.



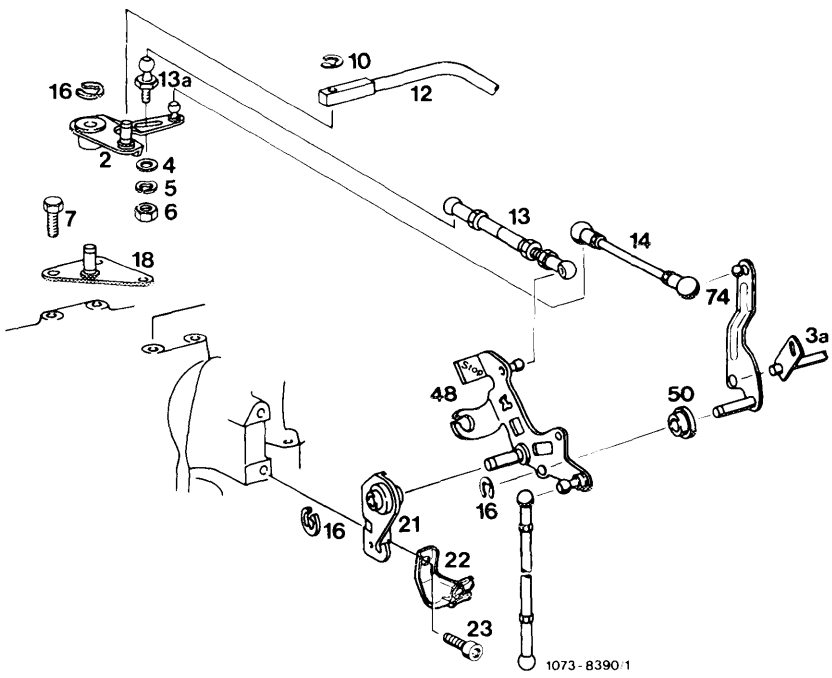
14 Adjust cruise control. Check whether actuator rests against idle speed stop of cruise control. For this purpose, disconnect connecting rod (21) and push lever of actuator (4) clockwise against idle speed stop. When attaching connecting rod (21), make sure that the lever of the actuator is pushed away from idle speed stop by approx. 1 mm. Adjust connecting rod, if required.



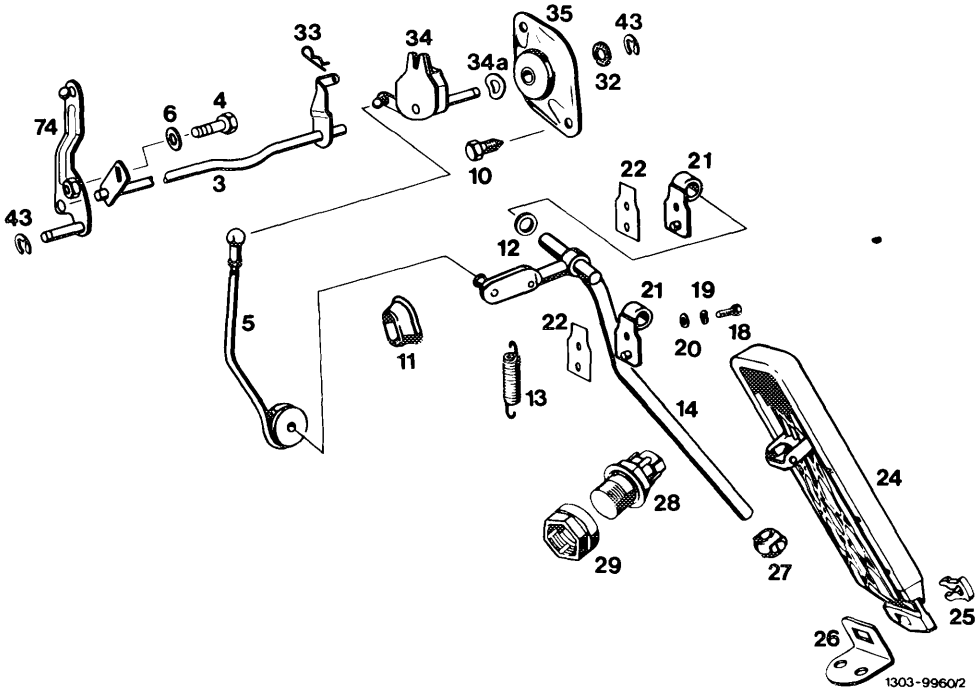
15 Check operation of emergency stop button. For this purpose, run engine at idle, push emergency stop button (arrow). Engine should stop, readjust pushrod toward injection pump, if required.



Engine regulation



2 Guide lever
3a Longitudinal regulating shaft
4 Washer
5 Corrugated washer
6 Nut
7 Screw
10 Lock
12 Control pressure rod
13 Free travel rod
13a Screw-type ball head
14 Connecting rod
16 Lock
18 Holder
21 Holder
22 Holder
23 Hex. socket screw
41 Pushrod
48 Angle lever
50 Plastic bushing
74 Guide lever

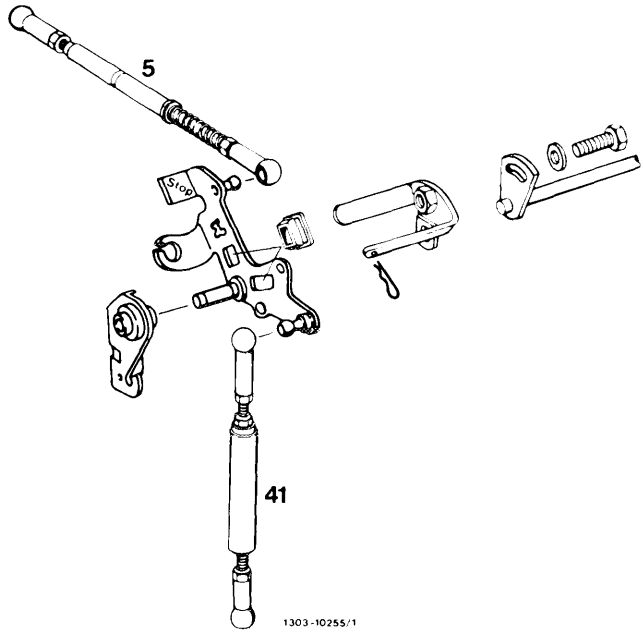


3a Longitudinal regulating shaft automatic transmission
4 Adjusting screw
5 Pushrod
6 Washer
10 Screw
11 Rubber grommet
12 Plastic spacing ring
13 Return spring
14 Accelerator pedal lever
18 Hex. screw
19 Corrugated washer
20 Washer
21 Bearing
22 Gasket
24 Accelerator pedal
25 Clip
26 Fastening plate
27 Joint
28 Kickdown switch
29 Adjusting nut
32 Copper netting-graphite disk
33 Lock
34 Regulating lever with damper
34a Corrugated washer
35 Bearing bracket
43 Lock

2nd version

Length of regulating rods in mm

Idle travel rod with elastic stop (5)	184
Connecting rod (41)	154



Auxiliary tool (spare part)

Adjusting sleeve (05 in Fig. item 1)	182 072 03 93

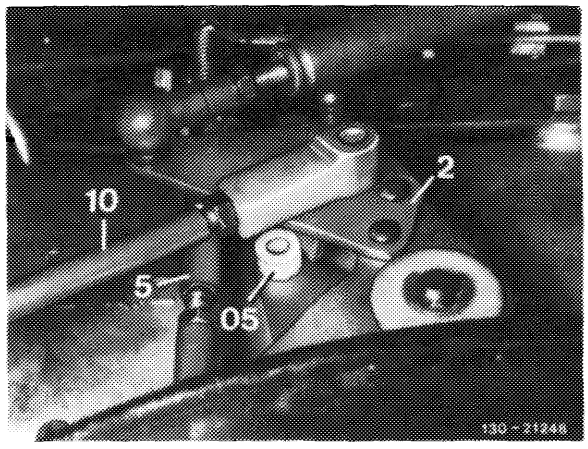
Start of series: April 1981

Model	Engine	Chassis end no.
123.193	617.952	003342

Adjusting

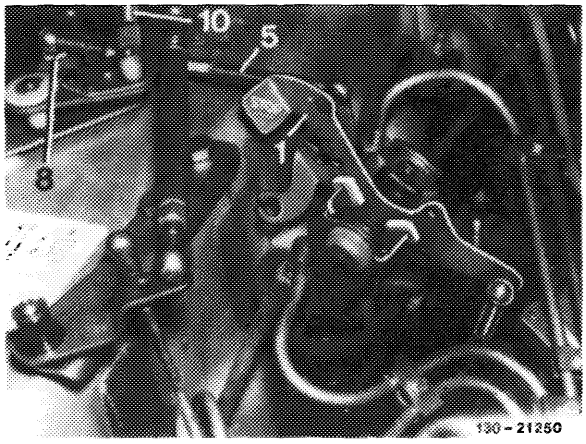
1 Check full throttle stop and adjust at longitudinal regulating shaft, if required.

Force connecting rod (5) from angle lever (1). Disconnect control pressure rod (10). Place adjusting sleeve (05) on stop pin.

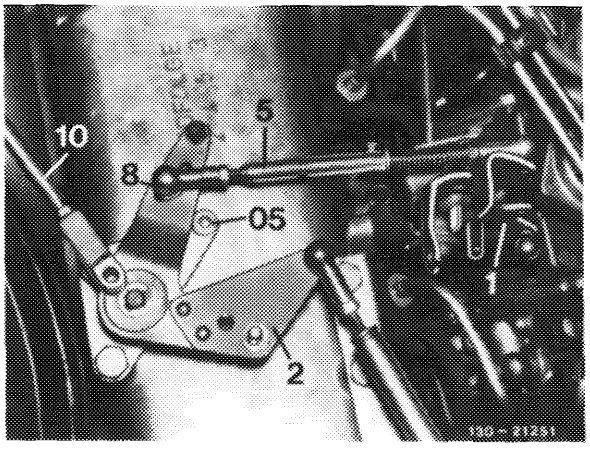


2 Push angle lever (1) into idle throttle position, so that it will rest against adjusting sleeve (05).

Adjust connecting rod (5) lengthwise in such a manner that it can be pushed in this position free of tension on angle lever (2).

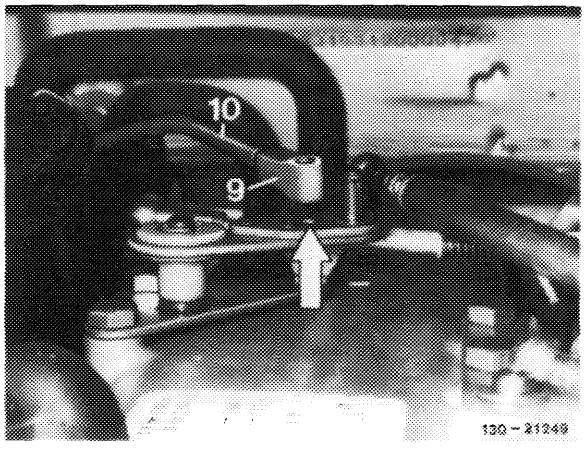


3 Pull anlge lever (1) to full load stop. Loosen ball head (8). Displace in slot until angle lever (1) rests against adjusting sleeve (full load stop). Tighten ball head (8) in this position.



4 In idle throttle position, hold control pressure rod (10) above test bore (arrow) in angle lever (1). Adjust lengthwise at end piece (9) in such a manner that the bore in end piece is in alignment with test bore.

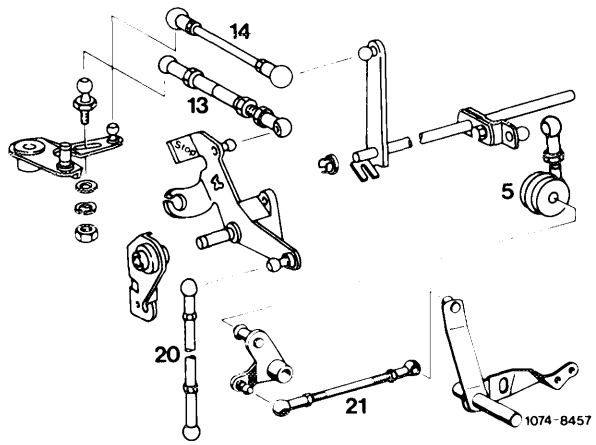
Remove adjusting sleeve (05). Connect control pressure rod (10) and adjust lock.



(USA) 1978/79 Federal and California version
(USA) 1980 Federal version

Length of regulating rods in mm

Free travel rod (13) in extended condition	154
Connecting rod (14)	140
Pushrod (20)	190
Pull rod (5)	68
Connecting rod (21)	122



Connecting rod (5 in Fig. item 4)	122

Auxiliary tool (spare part)

Adjusting sleeve (5 in Fig. item 5)		180 072 03 93

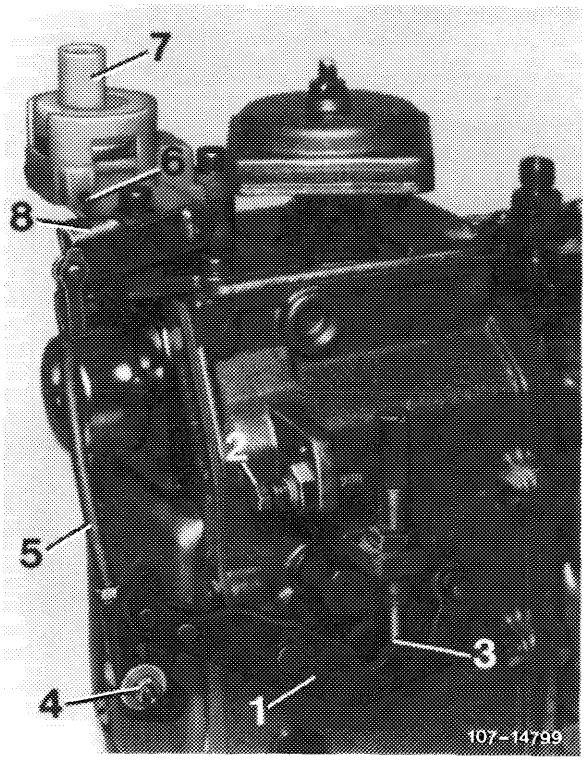
Adjustment

1 Check throttle linkage for easy operation and bends. Replace damaged parts, if any.

2 Disconnect all regulating rods.

3 Check whether regulating lever (1) of injection pump rests against idle speed stop (3).

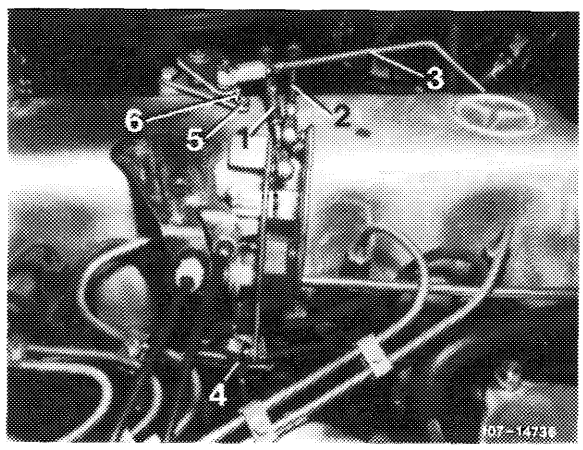
4 Check whether connecting rod (5) is correctly set. For this purpose, push regulating lever (1) to full load stop (2). Actuating lever (8) should have max. 0.5 mm play up to full load stop (6). Adjust connecting rod (5) with adjustable ball head (4), if required. Connecting rod (5) should be set to 122 mm, measured from center of ball socket to center of linkage.



1 Regulating lever
2 Full load stop
3 Idle speed stop
4 Adjustable ball head
5 Connecting rod
6 Full load stop on vacuum control valve
7 Vacuum control valve
8 Actuating lever for vacuum control valve

5 Plug-on adjusting sleeve (5).

6 Adjust free travel rod (1) in fully extended condition to 154 mm, measured from center to center of ball head and connect.



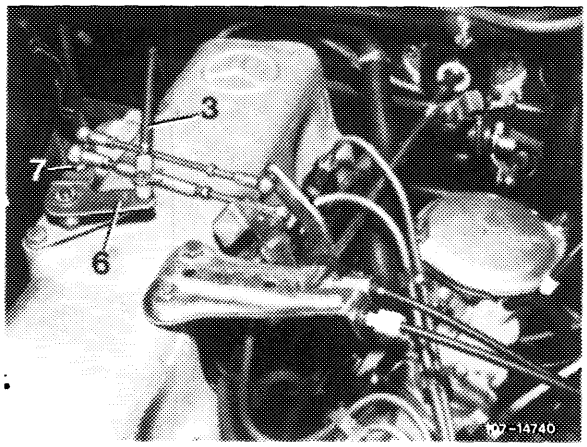
1 Free travel rod
2 Connecting rod
3 Control pressure rod
4 Pushrod
5 Adjusting sleeve
6 Regulating lever

7 Push regulating lever (1 and 6) against idle speed stop (Fig. item 3 and 6).

8 Adjust pushrod (4) in such a manner that rod can be connected free of tension (Fig. item 5).

9 Move regulating lever (6) to full load. Regulating lever (1) should also rest against full load stop (2) (Fig. item 3 and 6).

Adjust adjustable ball head (7) in slot, if required.



3 Control pressure rod
6 Regulating lever
7 Adjustable ball head

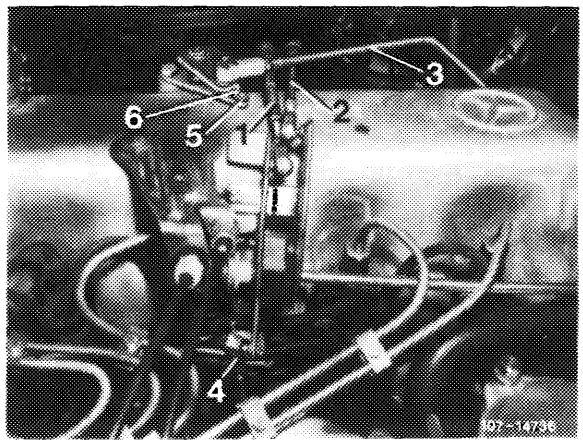
10 Adjust control pressure rod (3). Regulating lever (6) should rest against idle speed stop. Push control pressure rod carefully against idle stop on transmission, set to tension-free length, connect and secure.

Note: To facilitate assembly, make sure that trademark is facing in upward direction when connecting end piece.

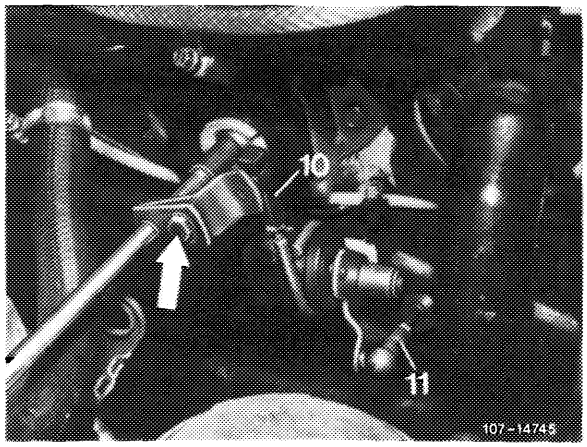
For longitudinal checkup, hold control pressure rod above test bore adjacent to bolt.

11 Remove adjusting sleeve (5).

12 Adjust connecting rod (2) to 140 mm, measured from center to center of ball head and connect.

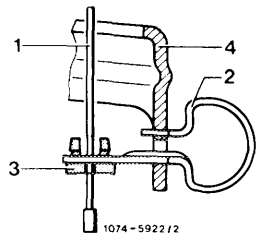


13 Check full load stop. With engine stopped, push accelerator pedal from inside vehicle up to stop on kickdown switch. Accelerator pedal and regulating lever on injection pump should rest against full load stop. Loosen adjusting screw (arrow), if required, adjust throttle linkage in such a manner that regulating lever rests against full load stop.



Attention!
If throttle linkage is not moving to full throttle, check whether the contour spring for idle speed adjuster has been correctly installed.

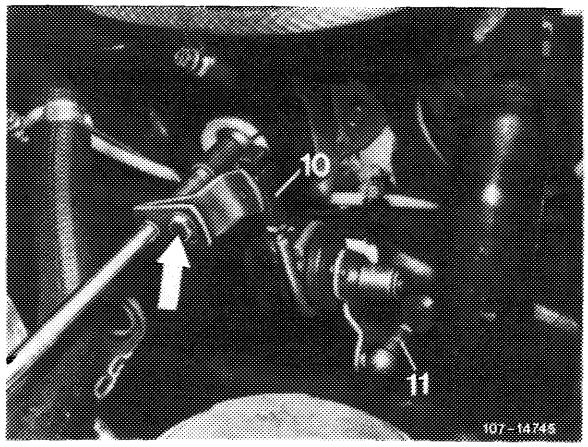
The idle speed adjuster is no longer installed starting model year 1980.



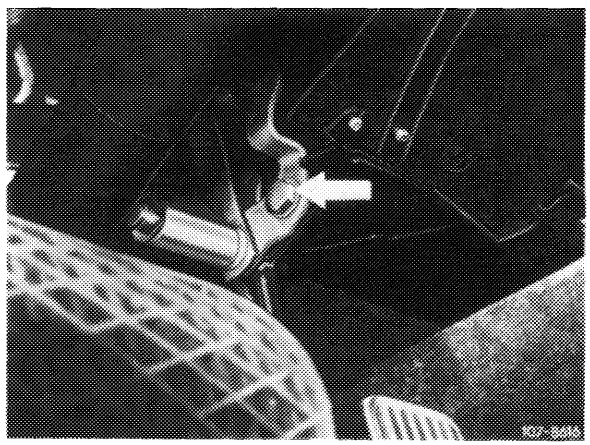
If full load or idle speed stop is not attained with this adjustment, set pull rod (10) from longitudinal regulating shaft to accelerator pedal to 68 mm, measured from center of ball socket to center of damping ring.

If the above adjustment does not attain full load or idle speed stop, set connecting rod (11) from guide lever engine compartment to accelerator pedal to specified length, measured from center to center of ball socket.

10 Pull rod
11 Connecting rod

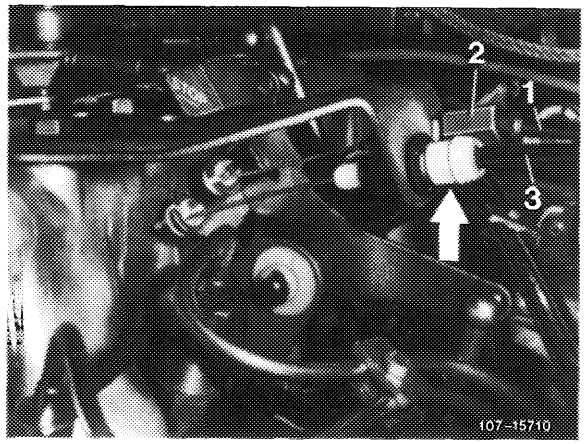


Adjust regulating lever inside vehicle, if required. For this purpose, loosen fastening screw (arrow), pull accelerator pedal slightly upward and tighten fastening screw again.

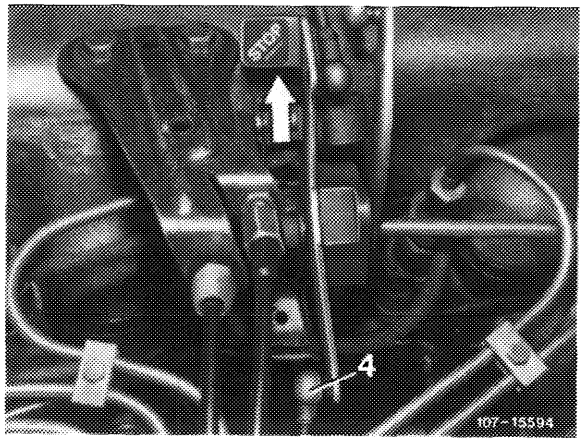


14 Adjust Bowden wire for cruise control. For this purpose, push shutoff lever up to stop. Bowden wire should rest free of tension against regulating lever.

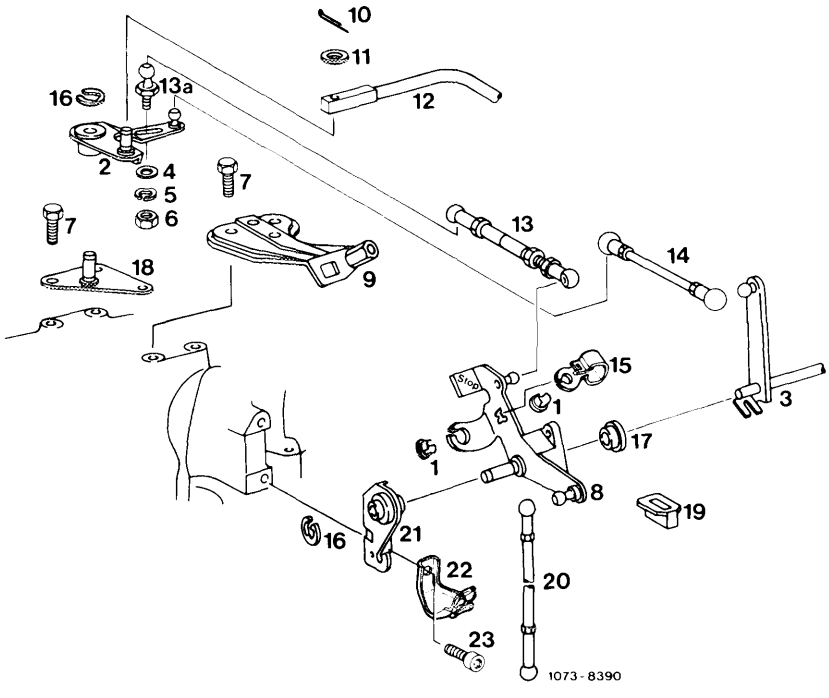
If required, adjust Bowden wire by means of adjusting nut (arrow). Release shutoff lever (idle speed position). In this position, Bowden wire has the required play.



15 Check operation of emergency stop button. For this purpose, run engine at idle, push emergency stop button (arrow). Engine should stop, adjust pushrod (4), if required.

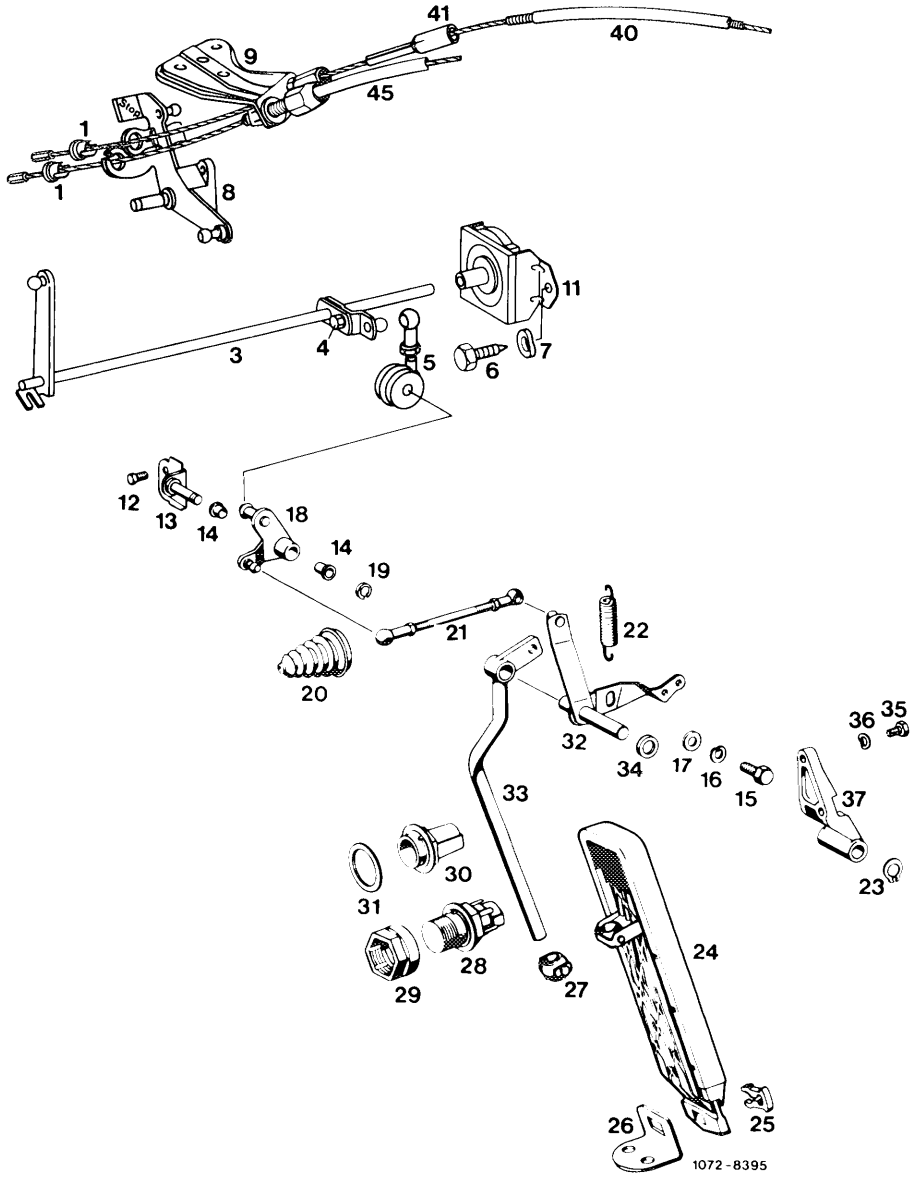


Engine regulation



1 Plastic sleeve
2 Guide lever
3 Longitudinal regulating shaft
4 Washer
5 Corrugated washer
6 Nut
7 Screw
8 Angle lever
9 Holder
10 Lock
11 Washer
12 Control pressure rod
13 Free travel rod
13a Screw-type ball head
14 Connecting rod
15 Contour spring
16 Lock
17 Plastic bushing
18 Holder
19 Plastic hub
20 Pushrod
21 Holder
22 Holder
23 Hex. socket screw

Chassis regulation



1 Plastic sleeve
3 Longitudinal regulating shaft
4 Hex. screw
5 Pull rod
6 Hex. screw
7 Corrugated washer
8 Angle lever
9 Holder
11 Holder for longitudinal regulating shaft
12 Hex screw
13 Bearing
14 Plastic bushing
15 Hex. screw
16 Corrugated washer
17 Washer
18 Guide lever
19 Lock
20 Rubber grommet
21 Connecting rod
22 Return spring
23 Lock
24 Accelerator pedal
25 Clip
26 Fastening plate
27 Joint
28 Kickdown switch
29 Adjusting nut
30 Full throttle stop
31 Washer
32 Guide lever
33 Accelerator pedal lever
34 Plastic spacing ring
35 Hex. screw
36 Corrugated washer
37 Bearing
40 Bowden wire for idle speed adjuster } no longer required starting model year 1980
41 Rubber sleeve }
45 Bowden wire for cruise control

(USA) 1980 California version

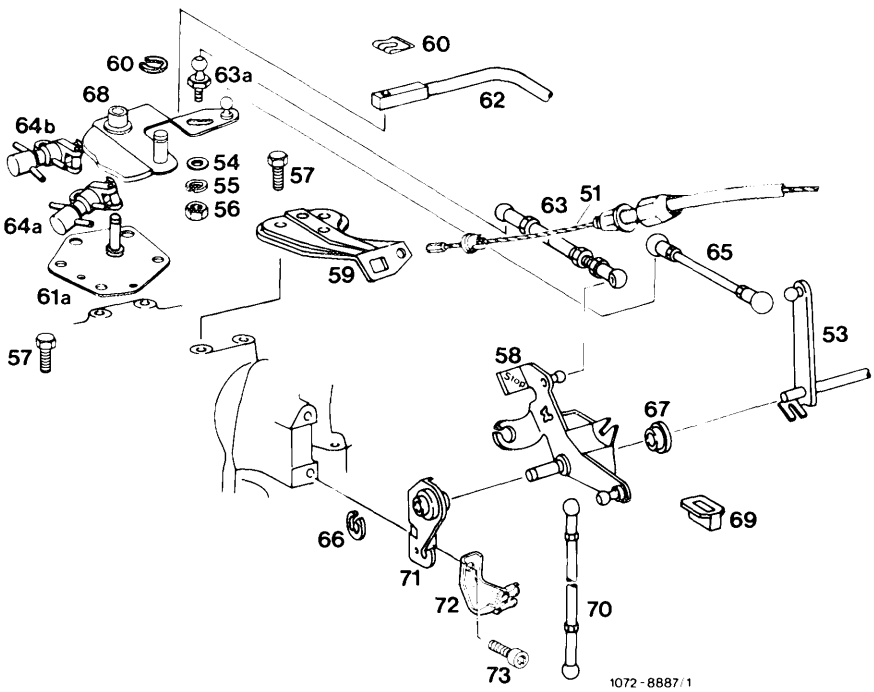
Length of regulating rods in mm

Free travel rod (63) in extended condition	154
Pull rod (65)	137
Pushrod (70)	184
Connecting rod (21 in Fig. chassis regulation)	122
Connecting rod (5 in Fig. item 4)	122
Pull rod (5 in Fig. chassis regulation)	68

Auxiliary tool (spare part)

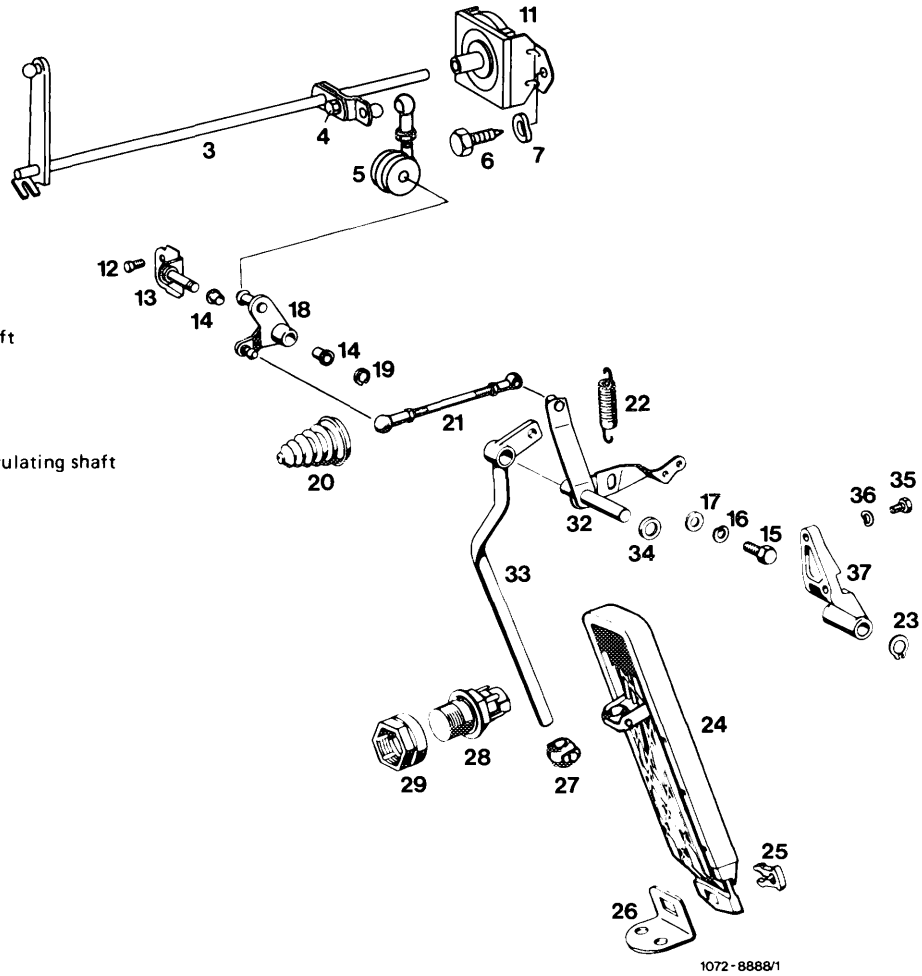
Adjusting sleeve		180 072 03 93

Engine regulation



51 Bowden wire for cruise control
53 Longitudinal regulating shaft
54 Washer
55 Corrugated washer
56 Nut
57 Screw
58 Angle lever
59 Holder
60 Lock
61a Holder
62 Control pressure rod
63 Free travel rod
63a Screw-type ball head
64a Switchover valve
64b Switchover valve
65 Pull rod
66 Lock
67 Plastic bushing
68 Guide lever
69 Plastic hub
70 Push rod
71 Holder
72 Holder
73 Hex. socket screw

Chassis regulation



3 Longitudinal regulating shaft
4 Hex. screw
5 Pull rod
6 Hex. screw
7 Corrugated washer
9 Holder
11 Bearing for longitudinal regulating shaft
12 Hex. screw
13 Bearing
14 Plastic bushing
15 Hex. screw
16 Corrugated washer
17 Washer
18 Guide lever
19 Lock
20 Rubber grommet
21 Connecting rod
22 Return spring
23 Lock
24 Accelerator pedal
25 Clip
26 Fastening plate
27 Joint
28 Kickdown switch
29 Adjusting nut
32 Guide lever
33 Accelerator pedal lever
34 Plastic spacing ring
35 Hex. screw
36 Corrugated washer
37 Bearing

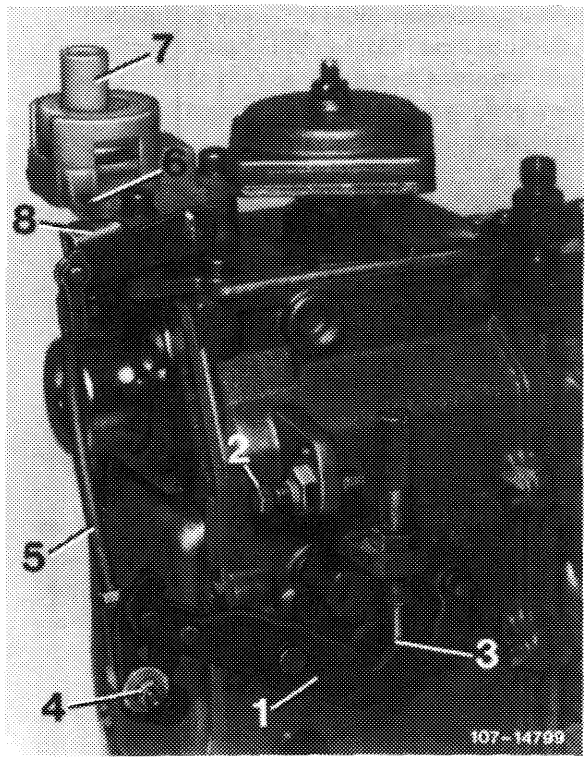
Adjustment

1 Check regulating linkage for easy operation and bends. Replace damaged parts, if any.

2 Disconnect all regulating rods.

3 Check whether regulating lever (1) of injection pump rests against idle speed stop (3).

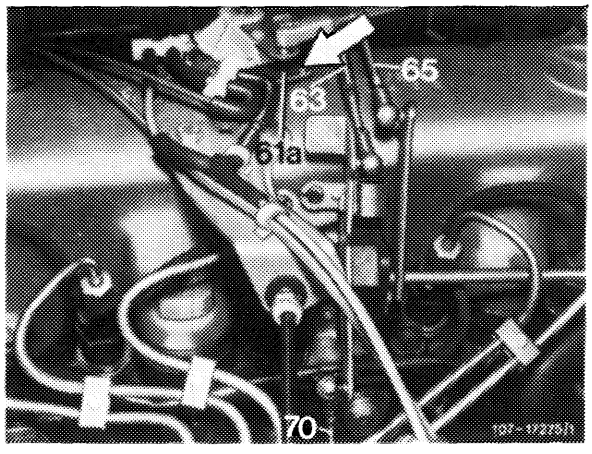
4 Check whether connecting rod (5) is correctly set. For this purpose, push regulating lever (1) to full load stop (2). Actuating lever (8) should have max. 0.5 mm play up to full load stop (6). Adjust connecting rod (5) with adjustable ball head (4), if required. Connecting rod (5) should be set to 122 mm, measured from center of ball socket to center of linkage.



1 Regulating lever
2 Full load stop
3 Idle speed stop
4 Adjustable ball head
5 Connecting rod
6 Full load stop on vacuum control valve
7 Vacuum control valve
8 Actuating lever for vacuum control valve

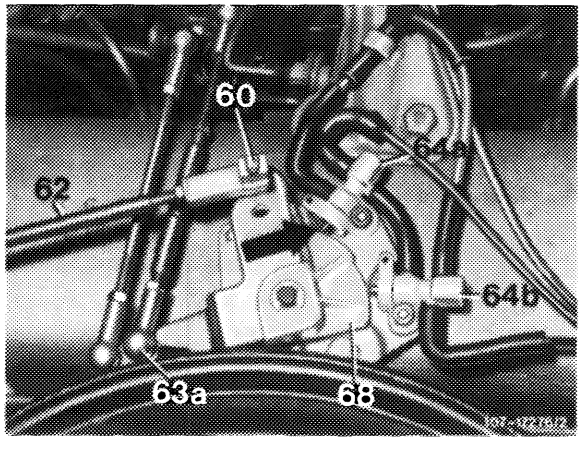
5 Plug adjusting sleeve on locating pin (arrow) of holder.

6 Set free travel rod (63) in fully extended condition to 154 mm, measured from center to center of ball head and connect.



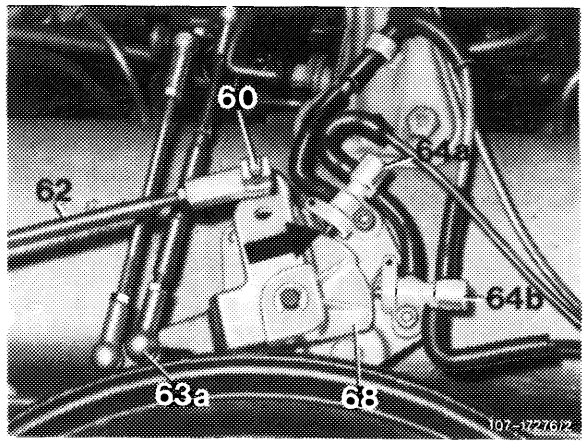
63 Free travel rod
65 Pull rod
70 Pushrod

7 Adjust pushrod (70) in such a manner that max. 0.5 mm play is available between control cam lobe of guide lever (68) and link (arrow) of switchover valve (64a). Regulating lever on injection pump should rest against idle speed stop.



62 Control pressure rod
63a Adjustable ball head
64a Switchover valve idle speed shutoff EGR
64b Switchover valve full throttle shutoff EGR
68 Guide lever
60 Lock

8 Push guide lever (68) in direction of full load. Adjust ball head (63a) in slot of guide lever (68) in such a manner that guide lever rests against adjusting sleeve and regulating lever on injection pump against full load stop.



9 Adjust control pressure rod (62). Regulating lever on injection pump should rest against idle speed stop (free travel rod should be extended). Carefully push control pressure rod on idle speed stop on transmission.

10 Hold control pressure rod (62) above check bore adjacent to bolt. Adjust end piece lengthwise in such a manner that bore in end piece is in agreement with test bore.

11 Connect control pressure rod (62), tighten counter-nut and secure with lock (60).

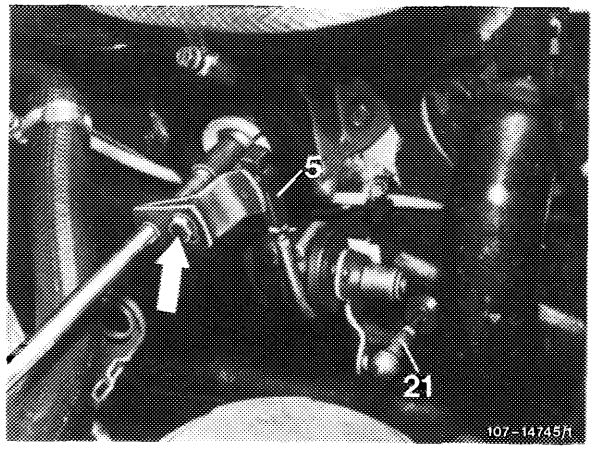
Note: When connecting end piece, trademark should face in upward direction.

12 Remove adjusting sleeve.

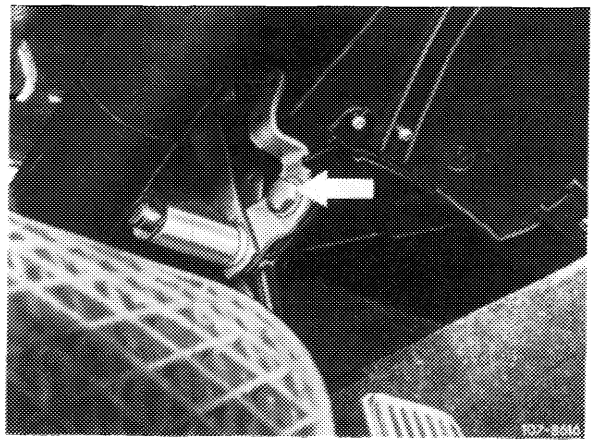
13 Adjust pull rod (65 in Fig. item 5) to 137 mm, measured from center to center of ball head and connect.

14 Check full throttle stop. With the engine stopped, push accelerator pedal from inside vehicle up to stop on kickdown switch. Accelerator pedal and regulating lever on injection pump should rest against full throttle stop. Loosen adjusting screw (arrow) if required. Adjust throttle linkage in such a manner that regulating lever rests against full throttle stop.

15 If full throttle stop is not attained with this adjustment, set pull rod (5) from longitudinal regulating shaft to accelerator pedal to 68 mm, measured from center of ball socket to center of damping ring.

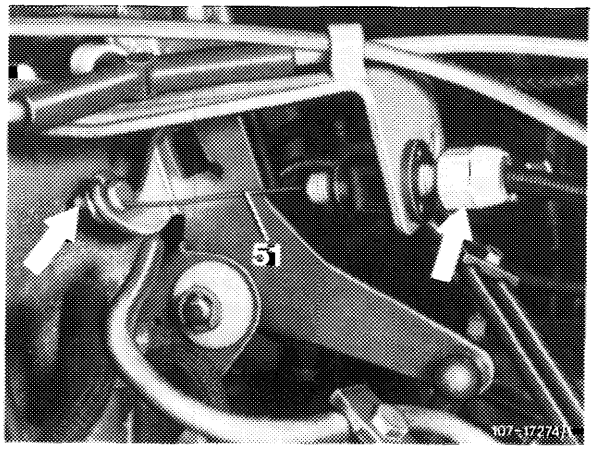


16 If the full throttle or idle speed stop is not attained with the above adjustment, set connecting rod (21) from guide lever engine compartment to accelerator pedal to 122 mm, measured from center to center of ball socket. Adjust regulating lever inside vehicle, if required. For this purpose, loosen fastening screw (arrow), pull accelerator pedal slightly up and tighten fastening screw again.



17 Set Bowden wire for cruise control. For this purpose, push shutoff lever up to stop. Bowden wire should rest free of play against regulating lever.

If required, adjust Bowden wire by means of adjusting screw (arrow). Release shutoff lever (idle speed position). In this position, Bowden wire has the required play (arrow).



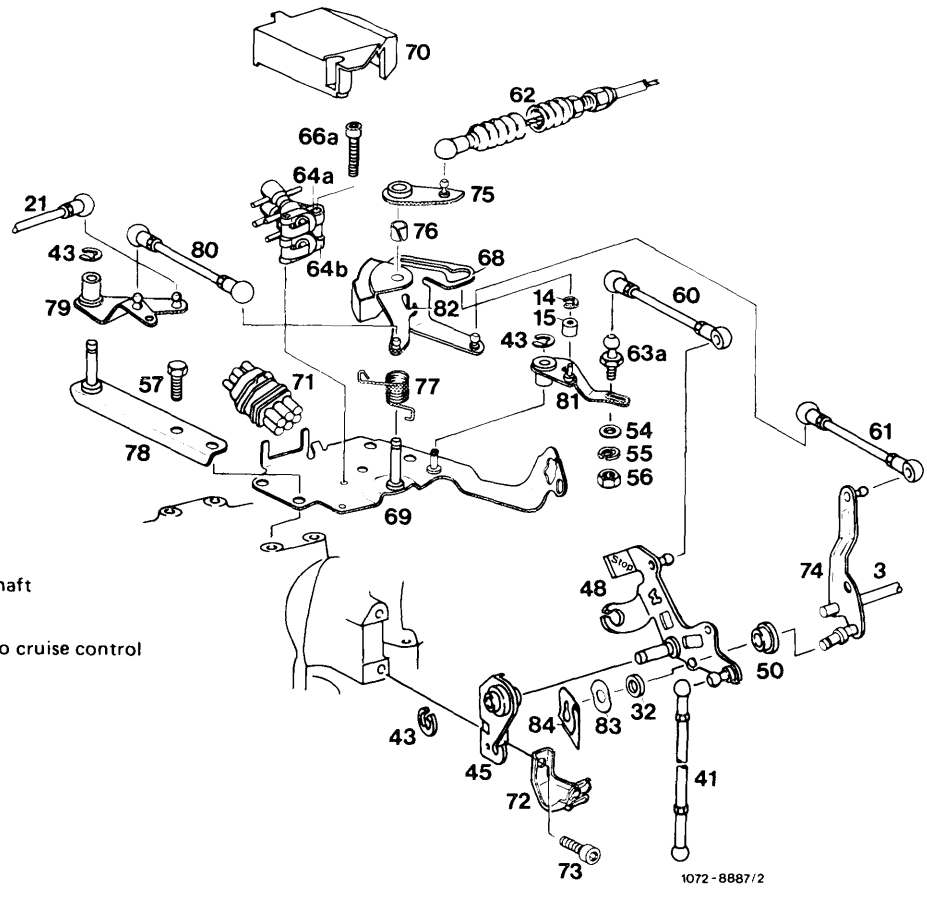
51 Bowden wire for cruise control

(USA) starting 1981 Federal and California version

Length of regulating rods in mm

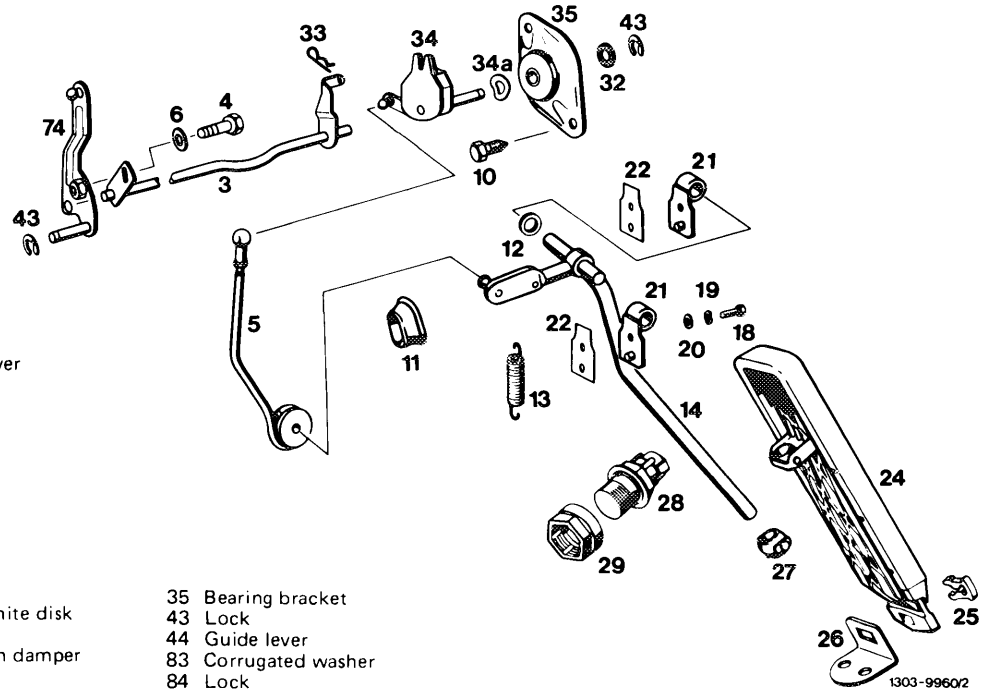
Pushrod (60)	160
Pull rod (61)	100
Pushrod (41)	184
Pushrod (5 in Fig. chassis regulation)	222
Connecting rod (80)	196
Connecting rod (5 in Fig. item 4)	122

Engine regulation



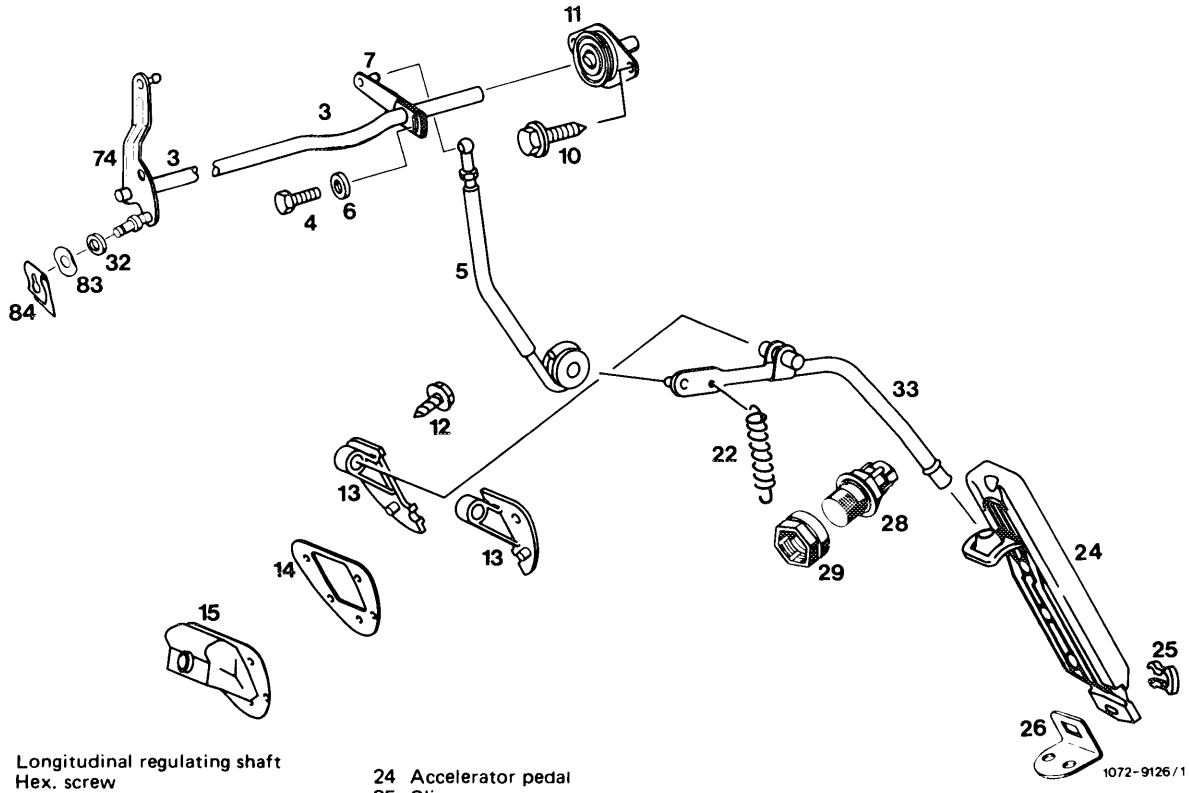
3 Longitudinal regulating shaft
14 Lock
15 Roller
21 Connecting rod for electro cruise control
32 Plastic spacing ring
41 Pushrod
42 Lock
44 Hex. screw
45 Bearing
47 Hex. socket screw
48 Angle lever
50 Plastic bushing
54 Washer
55 Spring washer
56 Nut
57 Screw
60 Pushrod
61 Pull rod
62 Bowden wire for automatic transmission
63a Adjustable ball head
64a Switchover valve idle speed shutoff – EGR
64b Switchover valve full throttle shutoff – EGR
66a Hex. socket screw
68 Guide lever
69 Valve plate
70 Cap
71 Central plug
72 Cable holder
73 Hex. socket screw
74 Guide lever
75 Drag lever
76 Plastic bushing
77 Spring
78 Holder
79 Guide lever
80 Connecting rod
81 Lever
82 Stop
83 Corrugated washer
84 Lock

Chassis regulation
Model 123.1



3 Longitudinal regulating shaft
4 Adjusting screw
5 Pushrod
6 Washer
10 Screw
11 Rubber grommet
12 Plastic spacing ring
13 Return spring
14 Accelerator pedal lever
18 Hex. screw
19 Corrugated washer
20 Washer
21 Bearing
22 Gasket
24 Accelerator pedal
25 Clip
26 Fastening plate
27 Joint
28 Kickdown switch
29 Adjusting nut
32 Copper netting-graphite disk
33 Lock
34 Regulating lever with damper
34a Corrugated washer
35 Bearing bracket
43 Lock
44 Guide lever
83 Corrugated washer
84 Lock

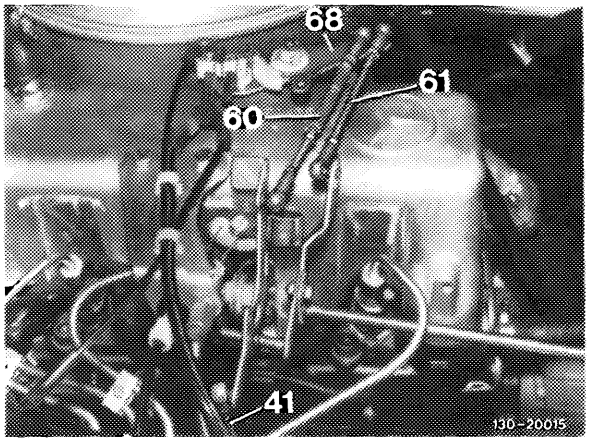
Model 126.120



3 Longitudinal regulating shaft
4 Hex. screw
5 Pushrod
6 Washer
7 Guide shaft
10 Hex. screw
11 Bearing for longitudinal regulating shaft
12 Hex. screw
13 Bearing
14 Intermediate plate
15 Rubber sleeve
22 Return spring
24 Accelerator pedal
25 Clip
26 Fastening plate
28 Kickdown switch
29 Adjusting nut
32 Plastic spacing ring
33 Accelerator pedal lever
74 Guide lever
83 Corrugated washer
84 Lock

Note

Two switchover valves (64a, 64b) are mounted on a valve plate (69) to control EGR. Connection is made by means of a central plug (71). A cap (70) is fitted to prevent dirt from settling on plastic running surface.



64a Switchover valve idle speed shutoff-EGR
64b Switchover valve full throttle shutoff-EGR
68 Guide lever
69 Valve plate
70 Cap
71 Central plug

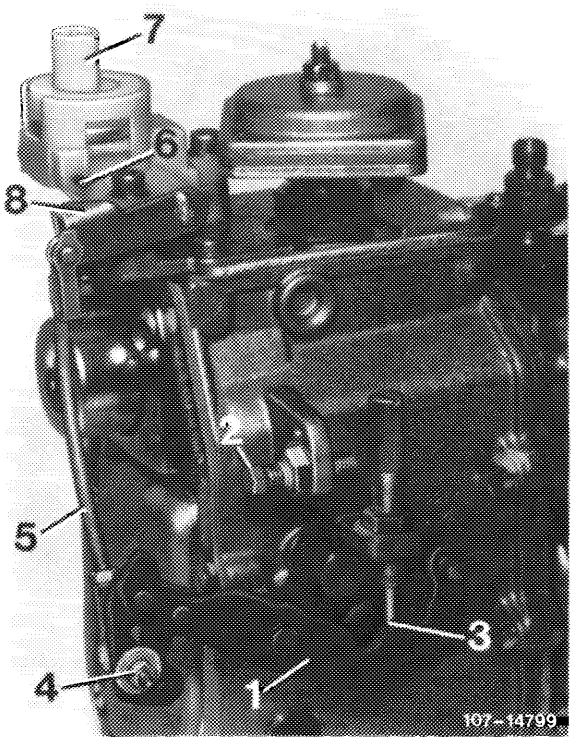
Adjustment

1 Check throttle linkage for easy operation and bends. Replace damaged parts.

2 Disconnect all regulating rods and bowden wire (62).

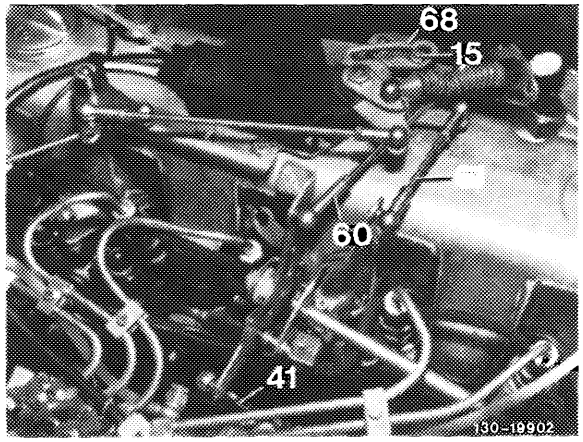
3 Check whether regulating lever (1) of injection pump rests against idle speed stop (3).

4 Check whether connecting rod (5) is correctly set. For this purpose, push regulating lever (1) to full throttle stop (2). Actuating lever (8) should have max. 0.5 mm play up to full throttle stop (6). Adjust connecting rod (5) with adjustable ball head (4), if required.
The connecting rod (5) should be set to 122 mm, measured from center of ball socket to center of linkage.



1 Regulating lever
2 Full throttle stop
3 Idle speed stop
4 Adjustable ball head
5 Connecting rod
6 Full throttle stop on vacuum control valve
7 Vacuum control valve
8 Actuating lever for vacuum control valve

5 Set pushrod (41) to 184 mm measured from center to center of ball socket and connect.



6 Adjust guide lever (68):

a) Idle speed position: Set pushrod (60) in such a manner that roller (15) in guide lever (68) rests free of tension against end stop.

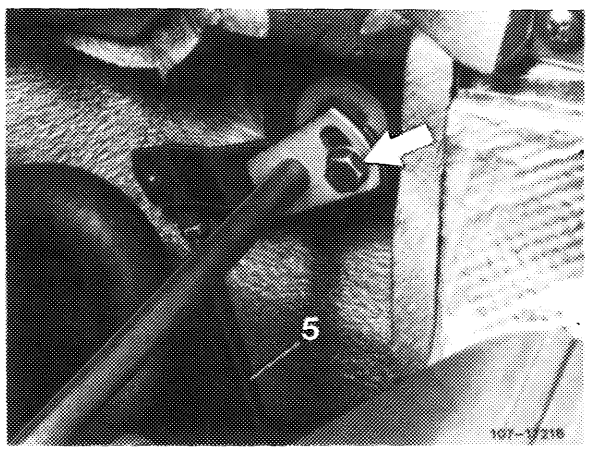
b) Full throttle position: Push guide lever (68) to full throttle, roller (15) should have approx. 1 mm distance in guide lever (68).

Set adjustable ball head (63a), if required. When adjusting ball head, readjust pushrod (41). (Fig. engine regulation).

Regulating lever on injection pump should also rest against full throttle stop.

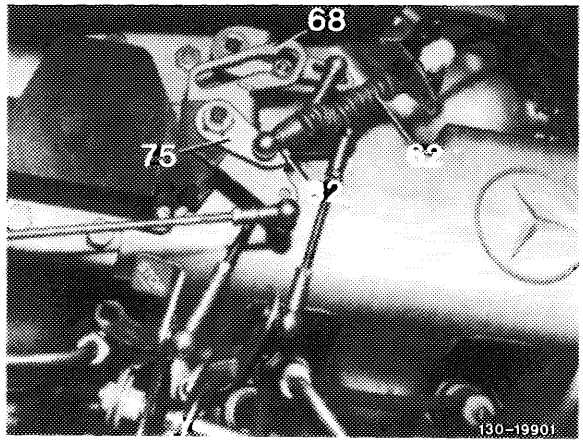
7 Check full throttle stop. With engine stopped, step on accelerator pedal from inside vehicle up to stop on kickdown switch. Regulating lever on injection pump should rest against full throttle stop. Loosen adjusting screw (arrow), if required. Set throttle linkage in such a manner that regulating lever rests against full throttle stop.

If full throttle or idle speed stop is not attained with this adjustment, set pushrod (5) from longitudinal regulating shaft to accelerator pedal to 222 mm, measured from center of ball socket to center of damping ring.

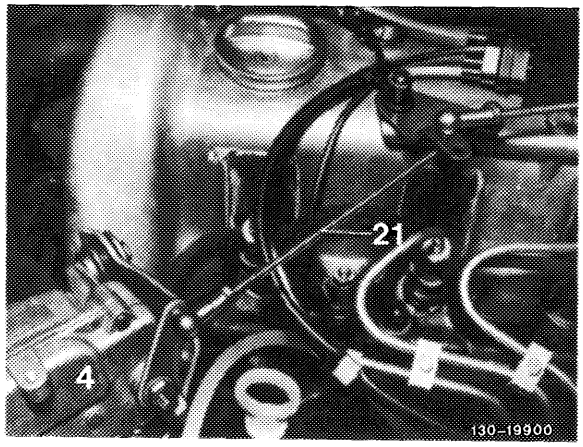


8 Set pull rod (61) to 100 mm, measured from center to center of ball socket and connect.

9 Adjust Bowden wire (62). Guide lever (68) should rest against idle speed stop and drag lever (75) against stop (82). Pull Bowden wire (62) against noticeable idle speed stop on transmission, adjust to tension-free length and connect.



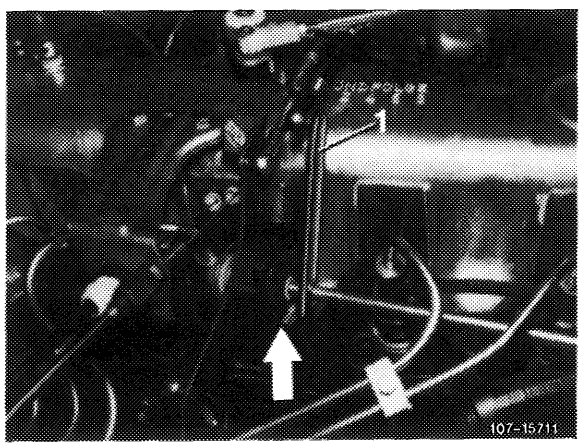
10 Adjust cruise control. Check whether actuator rests against idle speed stop of cruise control. For this purpose, disconnect connecting rod (21) and push lever of actuator (4) clockwise to idle speed stop. When attaching connecting rod (21), make sure that lever of actuator is pushed away from idle speed stop by approx. 1 mm. Adjust connecting rod, if required.



Note

When removing transmission, remove longitudinal regulating shaft, so that bearing on front wall is not damaged by tilting of engine.

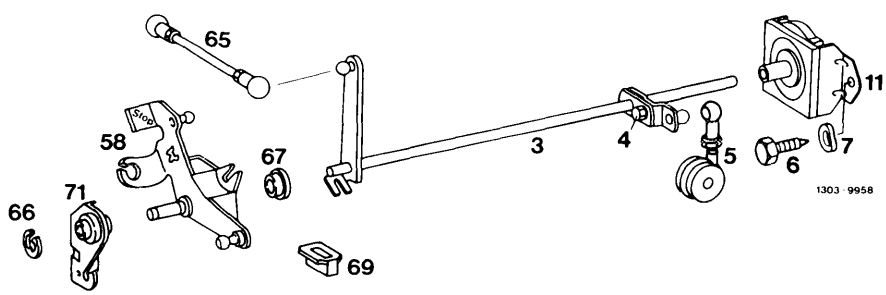
A. Model 116.120



Removal

1 Disconnect regulating rods.

2 Turn longitudinal regulating shaft to the left until groove disengages from clip. Push longitudinal regulating shaft to the rear and remove.

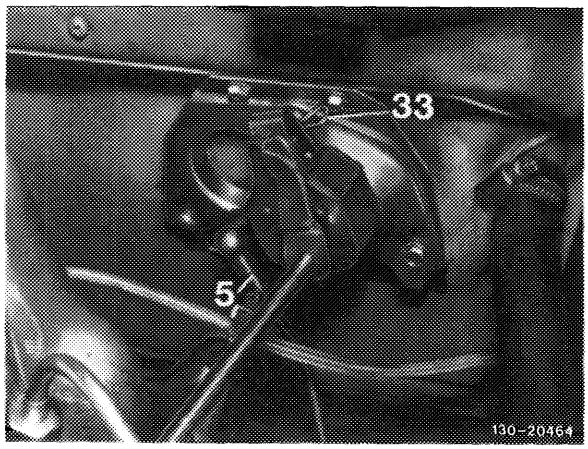


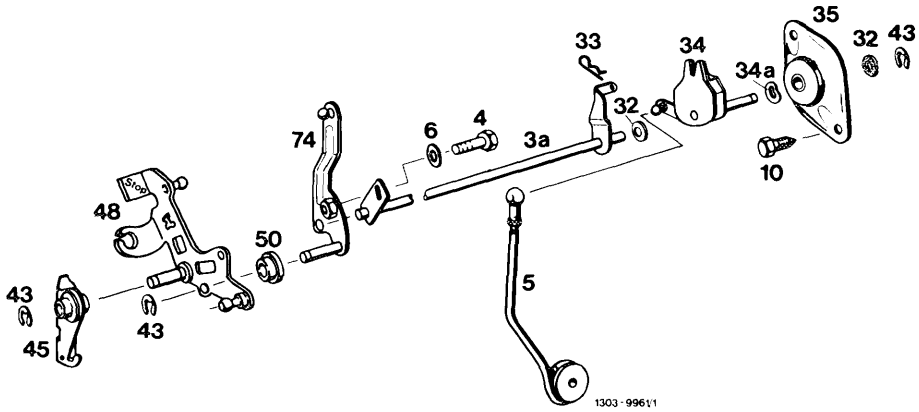
Installation

4 For installation proceed vice versa. Grease bearing points as well as ball sockets of regulation with Molykote Longterm 2.

5 Adjust throttle linkage (30–300).

B. Model 123.1





Removal

1 Remove regulating rod (5) and lock (33).

2 Slide longitudinal regulating shaft in forward direction out of bearing on front wall. Then remove toward the rear.

Installation

3 For installation proceed vice versa. Grease bearing points as well as ball sockets of regulation with Molykote Longterm 2.

4 Adjust throttle linkage (30–300).

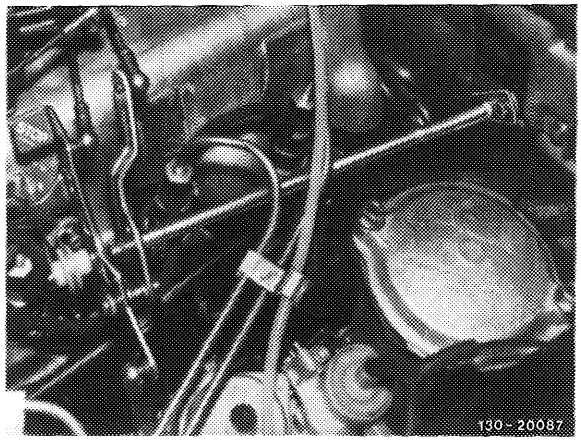
C. Model 126.120

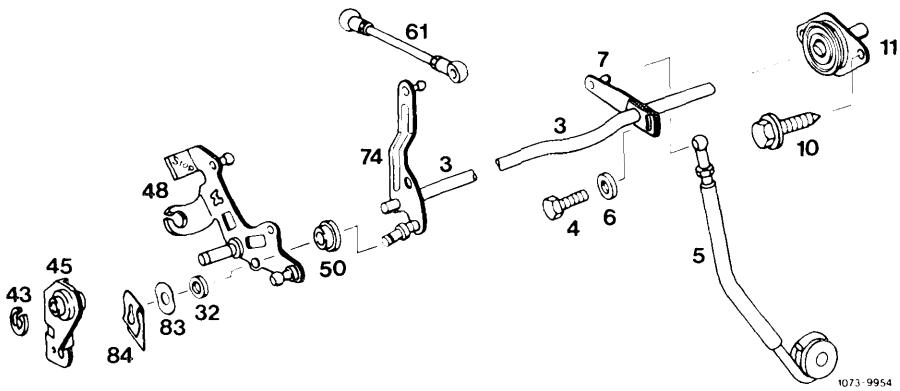
Removal

1 Disconnect regulating rods (5 and 61).

2 Remove lock (84), corrugated washer (83) and plastic spacing ring (32).

3 Push longitudinal regulating shaft (3) to the rear and remove.





Installation

4 For installation proceed vice versa. Grease bearing points as well as ball sockets of regulation with Molykote Longterm 2.

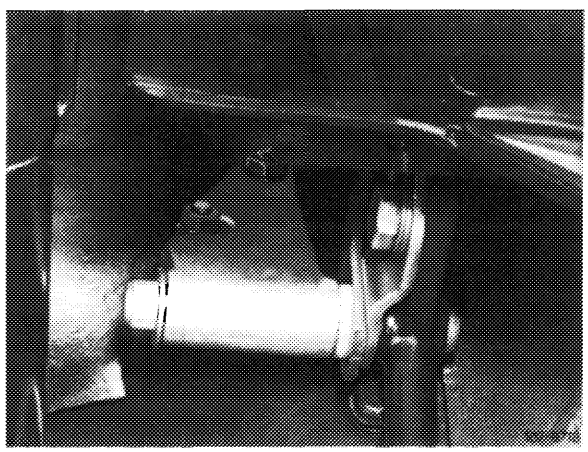
5 Adjust throttle linkage (30–300).

A. Model 116.120

Adjusting values in mm

Length of connecting rod (11) from accelerator pedal to guide lever	122
Length of pushrod (10) from longitudinal regulating shaft to accelerator pedal	60

Removal



1 Remove accelerator pedal (30–330).

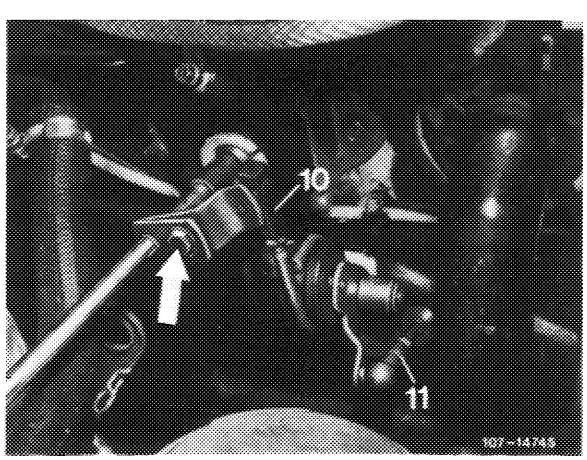
2 Disconnect connecting rod.

3 Disconnect return spring, unscrew fastening nuts from bearing bracket and remove regulating shaft together with bearing bracket.

Installation

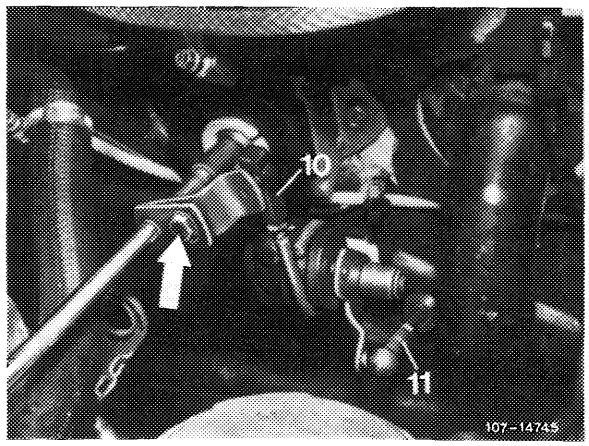
4 For installation proceed vice versa, while connecting return spring to inside hole. Grease bearing points as well as ball sockets of regulation with Molykote Longterm 2.

Adjustment

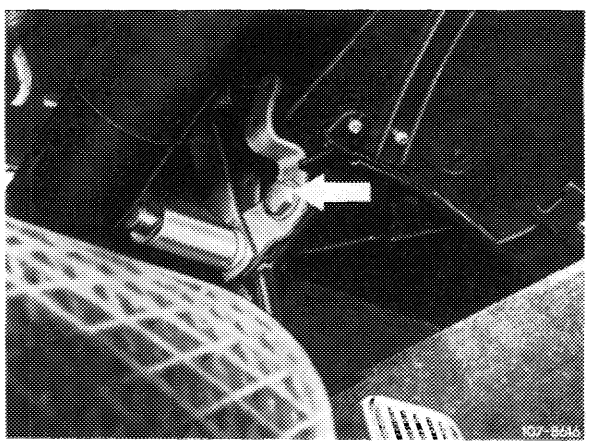


5 With engine stopped, step on accelerator pedal from inside vehicle up to stop on kickdown switch. Regulating lever on injection pump should rest against full load stop. Loosen adjusting screw (arrow), if required, adjust throttle linkage in such a manner that regulating lever rests against full throttle stop.

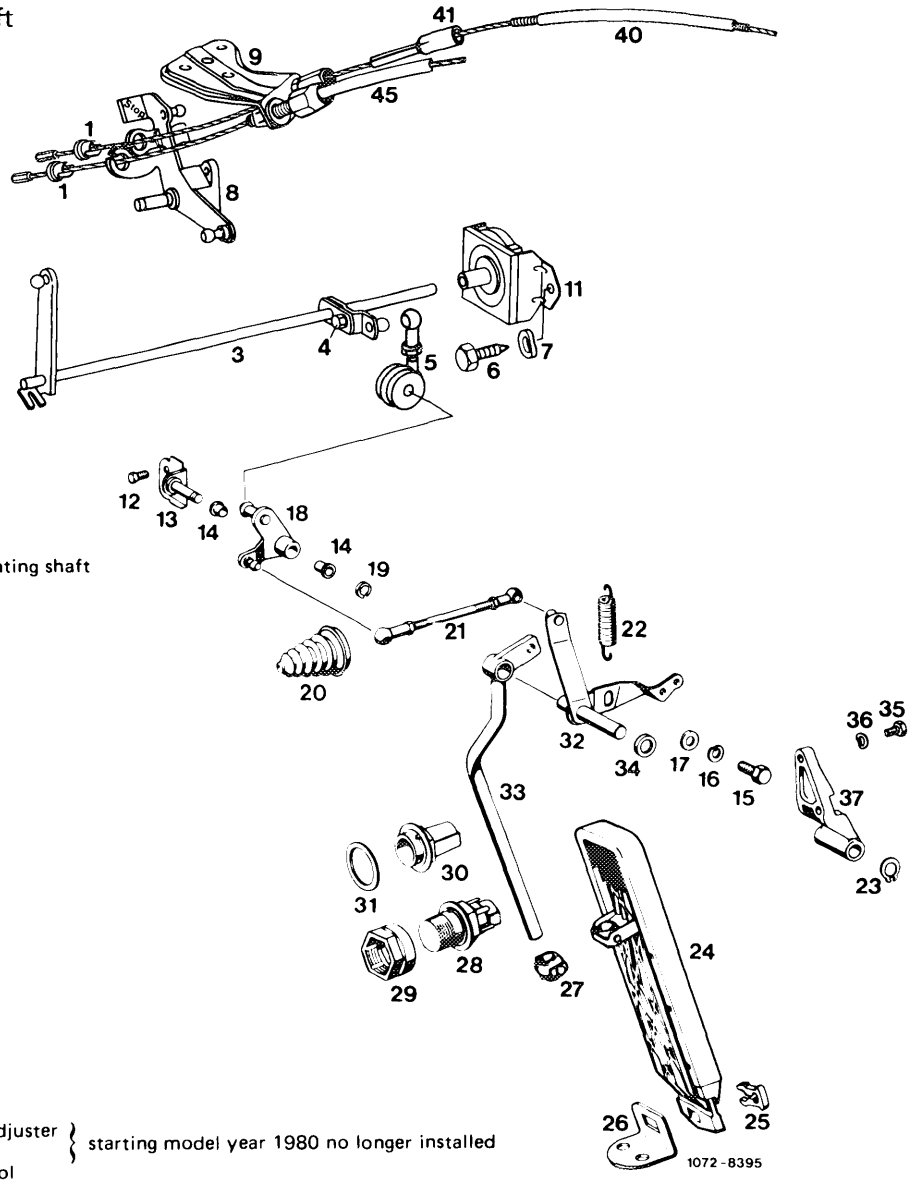
If the full load or idle speed stop is not attained with this adjustment, set pushrod (10) from longitudinal regulating shaft to accelerator pedal to 68 mm, measured from center of ball socket to center of damping ring.



If the full load or idle speed stop is not attained with the above adjustment, set connecting rod (11) from guide lever engine compartment to accelerator pedal to 122 mm, measured from center of ball socket to center of ball socket. Adjust regulating lever inside vehicle, if required. For this purpose, loosen fastening screw (arrow), slightly release accelerator pedal and tighten fastening screw again.



Front wall regulating shaft model 116.120



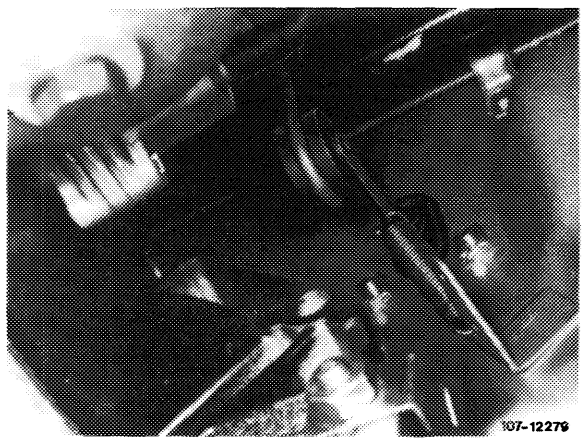
1 Plastic sleeve
3 Longitudinal regulating shaft
4 Hex. screw
5 Pull rod
6 Hex. screw
7 Corrugated washer
8 Angle lever
9 Holder
11 Holder for longitudinal regulating shaft
12 Hex. screw
13 Bearing
14 Plastic bushing
15 Hex. screw
16 Corrugated washer
17 Washer
18 Guide lever
19 Lock
20 Rubber grommet
21 Connecting rod
22 Return spring
23 Lock
24 Accelerator pedal
25 Clip
26 Fastening plate
27 Joint
28 Kickdown switch
29 Adjusting nut
30 Full throttle stop
31 Washer
32 Guide lever
33 Accelerator pedal
34 Plastic spacing ring
35 Hex. screw
36 Corrugated washer
37 Bearing
40 Bowden wire for idle speed adjuster
41 Rubber sleeve
} starting model year 1980 no longer installed
45 Bowden wire for cruise control

Length of regulating rod in mm	
Pushrod (5 in Fig. item 5)	200

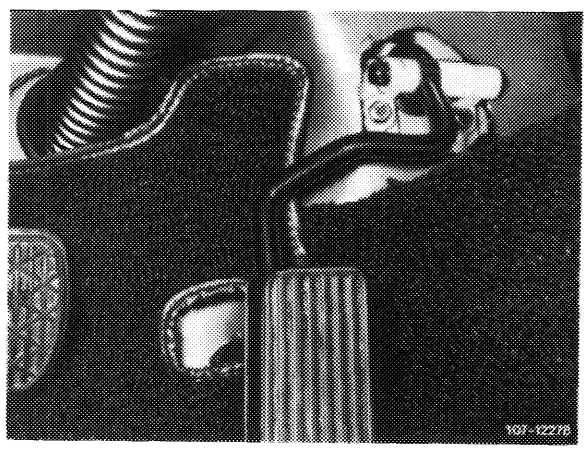
Removal

1 Remove accelerator pedal (30–330).

2 Disconnect return spring and pushrod.



3 Unscrew plastic bearing inside vehicle and remove shaft by turning.



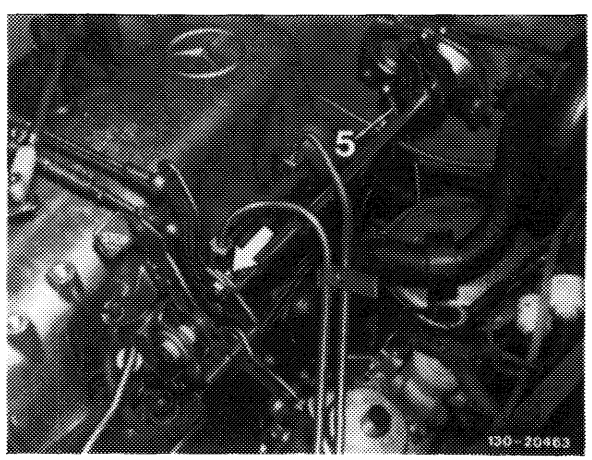
Installation

4 For installation proceed vice versa, while connecting return spring to inside hole.

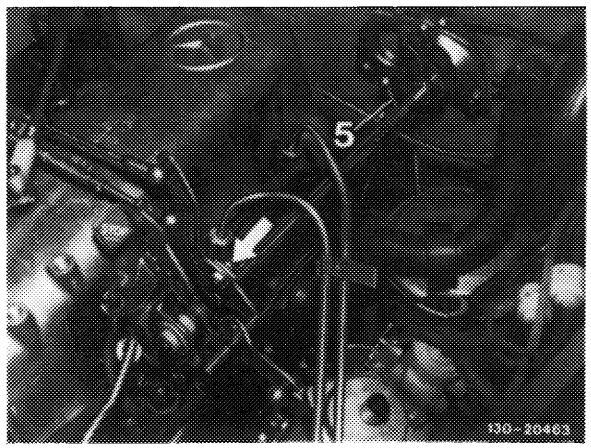
Grease bearing points as well as ball sockets of regulation with Molykote Longterm 2.

Adjustment

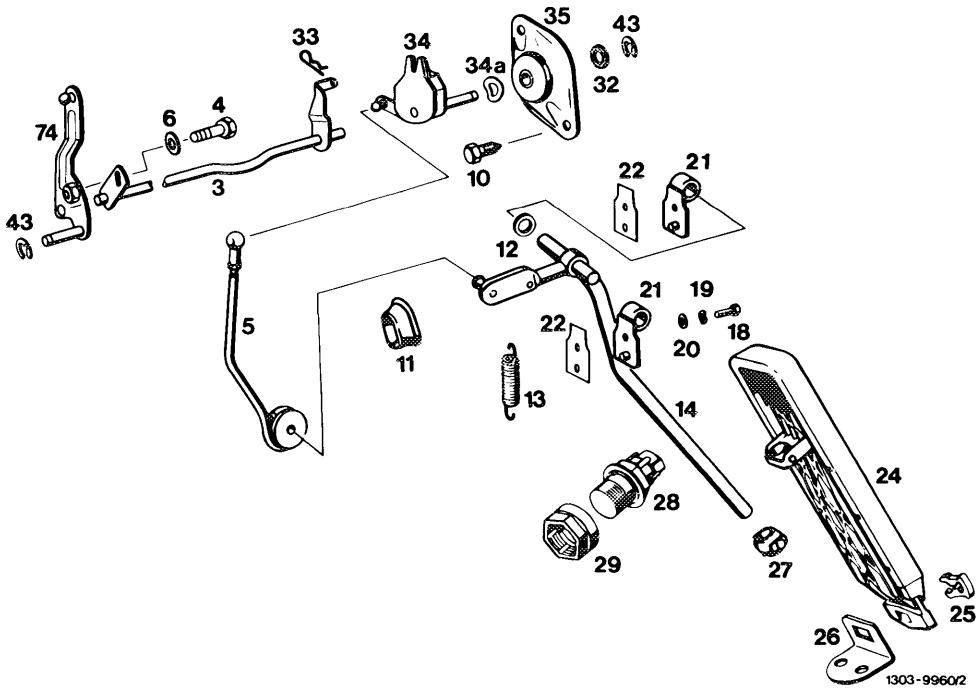
5 With engine stopped, step on accelerator pedal from inside vehicle up to stop on kickdown switch. Regulating lever on injection pump should rest against full load stop. Loosen adjusting screw (arrow), if required. Set throttle linkage in such a manner that regulating lever rests against full throttle stop.



If the full load or idle speed stop is not attained with this adjustment, set pushrod (5) from longitudinal regulating shaft to accelerator pedal to 200 mm, measured from center of ball socket to center of damping ring and connect.



Front wall regulating shaft model 123.1



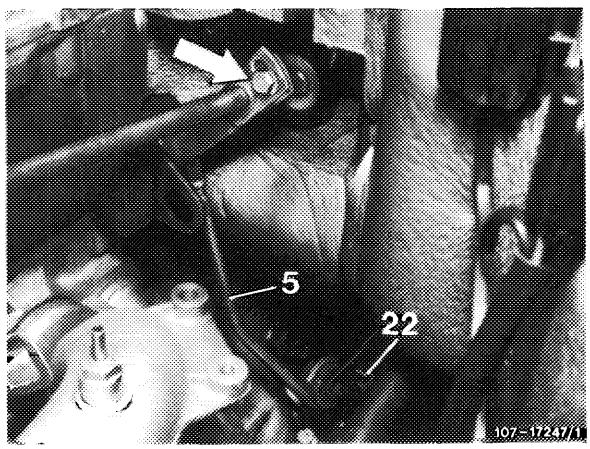
Adjusting values in mm

Length of pushrod (5) from longitudinal regulating shaft to accelerator pedal	222

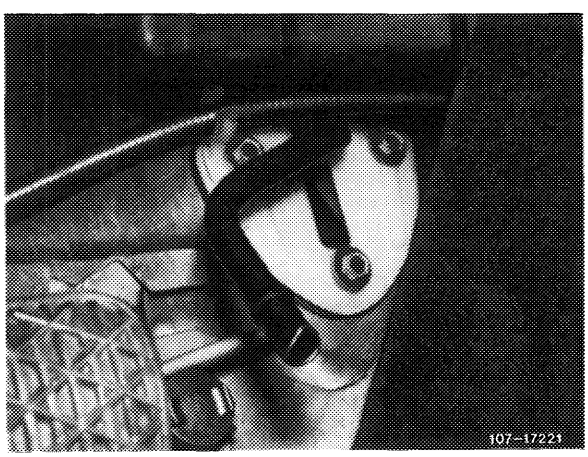
Removal

1 Disconnect return spring (22) and force-off connecting rod (5).

2 Remove accelerator pedal (30–330).



3 Unscrew fastening screws on bearing bracket, remove bearing bracket and accelerator pedal lever.

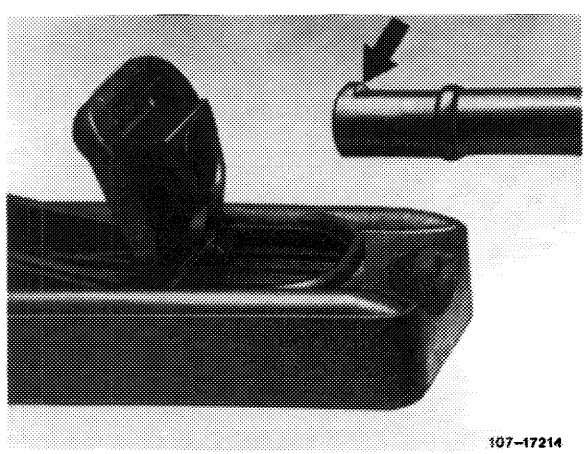


Installation

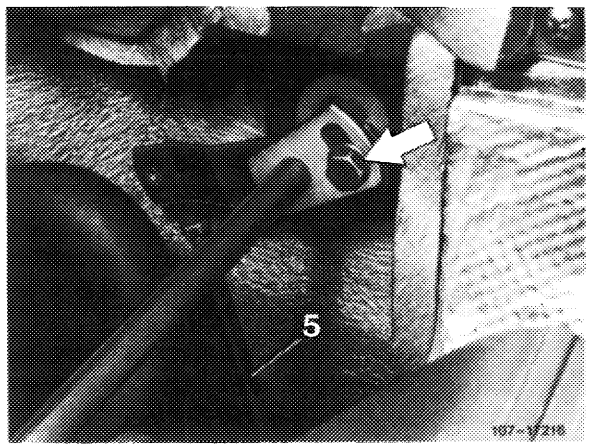
4 For installation proceed vice versa.

Grease bearing points as well as ball sockets of regulation with Molykote Longterm 2.

The connection from accelerator pedal lever to accelerator is maintenance-free and requires no lubrication.



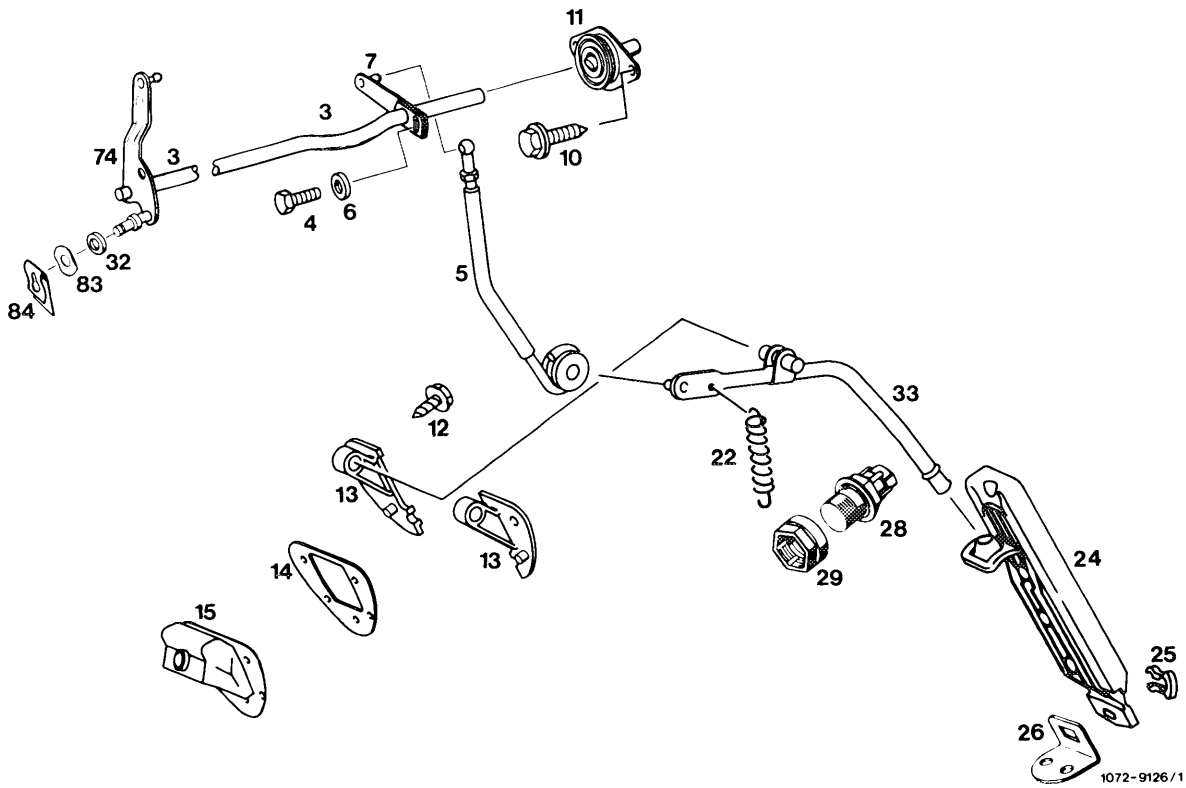
Adjustment



5 With engine stopped, step on accelerator pedal from inside vehicle up to stop on kickdown switch. Regulating lever on injection pump should rest against full load stop. Loosen adjusting screw (arrow), if required. Adjust throttle linkage in such a manner that regulating lever rests against full load stop.

If the full throttle or idle speed stop is not attained with this adjustment, set pushrod (5) from longitudinal regulating shaft to accelerator pedal to 222 mm, measured from center of ball socket to center of damping ring.

Front wall regulating shaft model 126.120

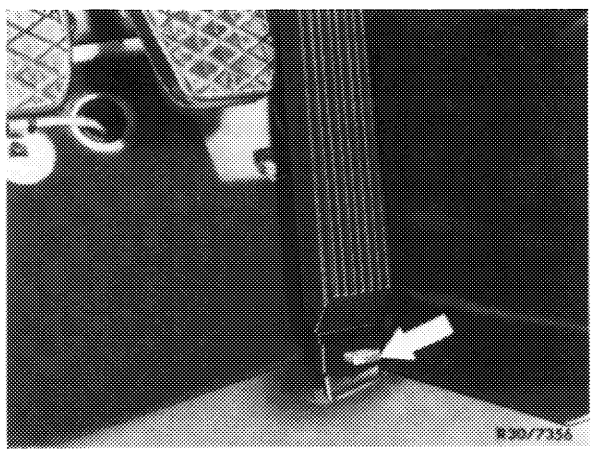


3 Longitudinal regulating shaft
4 Hex. screw
5 Pushrod
6 Washer
7 Guide lever
10 Hex. screw
11 Bearing for longitudinal regulating shaft
12 Hex. screw
13 Bearing
14 Intermediate plate
15 Rubber sleeve
22 Return spring
24 Accelerator pedal
25 Clip
26 Fastening plate
28 Kickdown switch
29 Adjusting nut
32 Plastic spacing ring
33 Accelerator pedal lever
74 Guide lever
82 Corrugated washer
84 Lock

A. Model 116.120 and model 123.193 1st version

Removal

1 Compress spreader clip (arrow) behind accelerator pedal and pull out.



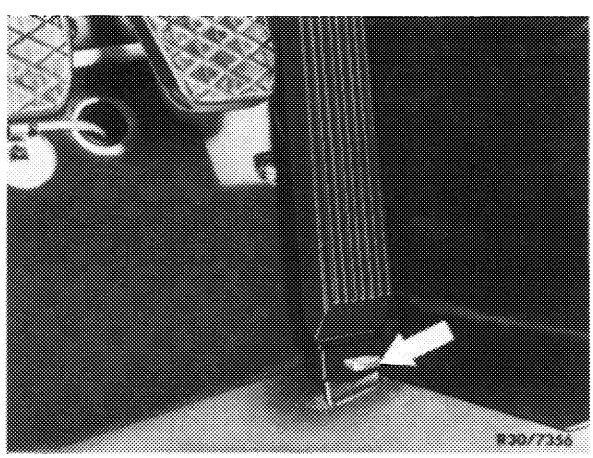
Installation

2 During installation, make sure that spreader clip is reliably engaging.

B. Model 123.193 2nd version and model 126.120

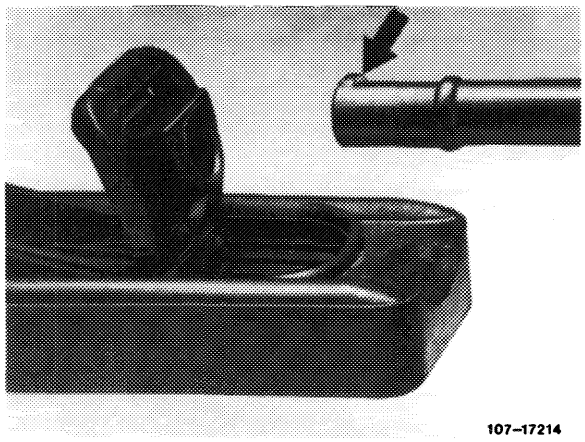
Removal

1 Compress spreader clip (arrow) behind accelerator pedal and pull out.



2 Slide accelerator pedal in upward direction and rotate by 180°.

3 Pull off accelerator pedal in downward direction, lug (arrow) on accelerator pedal lever should be in alignment with groove in accelerator pedal.



107–17214

Installation

4 For installation proceed vice versa, making sure that spreader clip is reliably engaging.

The connection from accelerator pedal lever to accelerator pedal is maintenance-free and requires no lubrication.

A. Model 116 (USA) 1978–1980

Filling capacities in liters	
Full readout	approx. 82
Warning lamp – reserve	approx. 14

Tightening torques	Nm
Fastening nuts for fuel tank	17–25
Immersion tube indicator	35–43
Fuel filter	
Suction hose	24–32

Conventional tool	
Torque wrench double arm, 1/2" square, 15–65 Nm	e.g. Wille, D–5600 Wuppertal order no. 72 Nm/6

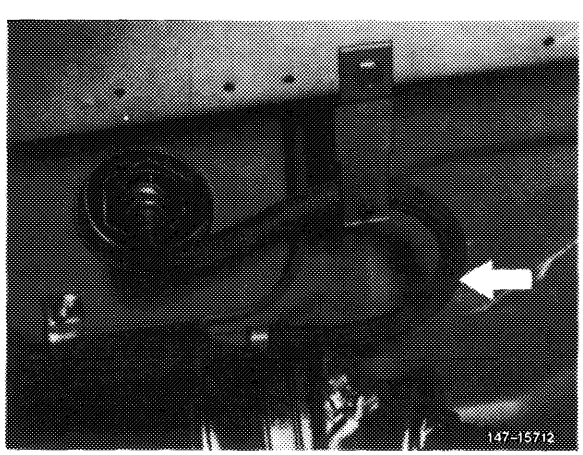
Attention!
When removing fuel tank, pay attention to **safety rules.**

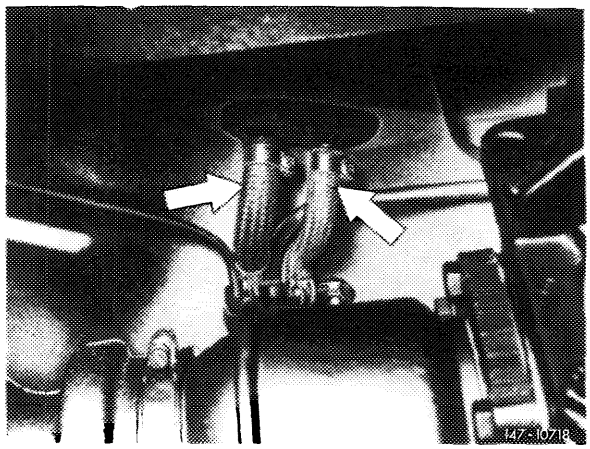
Removal

1 Disconnect ground connection line on battery.

2 Drain fuel tank. Carefully pump off fuel, so that no residual fuel remains in fuel tank.

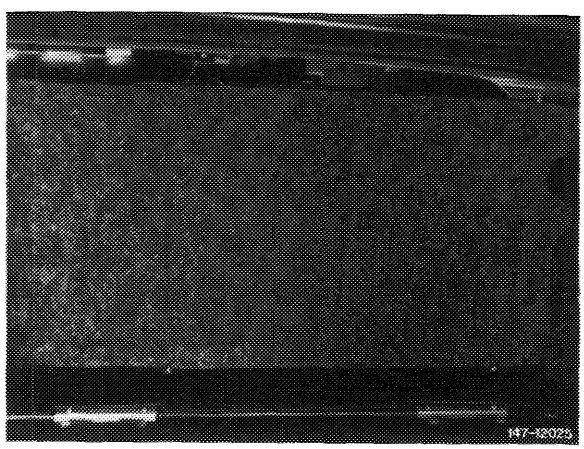
3 Loosen suction hose, return hose and vent hose (arrows). Collect residual fuell still in hoses. Close hoses and connections.





4 Remove trunk mat from trunk.

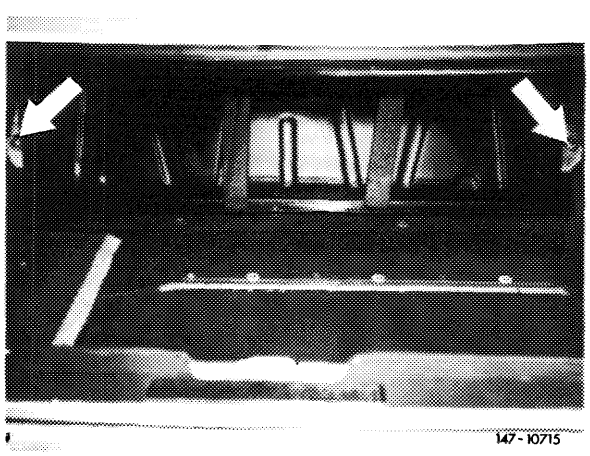
5 Remove rear wall for fuel tank cover.



6 Unscrew fastening nuts (arrows).

7 Pull out fuel tank slightly and pull off coupler for fuel gauge.

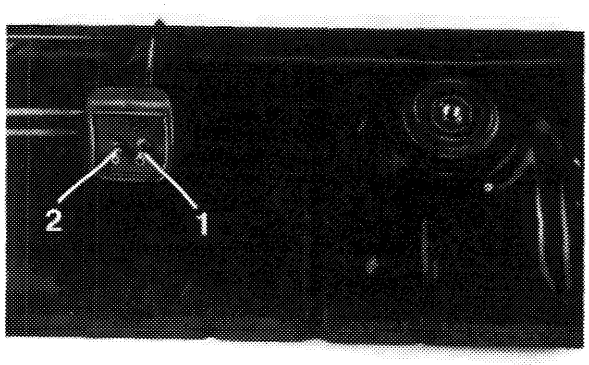
8 Remove fuel tank.



Installation

9 Install fuel tank in vice versa sequence and proceed as follows:

a) Glue down both gaskets on underside of fuel tank by means of MB universal glue, part No. 000 989 92 71. For installation, coat both gaskets on sealing surface or bead with sliding compound (talcum, wax or the like).



1 Positive and negative vent line
2 Fuel return line

147 - 16744

b) Check whether foam rubber strips on fuel tank are tight, glue down with MB universal glue, part No. 000 989 92 71, if required.

c) Blow out filter (b) and check for damage. Renew sealing ring (a). Tighten fuel filter (68) to 35–43 Nm.

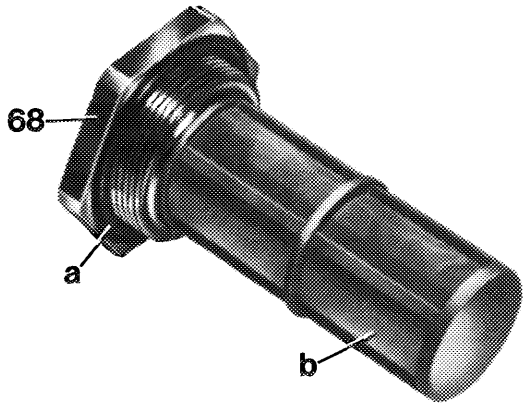
d) Be sure to mount fuel tank with reinforcing plates and washers provided. Tighten fastening nuts to 17–25 Nm.

e) Pay attention to correct seat of rubber sleeve on fuel filler neck.

f) Plug-on coupler for fuel gage and check for function (ground connection line on battery connected).

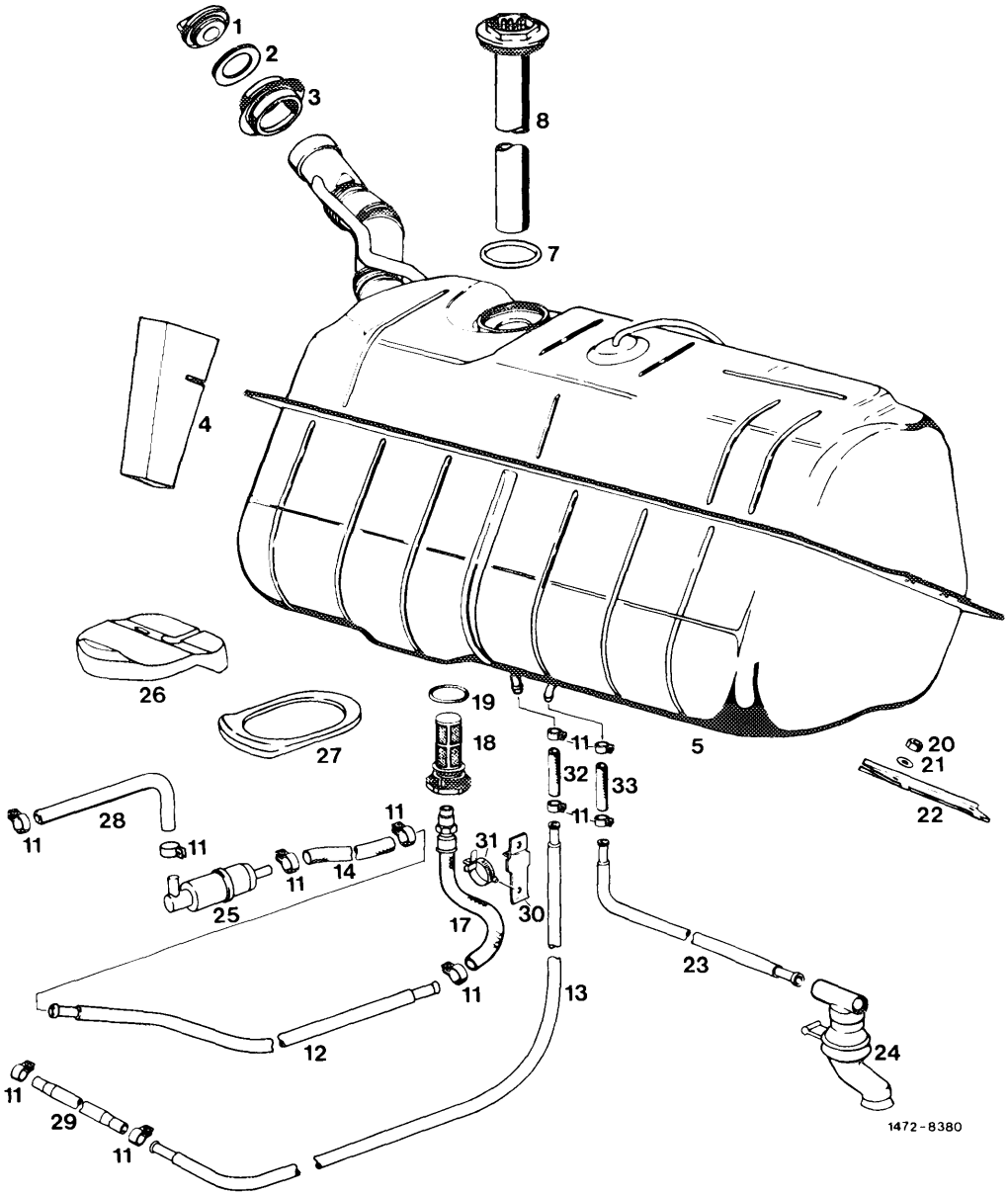
g) Renew damaged fuel hoses.

h) Check fuel system for leaks.



147-17012/1

Fuel tank
Model 116



1 Cap
2 Seal
3 Rubber sleeve
4 Damping insert
5 Fuel tank
7 Sealing ring
8 Immersion tube indicator (screw-type)
11 Hose clamp
12 Fuel feed line
13 Fuel return line
14 Fuel hose
17 Fuel suction hose
18 Fuel filter
19 Sealing ring
20 Nut
21 Washer
22 Reinforcing plate
23 Vent line
24 Vent sleeve
25 Fuel prefilter
26 Rubber seal
27 Rubber seal
28 Fuel hose
29 Expanding hose
30 Holder
31 Cable strap
32 Fuel hose
33 Fuel hose

B. Model 123 T-sedan

Filling capacity in liters	
Full readout	approx. 70
Warning lamp reserve	approx. 11

Tightening torques	Nm
Fastening nuts for fuel tank, self-locking	26–34
Fuel filter	35–43
Immersion tube indicator	

Conventional tool	
Torque wrench double arm, 1/2" square, 15–65 Nm	e.g. Wille, D–5600 Wuppertal order no. 72 Nm/6

Attention!
When removing fuel tank, pay attention to **safety rules.**

Removal

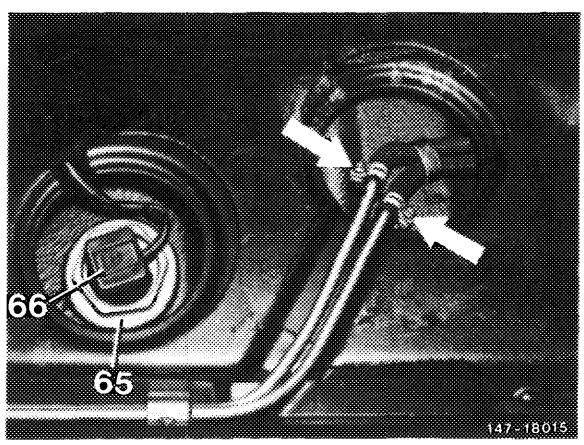
1 Disconnect ground connecting line on battery.

2 Drain fuel tank. Carefully pump off fuel, so that no residual fuel remains in fuel tank.

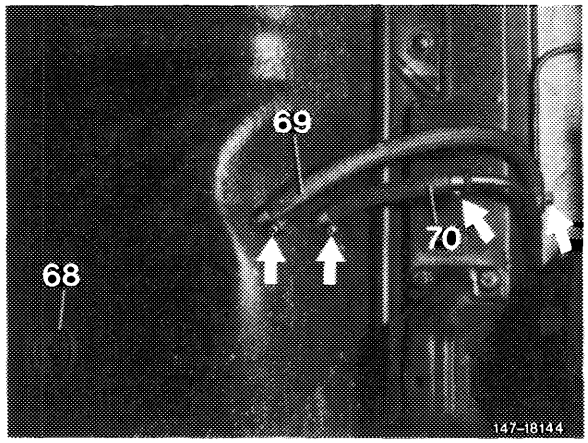
3 Remove trunk floor and intermediate shelf.

4 Pull off coupler (66) for fuel gage.

5 Loosen hose clips (arrows) on vent lines, pull off hoses, tightly close lines and hoses.

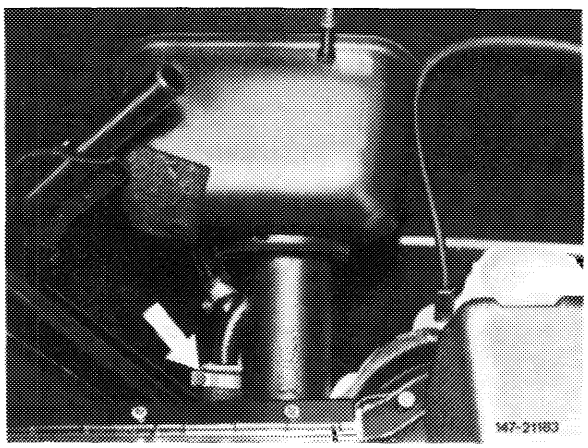


6 Loosen hose clamps on front (69) and return line (70), pull off both hoses on fuel tank and catch residual fuel in hose (69). Tightly close hoses and filler neck.



7 Loosen hose clamp (arrow) and pull off vent hose. Close hose and filler neck.

8 Unscrew fastening nuts and remove fuel tank in downward direction.



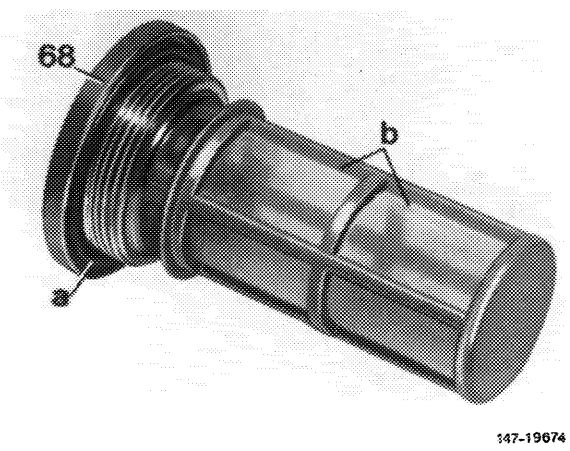
Installation

9 Install fuel tank in vice versa sequence and proceed as follows:

a) Glue foam rubber strip on fuel tank at level of filler neck crosswise to driving direction.

Note: Never use felt or similar material, since otherwise corrosion damage may result.

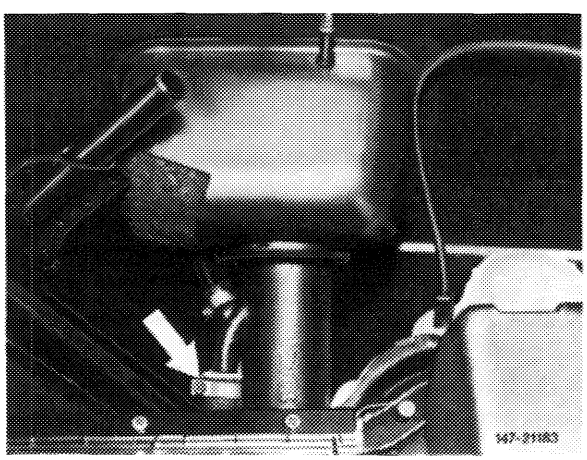
b) Blow out filter (b) and check for damage. Renew sealing ring (a). Install fuel filter (68) and tighten to 35–43 Nm.



c) Be sure to install fuel tank with specified reinforcing plates and washers. Tighten self-locking fastening nuts to 26–34 Nm.

d) Install vent hose (arrow) between fuel tank and filler neck free of kinks and with a continuous slope toward fuel tank.

The slipped-on O-ring serves for sealing at passage to interior.



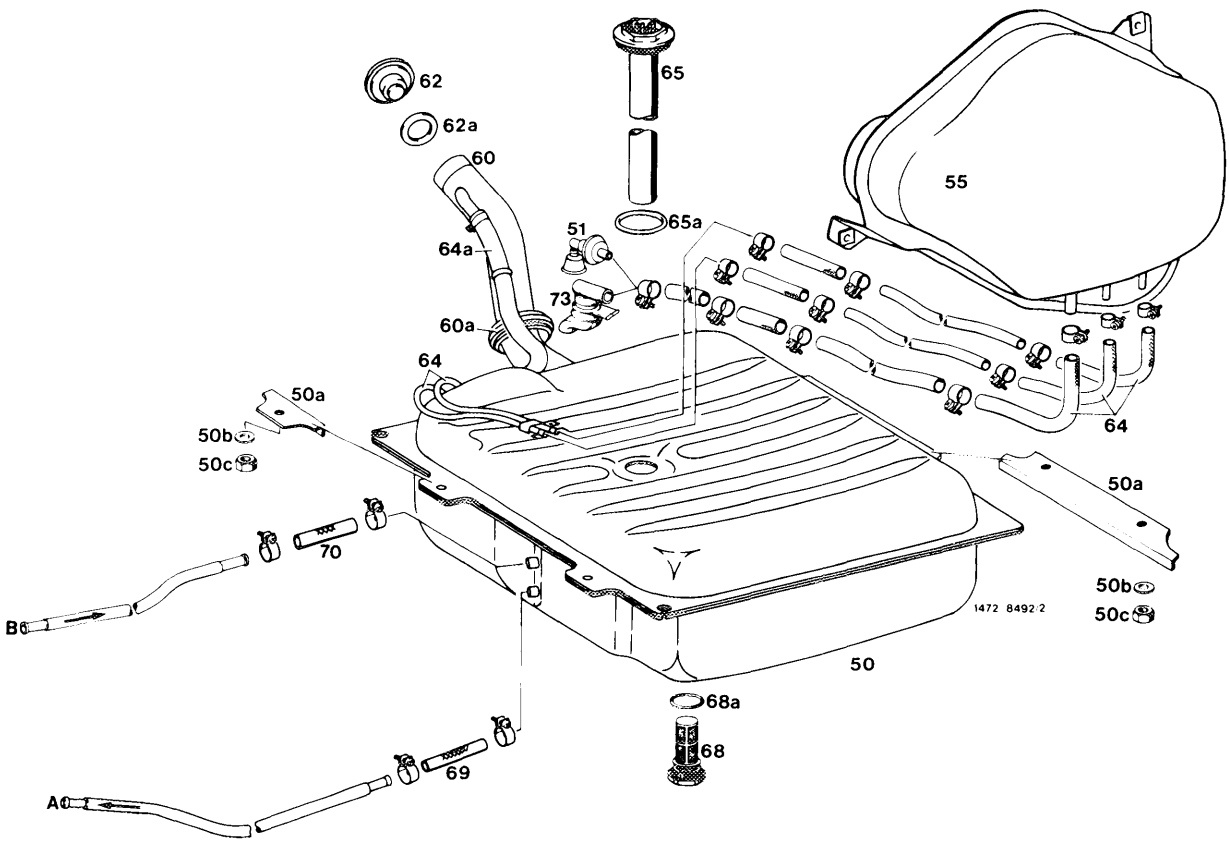
e) Pay attention to correct seat of sleeves on filler neck.

f) Renew damaged fuel hoses.

g) Check operation of fuel gage (ground connection line on battery connected).

h) Check fuel system for leaks.

Fuel tank
Model 123 T-sedan



50 Fuel tank
50a Reinforcing plate
50b Washer
50c Self-locking nut
51 Vent valve (USA only starting 1981)
55 Expansion tank
60 Filter neck
60a Sealing sleeve (2 each)
62 Cap
62a Sealing ring
64 Vent line
64a Negative vent line
65 Immersion tube indicator
65a Sealing ring
68 Fuel filter
68a Sealing ring
69 Feed line
70 Return line
73 Vent sleeve

C. Model 126 (USA) starting 1981

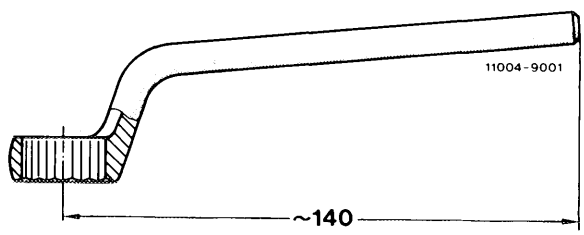
Filling capacities in liters	
Full readout	approx. 77
Warning lamp – reserve	approx. 12

Tightening torques	Nm
Fastening nuts for fuel tank	17–25
Fuel filter	35–43

Conventional tool	
Torque wrench, double-arm, 1/2'' square, 15–65 Nm	e.g. Wille, D–5600 Wuppertal order no. 72 Nm/6

Self-made tool (model 126)

Conventional, offset box end wrench 19 mm, shorten according to drawing



Attention!
When removing fuel tank, pay attention to **safety rules.**

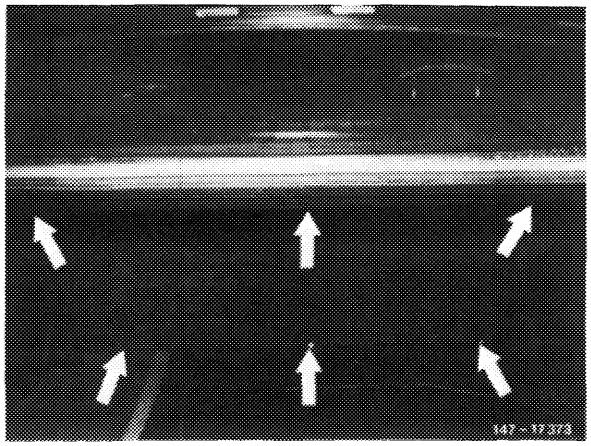
Removal

1 Disconnect ground connection line on battery.

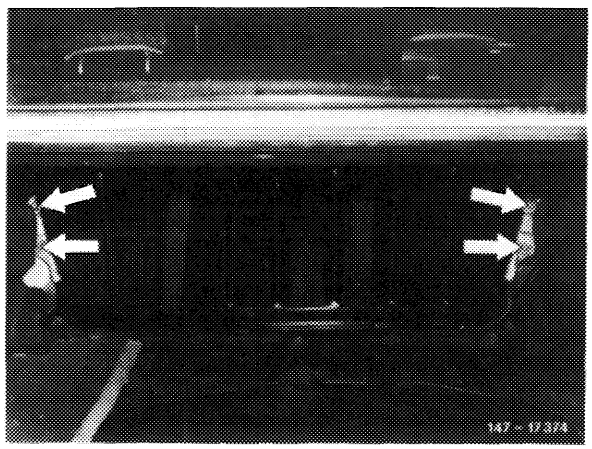
2 Drain fuel tank. Carefully pump off fuel so that no residual fuel remains in fuel tank.

3 Remove trunk mat.

4 Remove rear wall for fuel tank cover. For this purpose, unscrew fastening screws (arrows).

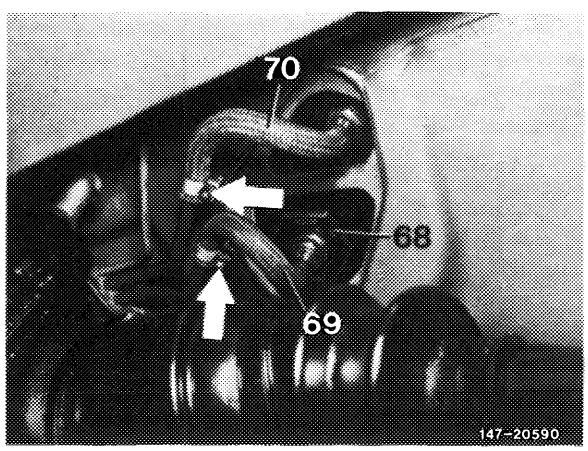


5 Unscrew fuel tank fastening nuts (arrows).

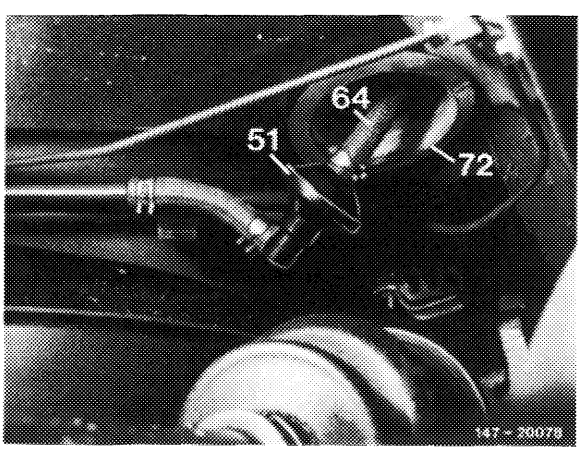


6 Remove suction hose (69) and return flow hose (70) (use shortened box end wrench for return flow hose).

Note: Carefully catch residual fuel from lines. Tightly close lines and fuel tank.



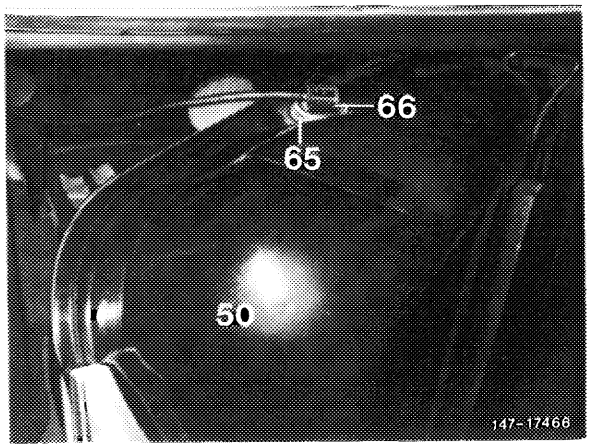
7 Pull hose (64) from vent line and tightly close hose and line.



51 Vent valve
(USA) only starting 1981

8 Lift fuel tank (50) out of mounting bracket and pull to the rear until coupler (66) for fuel gage can be pulled from immersion tube indicator (65).

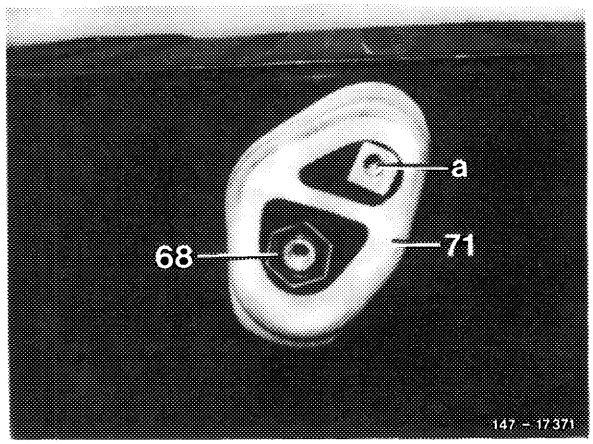
9 Remove fuel tank.



Installation

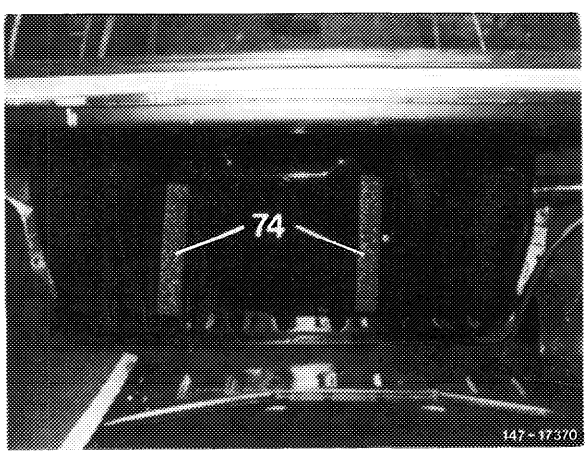
10 Install fuel tank in vice versa sequence while proceeding as follows:

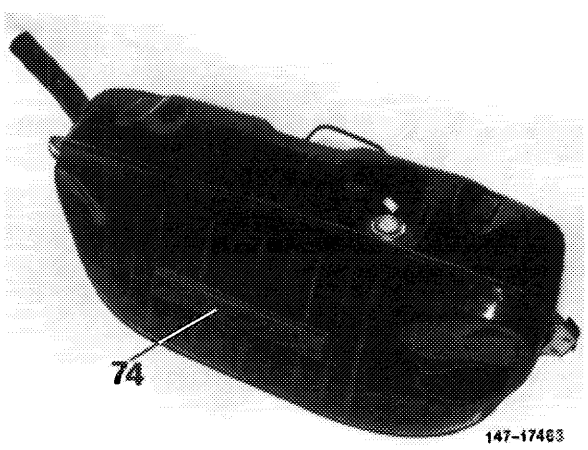
a) Check gasket (71) for tight seat and glue down with MB universal glue, part No. 000 989 92 71, if required. For installation, coat sealing bead with sliding compound (talcum, wax or the like).



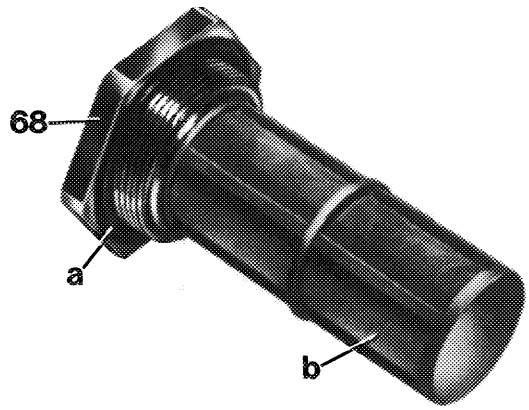
68 Connection intake hose
71 Gasket
a Connection return flow line

b) Check damping shims (74) for tight seat and glue down with MB universal glue, part No. 000 989 92 71, if required.





c) Blow out filter (b) and check for damage. Renew sealing ring (a). Tighten fuel filter (68) to 35–43 Nm).



147-17012/1

d) When installing fuel tank, make sure that coupler (66) is plugged on immersion tube indicator (65). Check for function.

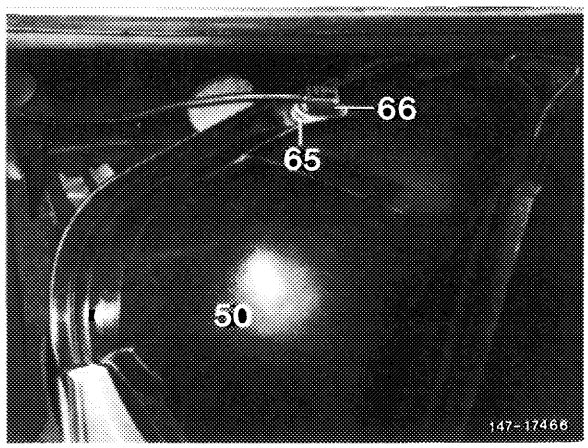
e) Mount fuel tank with reinforcing plates and washers provided. Tighten fastening nuts to 17–25 Nm.

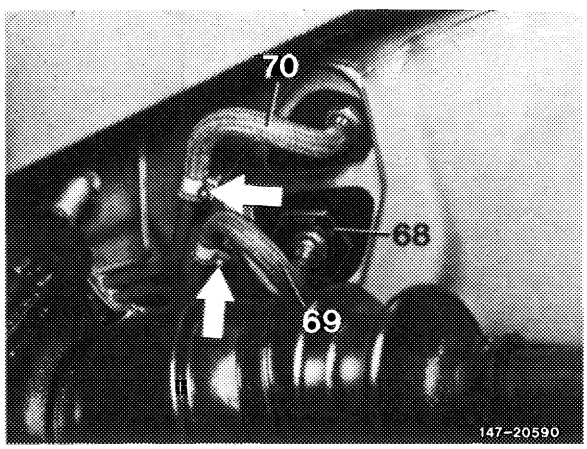
f) Pay attention to correct seat of sealing sleeve on filler neck, of gaskets between fuel tank and trunk floor and of sealing sleeve on vent line.

g) Replace copper sealing ring between fuel tank and return flow hose (70).

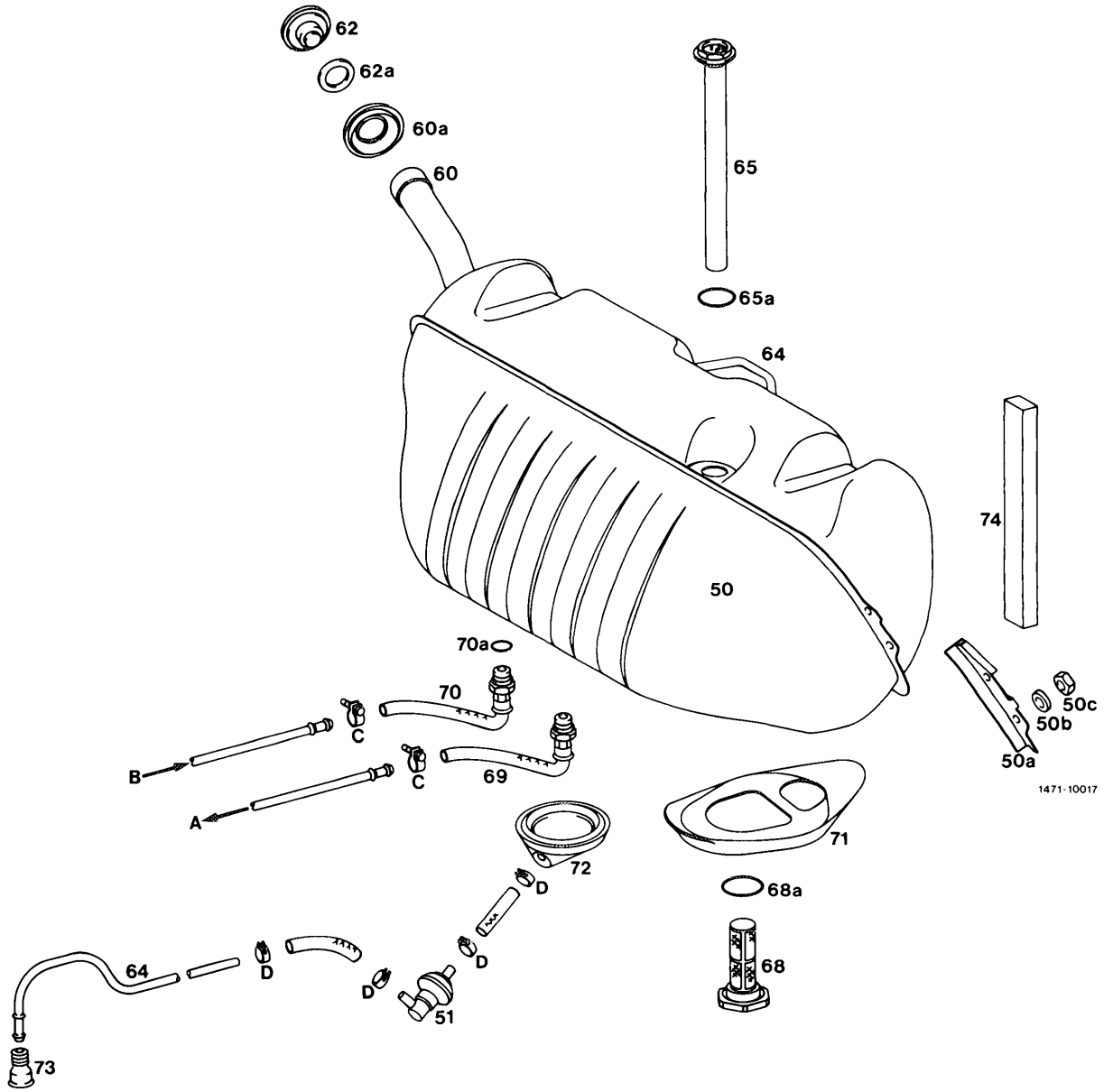
h) Renew damaged fuel hoses.

i) Check fuel system for leaks.





Fuel tank
Model 126



50 Fuel tank
50a Reinforcing plate
50b Washer
50c Nut
51 Vent valve (USA only, starting 1981)
60 Filler neck
60a Sealing sleeve
62 Cap
62a Sealing ring
64 Vent line
65 Immersion tube indicator
65a Sealing ring
68 Fuel filter
68a Sealing ring
69 Feed line
70 Return flow line
70a Copper sealing ring
71 Gasket
72 Sealing sleeve
73 Protective sleeve
74 Damping shim
C Clamp
D Clamp strap

Model 123 T-sedan

Removal

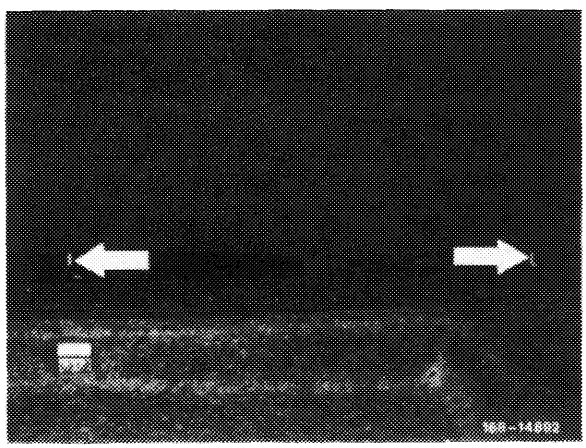
1 Remove spare wheel paneling and spare wheel.

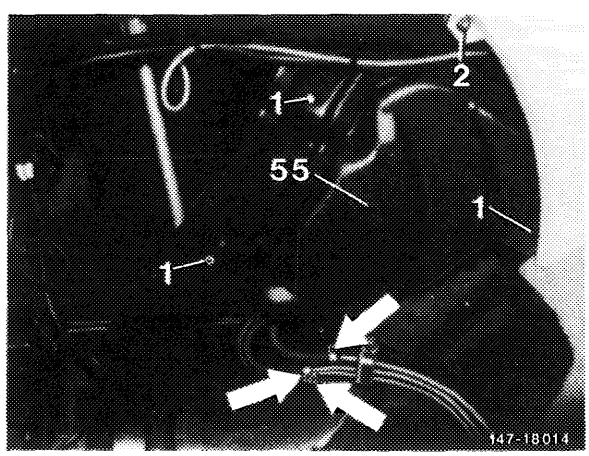
Lift spare wheel paneling slightly during removal until pins (arrows) disengage.

2 Unscrew fastening screw (2) of side paneling.

3 Loosen hose clamps (arrows) on vent lines and pull off hoses, tightly close lines and hoses.

4 Unscrew fastening screws (1) of expansion tank (55). For this purpose, slightly lift side and wheel house paneling at fastening screw located at the front when seen in driving direction. Remove expansion tank.





Installation

5 For installation proceed vice versa.

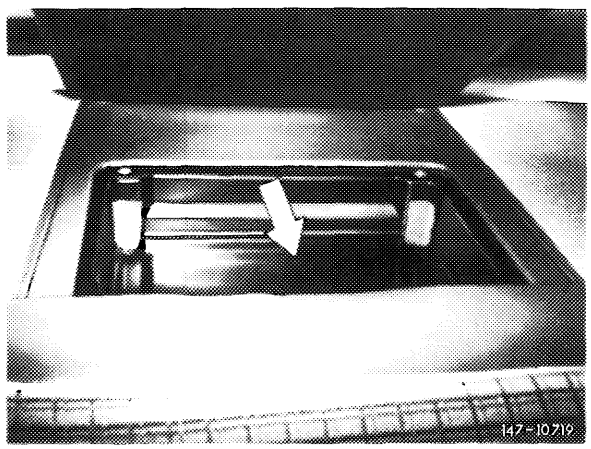
Note: Check hose connections for leaks.

A. Model 116

Tightening torque	Nm
Immersion tube indicator	35–43

Removal

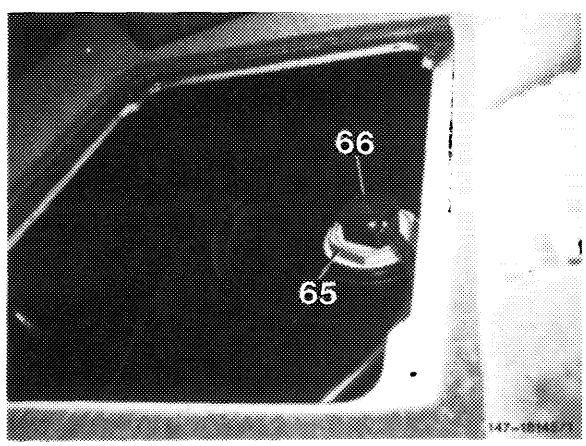
1 Remove first aid kit and first aid kit mounting shell (arrow).



2 Pull coupler (66) for fuel gage from immersion tube indicator (65) and protect with wire against slipping off.

3 Unscrew immersion tube indicator.

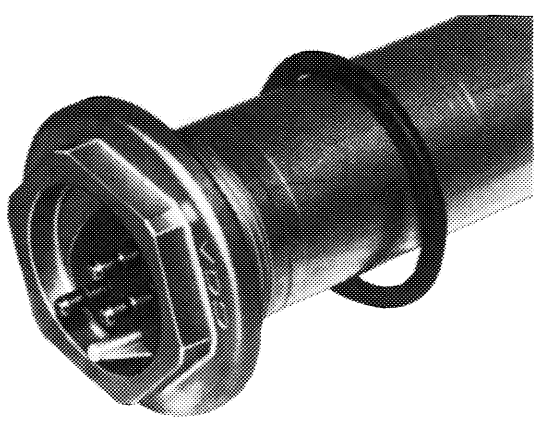
Note: Let immersion tube indicator run dry, if required.



Installation

4 For installation proceed vice versa, while proceeding as follows:

a) Use new rubber sealing ring.



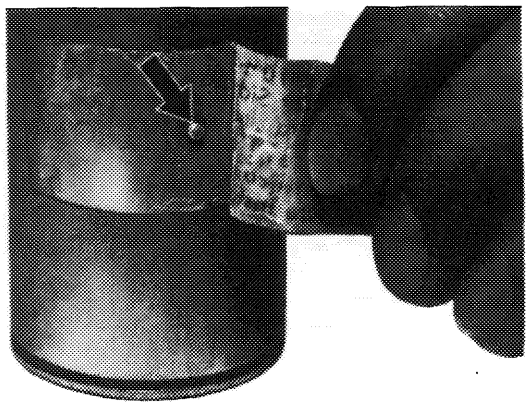
b) Remove locking pin (arrow) prior to installing immersion tube indicator.

c) Check fuel gage for function.

d) Tighten immersion tube indicator to 35—43 Nm.

e) Plug-on coupler for fuel gage.

f) Check for leaks.

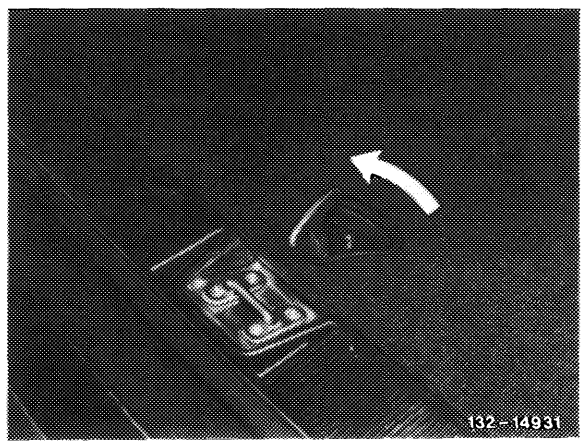


107-10702

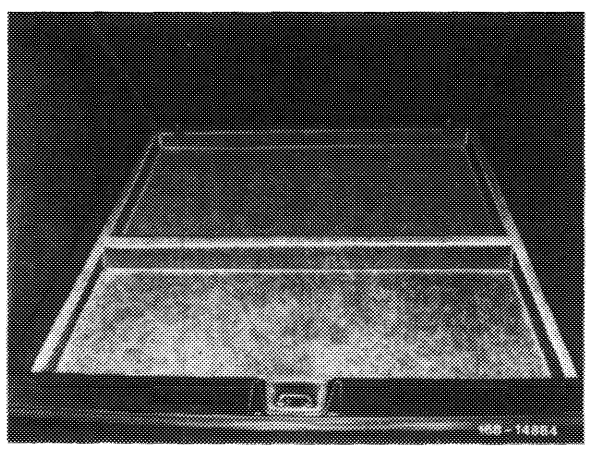
Tightening torque	Nm
Immersion tube indicator	35–43

Removal

1 Loosen trunk floor by turning tommy lock and remove.

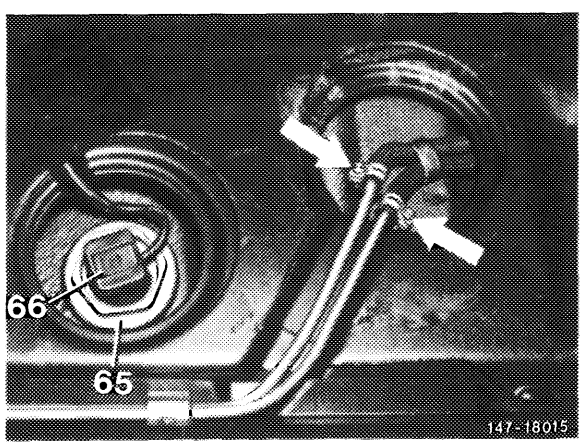


2 Remove storage shelf.



3 Pull off coupler (66) for fuel gage and unscrew immersion tube indicator (65).

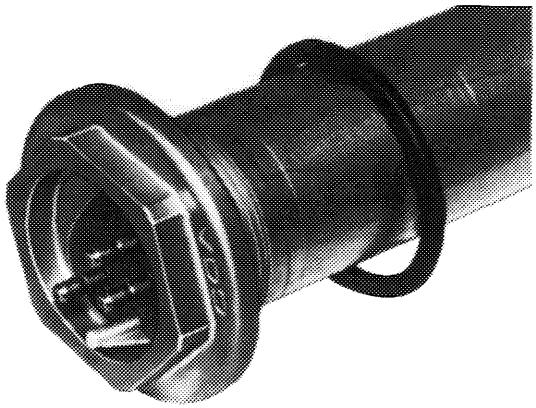
Note: Let immersion tube indicator run dry, if required.



Installation

4 For installation proceed vice versa as follows:

a) Use new rubber sealing ring.



147-10810

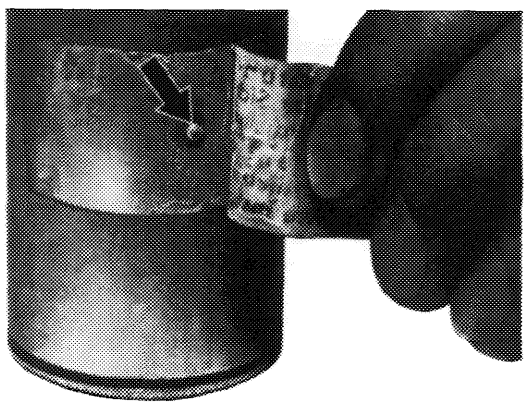
b) Prior to installation of immersion tube indicator, remove locking pin (arrow).

c) Check fuel gage for function.

d) Tighten immersion tube indicator to 35–43 Nm.

e) Plug-on coupler for fuel gage.

f) Check for leaks.



107-10702

Tightening torque	Nm
Immersion tube indicator	35–43

Removal

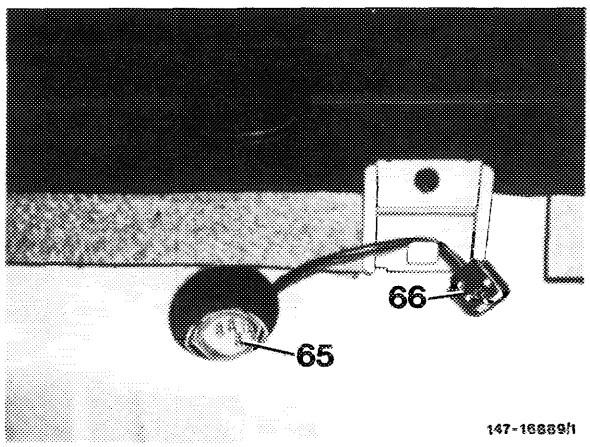
1 Remove rear seat bench and backrest (refer to section covering body).

2 Remove filler cap.

3 Pull off coupler (66) and protect against slipping off.

4 Unscrew immersion tube indicator (65).

Note: Let immersion tube indicator run dry, if required.



147-16889/1

Installation

5 For installation proceed vice versa as follows:

a) Use new rubber sealing ring.

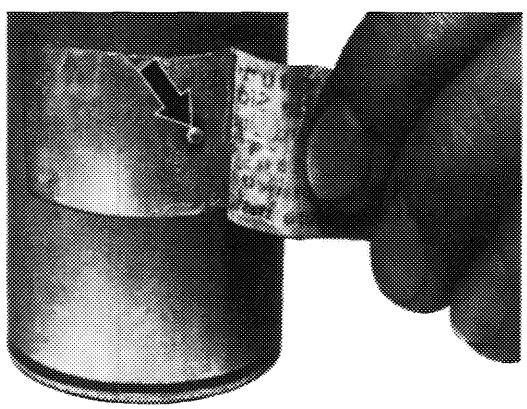
b) Prior to inserting a new immersion tube indicator, remove locking pin (arrow).

c) Check fuel gage for function.

d) Tighten immersion tube indicator to 35–43 Nm.

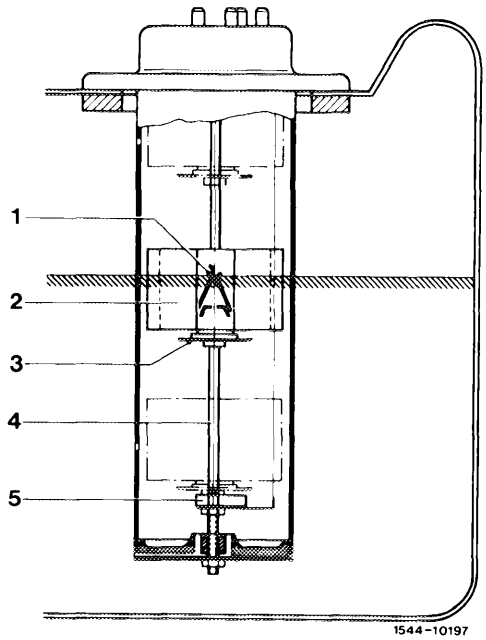
e) Plug-on coupler for fuel gage.

f) Check for leaks.


107-10702

With fuel level going down, the slide contact (1) on float (2) of immersion tube indicator increases the resistance value, the voltage will drop and the indicating needle in instrument will therefore swing back.

If the fuel level goes down still further, the reserve warning contact (5) in immersion tube indicator is closed and will connect reserve warning lamp to ground, which will then light up.



Immersion tube indicator

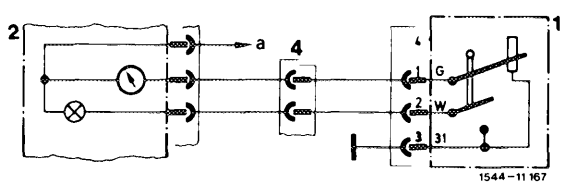
1 Slide contact
2 Float
3 Contact plate
4 Guide and contact rod
5 Reserve warning contact

The circuit has been modified starting September 1982. The reserve warning lamp will light up with ignition switched on (checkup). As soon as engine starts, the lamp will go out, if the fuel tank holds more than the reserve fuel.

Note: During checkup, the reserve warning lamp will light up weaker, with reserve stronger.

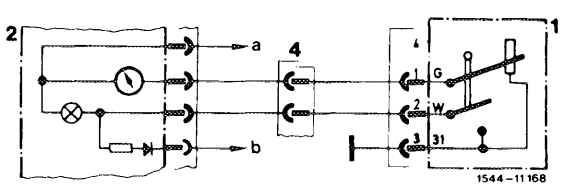
Model 123, 126 sedan and coupe up to August 1982

1 Immersion tube indicator
2 Fuel gauge
4 Cable connector tail lamp unit harness
a To terminal 15



Model 123, 126 sedan and coupe starting September 1982

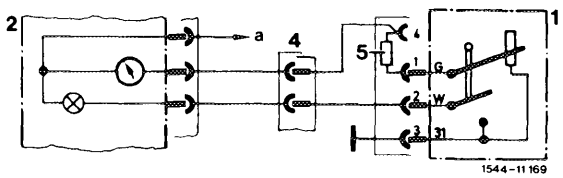
1 Immersion tube indicator
2 Fuel gauge
4 Cable connector tail lamp unit harness
a To terminal 15
b To terminal 61



On T-sedans the coupler of the immersion tube indicator is provided with a built-in compensating resistor 4.7 Ω (color rings yellow/purple/gold/gold), so that in spite of different fuel tanks the same indicating instruments can be used.

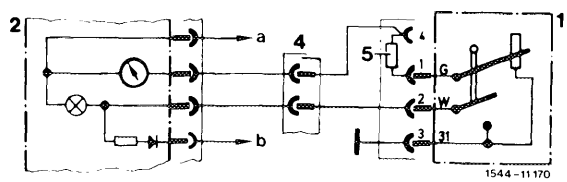
Model 123 T-sedan up to August 1982

1 Immersion tube indicator
2 Fuel gauge
4 Cable connector tail lamp unit harness
5 Resistor 4.7 Ω
a To terminal 15



Model 123 T-sedan starting September 1982

1 Immersion tube indicator
2 Fuel gauge
4 Cable connector tail lamp unit harness
5 Resistor 4.7 Ω
a To terminal 15
b To terminal 61

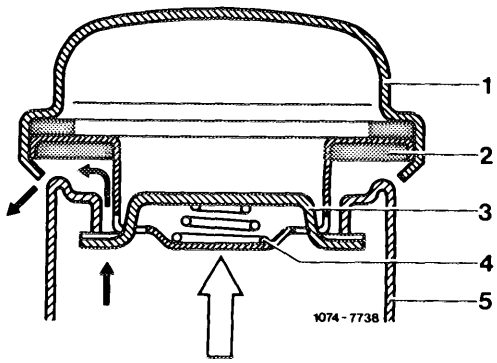


Test fuel gauge (54–269).

A. All models

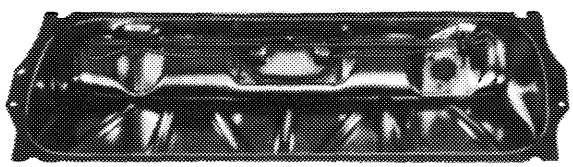
Closing cap

At a gauge pressure of 100–300 mbar the fuel evaporation vapors can escape via closing cap.



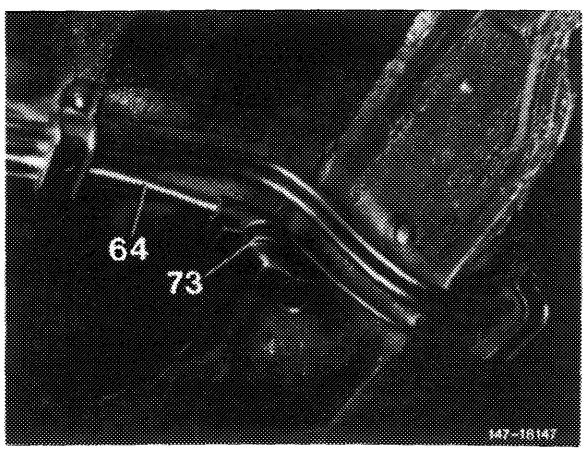
B. Model 116

A venting system, comprising lines and a collecting tray, is installed in fuel tank for positive and negative venting of tank.

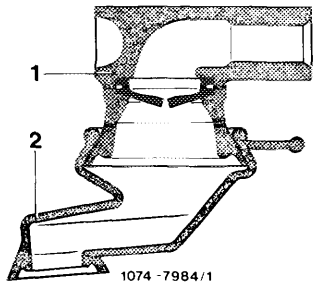


147-13628

The fuel vapors are escaping through vent line (64) and vent sleeve (73) into the atmosphere. Outlet of vent line is at the left on frame floor in front of rear axle suspension.



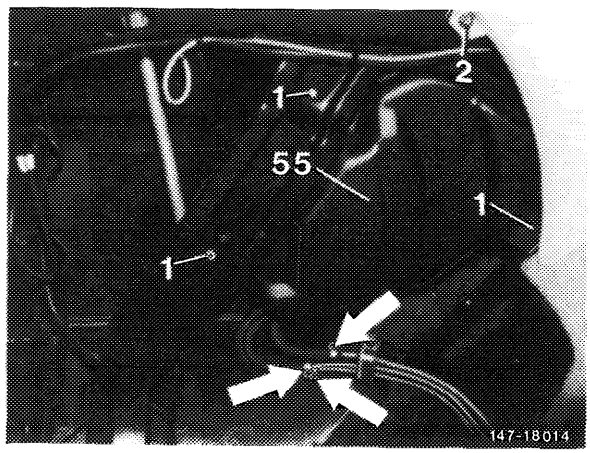
A diaphragm in vent sleeve increases pressure in fuel tank by approx. 10 mbar.



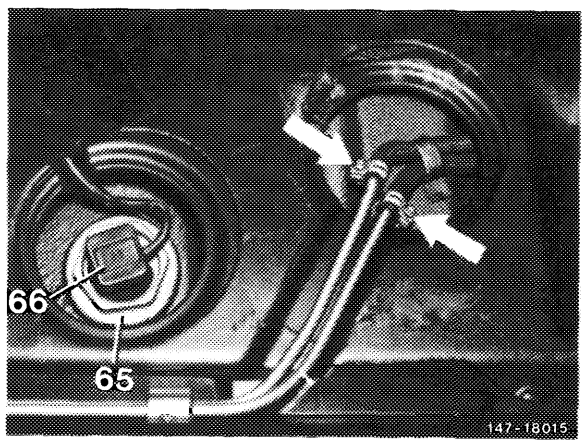
Vent sleeve with diaphragm

C. Model 123 T-sedan

An expansion tank (55) for positive and negative venting of fuel tank is located in rear lefthand fender.

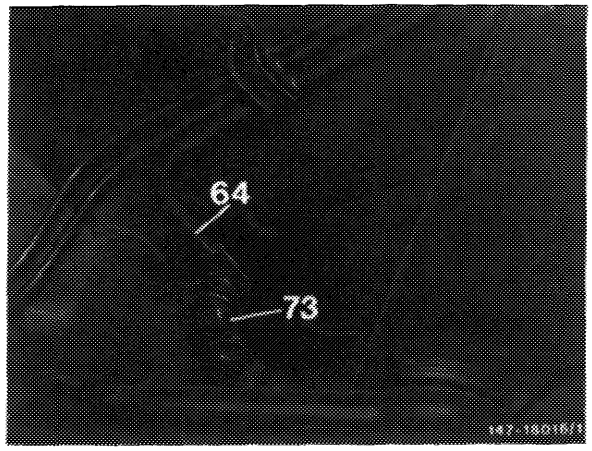


The expansion tank is provided with two connecting lines (arrows) entering the fuel tank and a vent line (64).



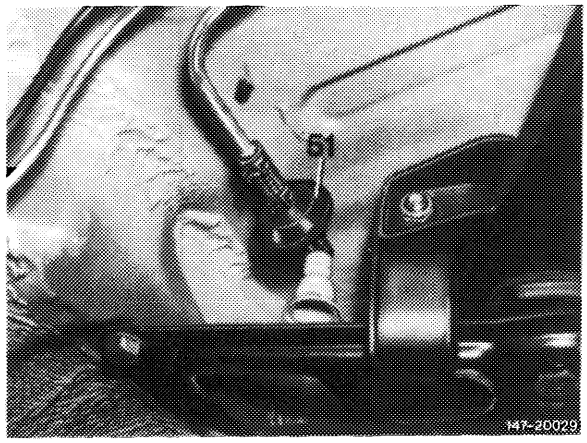
The fuel vapors are escaping through vent line (64) and vent sleeve (73) into the atmosphere.

The vent line outlet is at the right on frame floor in front of rear axle suspension.



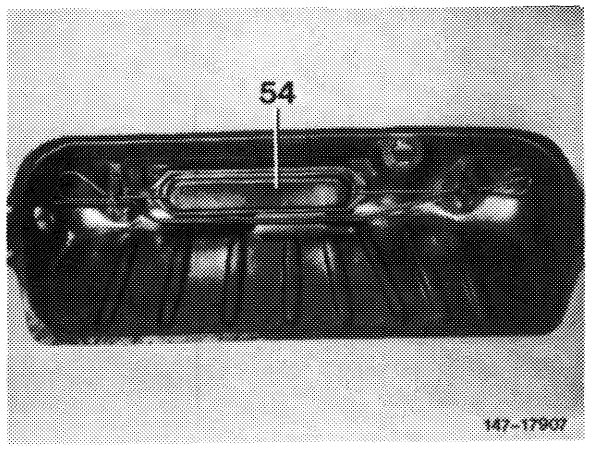
(USA) starting 1981

The vent valve (51) is located at end of vent line (64). The vent valve (51) opens at a gage pressure of 30–50 mbar and a vacuum of 1–16 mbar in fuel tank.



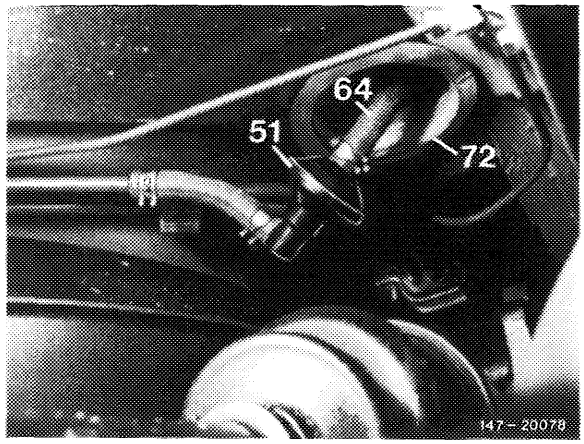
D. Model 126 (USA) starting 1981, (J) starting 1982

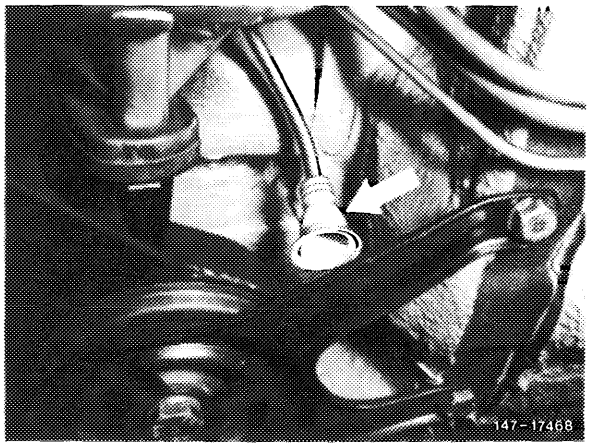
On model 126 the vent system consists of the respective lines and a collecting tray (54) in fuel tank.



The fuel vapors are escaping through vent line (64) and vent valve (51) to a single sleeve (arrow) at left-hand rear vehicle side above supporting plate of rear axle.

The vent valve (51) opens at a gauge pressure of 30–50 mbar and a vacuum of 1–16 mbar in fuel tank.





Tightening torques	Nm
Self-locking hex. nuts on lateral support of clamp	7
Self-locking hex. nut on exhaust flange to exhaust gas turbocharger	20–25
Self-locking hex. nut of exhaust pipe flange connection	20
Hex. screws of lateral support on transmission	20

Removal and installation of exhaust system is not described in full, reference will be made only to special, important points to which special attention must be paid during removal and installation or when renewing components, for example the end muffler with plug connection.

Removal

1 Check suspension members for re-use or renew, if required.

2 If a separation of plug connection between center and end muffler during repairs is impossible, heat exhaust pipe. For safety reasons, provide a protective shield on vehicle between frame floor and exhaust pipes prior to heating pipes.

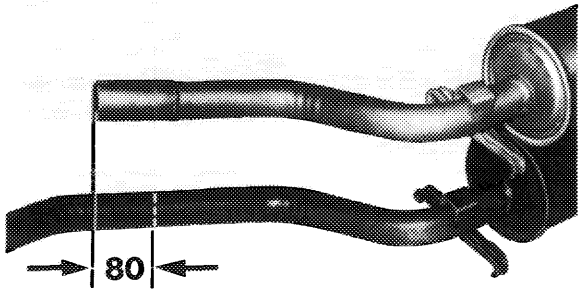
3 Prior to mounting exhaust system, make sure that the flange to exhaust manifold is not distorted and align flange, if required. Clean cone connections of pipes and sintered sealing ring, if required, with emery cloth from combustion residue.

Installation

Replacement of end muffler.

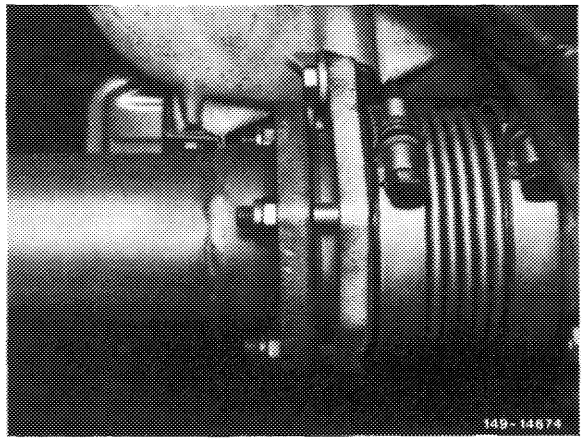
4 Place new end muffler with plug connection accurately above removed assembly and mark pipe length of new end muffler similar to removed assembly.

Separate pipe at a point 80 minus 10 mm from mark in direction of end muffler to provide a plug-in depth of 70–80 mm.



149-13368

5 Always replace self-locking hex. nuts.

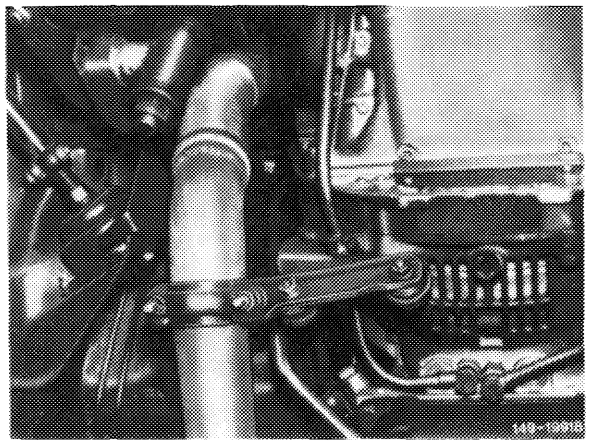


Connection exhaust pipe — exhaust turbocharger

6 Tighten flange connection to exhaust gas turbocharger only after the complete assembly has been suspended in rubber rings. Tightening torque of hex. nuts 20—25 Nm.

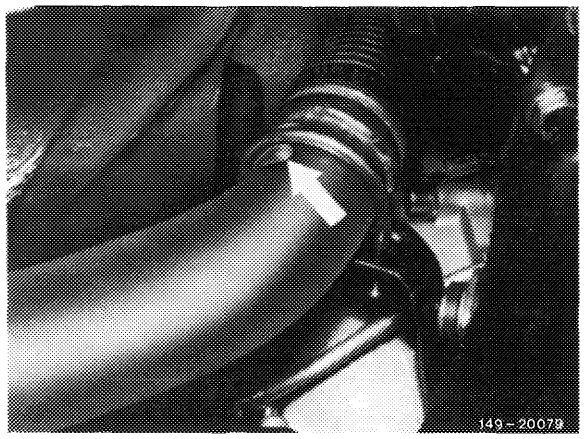
7 Mount rear exhaust assembly with center and end mufflers.

Note: The front exhaust pipe is provided with a rolled hose. Prior to connecting the rear exhaust assembly to front exhaust pipe, mount clamp of lateral support in a lightly tightened condition to relieve rolled hose.



Model 123.193

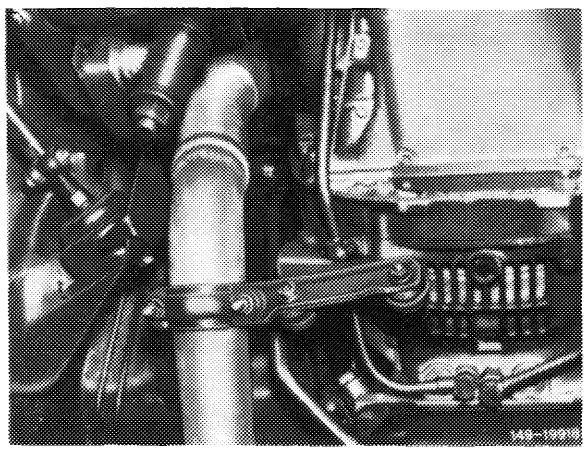
8 Clamp of front exhaust pipe should be mounted in such a manner that it is located between the two lugs on exhaust pipe (arrow).



Model 126.120

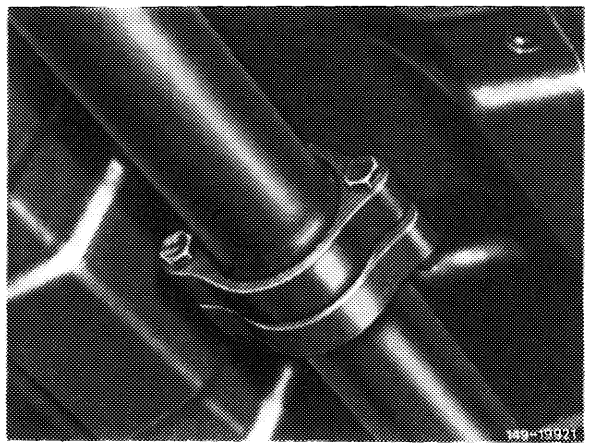
9 Mount exhaust lateral support free of tension. Tightening torque of self-locking hex. nuts on clamp 7 Nm, hex. bolts of lateral support on transmission 20 Nm.

Note: Mount 4 cup springs each per side on holding bracket in such a manner that their crowns are each opposed to the other.



Model 123.193

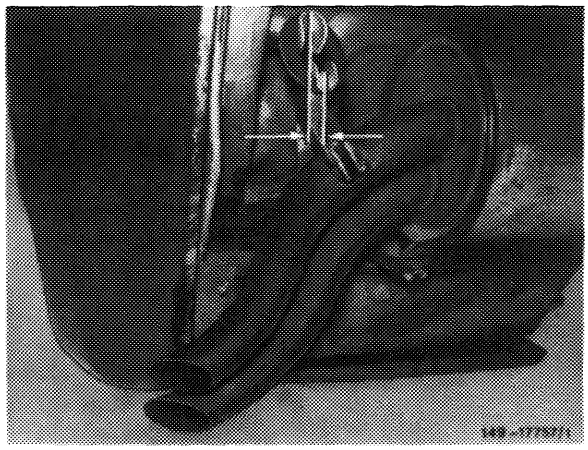
10 Mount sintered sealing ring on flange connection and pay attention to correct seat. Tightening torque of self-locking hex. nuts 20 Nm.



Model 126.120

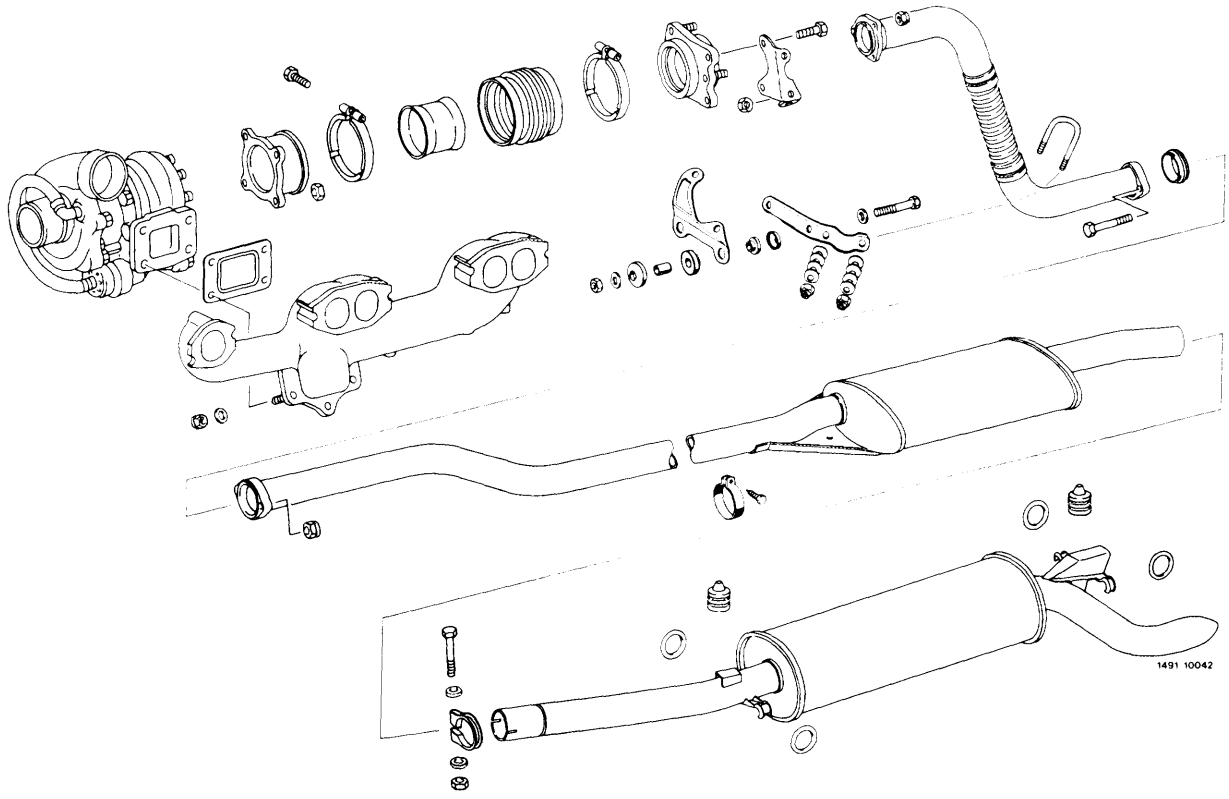
11 Mount end muffler in such a manner that the clamps of the end muffler are approx. 10 mm in front of holders on frame floor (arrows), so that in the event of an elongation of exhaust system the correct installation position is ensured.

Note: The checkup refers only to repair version mufflers with plug connection between center and end muffler.



12 Run engine and check exhaust system for leaks.

Exhaust manifold with exhaust gas turbocharger and complete exhaust system model 123.193



Exhaust manifold with exhaust gas turbocharger and complete exhaust system model 126.120

