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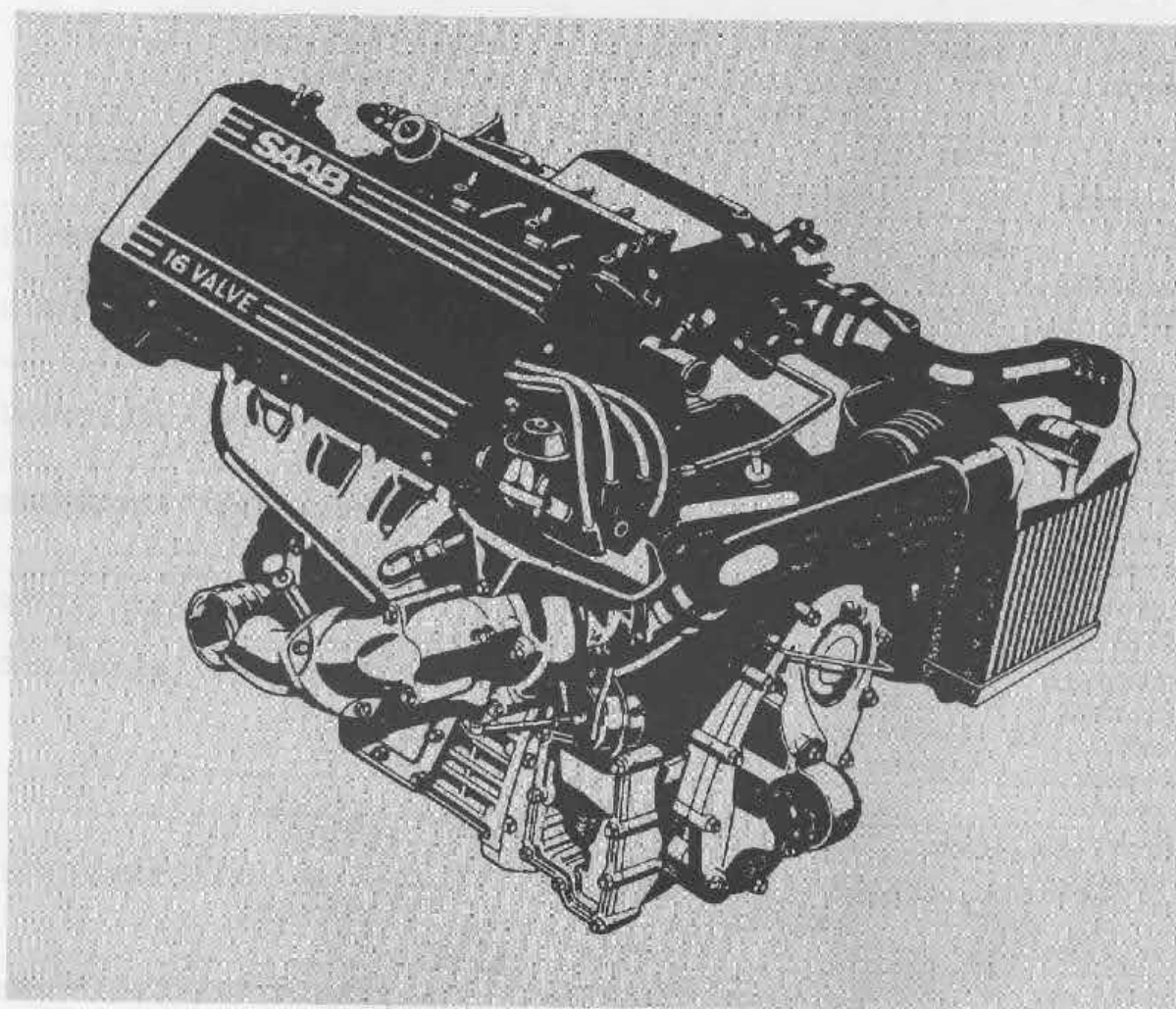
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**SERVICE
MANUAL**

2:1 Basic engine

M 1981-88-

Technical data



Engine

General data

Type: B201		4-cylinder, 4-stroke engine with overhead cam shaft
B202		4-cylinder, 4-stroke engine with twin overhead camshafts
Cylinder bore	mm (in)	90 (3.54)
Stroke	mm (in)	78 (3.07)
Swept volume	cm ³ (in ³)	1985 (121)
Firing order (No. 1 cylinder at rear)		1-3-4-2
Approximate weight, B201	kg (lb)	140 (309)
B202	kg (lb)	150 (331)

Performance, compression ratio, fuel octane number, etc.

Engine Variant	Model Year	Octane Requirement RON (AKI)*	Suitable sion for lead-free fuel	Compres- ratio kW (hp)/rpm	Rating (DIN), Nm (lbf ft)/rpm	Torque
Single carburettor	81-84	Min 96		9.5	73(100)/5200	162(120)/3000
	85-	Min 95	X			
Twin carburettor	81-84	Min 96		9.5	79(108)/5200	164(120)/3300
B201i	81-84	Min 96		9.5	87(118)/5500	167(124)/3000
	85-	Min 95	X			
B201i with catalytic converter	81-	Min 91(87)	X	9.25	81(110)/5250	161(119)/3000
B202i with catalytic converter	86-	Min 91 Rec 95(91)	X	10.1	96(130)/5500	173(128)/3000
B201 Turbo, (N/A APC)	81-82	Min 98		7.2	107(145)/5000	235(174)/3000
B201 Turbo (N/A APC) with catalytic converter	81-82	Min 95 (91)	X	7.2	99(135)/4800	217(160)/3500
B201 Turbo with APC	82-84	Min 91 Rec 98		8.5	107(145)/5000	235(174)/3000
	85	Min 91 Rec 98	X			
B201 Turbo with APC	86-	Min 91 Rec 98	X	8.5	114(155)/5000	240(178)/3000
B201 Turbo with APC and catalytic converter	82-86	Min 91 (87) Rec 95 (91)	X	8.5	99(135)/4800	217(160)/3500
	87-	Min 91 (87) Rec 95 (91)	X	8.5	103(140)/5000	235(174)/2500
B202 Turbo	84-	Min 91 Rec 98	X	9.0	129(175)/5300	273(200)/3000
B202 Turbo with catalytic converter	85-	Min 91 (87) Rec 95 (91)	X	9.0	118(160)/5500	255(188)/3000
B202 Turbo SPG USA**	87-	Min 95 (91)	X	9.0	121(165)/5500	265(195)/3000

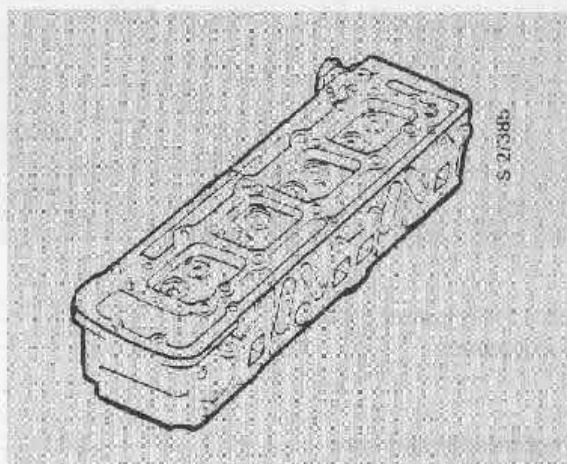
The specified octane ratings are minimum values and may deviate from those specified in the Owner's Manual, as the ratings specified in the latter are adapted to the quality of fuel available in the country concerned.

$$*) AKI = \frac{MON + RON}{2}$$

**) Upated B202 Turbo with catalytic converter (US & CA)

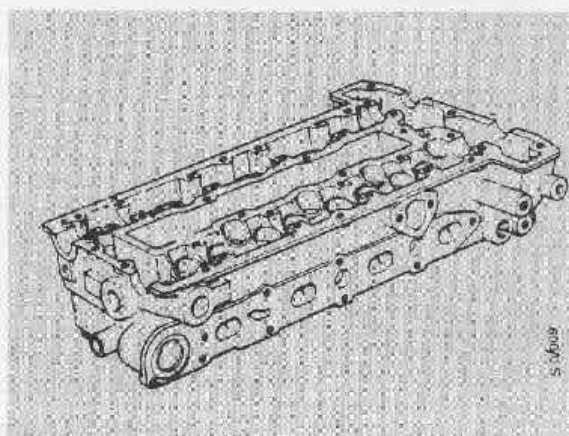
Premium = 91 AKI
Regular = 87 AKI

Engine block



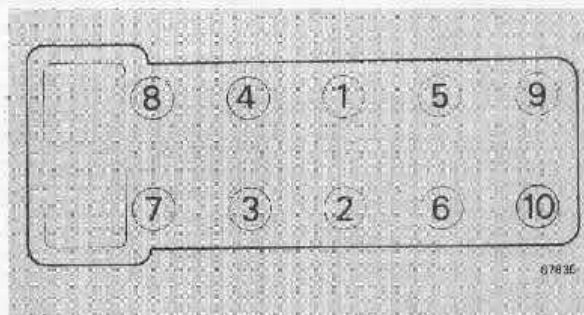
Cylinder head (B201)

Height of new cylinder head:	mm (in)	92.75 ± 0.05 (3.652 ± 0.002)
Minimum after regrinding:	mm (in)	92.35 ± 0.05 (3.636 ± 0.002)
For cylinder heads that have been reground, a head gasket, 0.3 mm (0.012 in) thicker, is available for H engines (M81 onwards).		



Cylinder head (B202)

Height of new cylinder head:	mm (in)	140.5 ± 0.1 (5.533 ± 0.003)
Minimum after regrinding:	mm (in)	140.1 ± 0.1 (5.516 ± 0.004)

Tightening sequence**Tightening torques**

The specified torques applied to lubricated bolts and washers and to new head gaskets.

Tightening torques for M17 cylinder head bolts:

Stage I	Nm (lbf ft)	60 (44)
Stage II	Nm (lbf ft)	80 (59)
Stage III		Run the engine to normal temperature and then allow it to cool for 30 min
Stage IV	Nm (lbf ft)	Slacken and then retighten each bolt to 95 (70)
Stage V		Tighten a further quarter-turn (90°)

Tightening torques for M15 and TORX M12 head bolts

(M87 and earlier with cylinder head gasket 75 16 529 or 75 05 217)

Stage I	Nm (lbf ft)	60 (44)
Stage II	Nm (lbf ft)	80 (59)
Stage III		Run the engine to normal temperature and then allow it to cool for 30 min
Stage IV	Nm (lbf ft)	Slacken and then retighten each bolt to 80 (59)
Stage V		Tighten a further quarter-turn (90°)

Tightening torques for M15 and TORX M12 head bolts

(M88 onwards with cylinder head gasket 75 61 301 or 75 85 037)

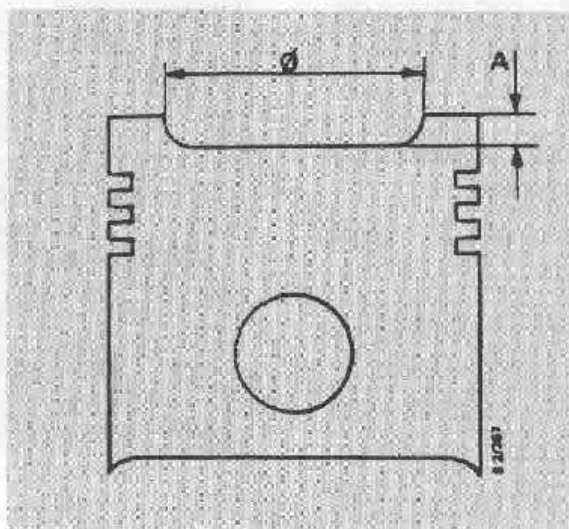
Stage I	Nm (lbf ft)	60 (44)
Stage II	Nm (lbf ft)	80 (59)
Stage III		Tighten a further quarter-turn (90°)

Cylinder block

Standard (A)	mm (in)	90.00 - 90.01 (3.543 - 3.544)
Standard (B)	mm (in)	90.01 - 90.02 (3.544 - 3.544)
First oversize	mm (in)	90.50 (3.563)
Second oversize	mm (in)	91.00 (3.583)

Pistons

Make		Mahle, Karl Schmidt or Hepolite
Piston speed (average)	m/s (ft/s)	13 (39.7) at 5000 rpm

**Pistons**

The type of piston used varies with the compression ratio of the engine.

Engine	Model year	Piston dia, mm (in)	A, mm (in)	Piston weight, g (oz)
B201, Carb.	1981-	58 (2.28)	0.4 (0.016)	480-492 (17.2-17.7)
B201i	1981-	58 (2.28)	0.4 (0.016)	480-492 (17.2-17.7)
B202i	1986-	64 (2.52)	1.0 (0.04)	504-516 (18.1-18.6)
B201, Turbo	1981	70 (2.76)	6.6 (0.260)	492-504 (17.7-18.1)
B201, Turbo APC	1982-	70 (2.76)	2.65 (0.104)	497-506 (17.8-18.2)
B202, Turbo	1984-	64 (2.52)	4.7. (0.185)	514-526 (18.5-18.9)
B202, Turbo	1986-	64 (2.52)	3.85 (0.152)	519-531 (18.7-19.1)

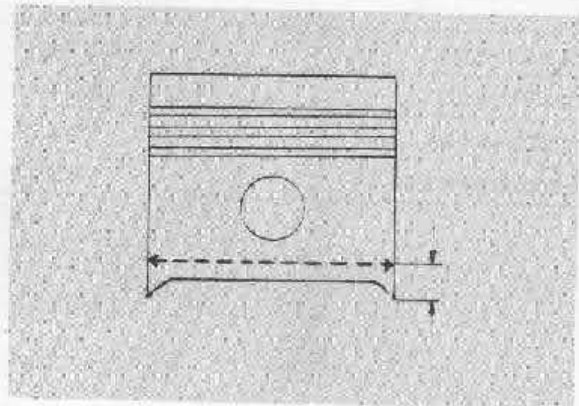
Piston diameter

Measured at right angles to gudgeon pin and:

- Mahle: 16 mm above lower edge
- Schmidt: 26 mm above lower edge

N.B.

Pistons of different makes must not be fitted in the same engine.



Classification of pistons and cylinder bores

The piston classification code is stamped on the crown of the piston. The codes for servicing are:

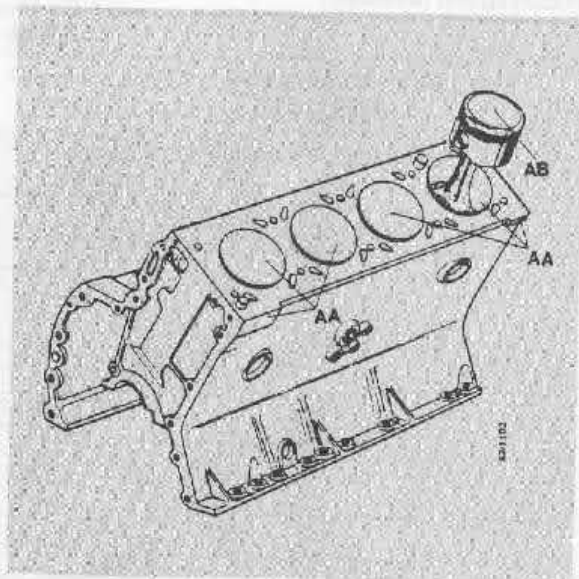
AB

B

C

The cylinder classification code is punched on the block adjacent to each cylinder.

Cylinders are either class A or B. Both classes may occur in the same block.



Earlier classification

Turbo (Mahle)

Standard A (not spare part)	mm (in)	89,960-89,970 (3.5417-3.5421)
Standard AB	mm (in)	89,970-89,976 (3.5421-3.5424)
Standard B	mm (in)	89,976-89,986 (3.5424-3.5428)
Standard C	mm (in)	89,986-90,002 (3.5428-3.5434)
First oversize (0.5 mm)	mm (in)	90,460-90,475 (3.5614-3.5620)
Second oversize (1.0 mm)	mm (in)	90,960-90,975 (3.5811-3.5817)
Piston clearance (nominal)	mm (in)	0,024-0,050 (0.0009-0.0020)

Other engines (Schmidt)

Standard A (not spare part)	mm (in)	89,972-89,980 (3.5422-3.5425)
Standard AB	mm (in)	89,980-89,986 (3.5425-3.5428)
Standard B	mm (in)	89,986-89,994 (3.5426-3.5431)
Standard C	mm (in)	89,994-90,010 (3.5431-3.5437)
First oversize (0.5 mm)	mm (in)	90,472-90,487 (3.5619-3.5625)
Second oversize (1.0 mm)	mm (in)	90,972-90,987 (3.5816-3.5822)
Piston clearance (nominal)	mm (in)	0.014-0.040 (0.0006-0.0016)

New classification**Turbo + carburettor (Mahle)**

Standard A (not spare part)	mm (in)	89,960-89,970 (3.5417-3.5421)
Standard AB	mm (in)	89,970-89,978 (3.5421-3.5424)
Standard B	mm (in)	89,978-89,986 (3.5424-3.5428)
Standard C	mm (in)	89,986-90,002 (3.5428-3.5434)
First oversize (0.5 mm)	mm (in)	90,460-90,475 (3.5614-3.5620)
Second oversize (1.0 mm)	mm (in)	90,960-90,975 (3.5811-3.5817)
Piston clearance (nominal)	mm (in)	0.02-0.050 (0.0009-0.0020)

Turbo + injection (Mahle & Schmidt)

Standard A (not spare part)	mm (in)	89,978-89,988 (3.5424-3.5428)
Standard AB	mm (in)	89,988-89,996 (3.5428-3.5431)
Standard B	mm (in)	89,996-90,004 (3.5431-3.5435)
Standard C	mm (in)	90,004-90,020 (3.5435-3.5441)
First oversize (0.5 mm)	mm (in)	90,482-90,497 (3.5623-3.5629)
Second oversize (1.0 mm)	mm (in)	90,982-90,997 (3.5820-3.5826)
Piston clearance (nominal)	mm (in)	0.004-0.032 (0.0002-0.0013)

Non-Turbo injection (Hepolite)

Standard A (not spare part)	mm (in)	89,977-89,985 (3.5424-3.5427)
Standard AB	mm (in)	89,985-89,991 (3.5427-3.5430)
Standard B	mm (in)	89,991-89,999 (3.5430-3.5433)
Standard C	mm (in)	89,999-90,015 (3.5433-3.5439)
First oversize (0.5 mm)	mm (in)	90,477-90,492 (3.5621-3.5627)
Second oversize (1.0 mm)	mm (in)	90,977-90,992 (3.5818-3.5824)
Piston clearance (nominal)	mm (in)	0.009-0.035 (0.0004-0.0014)

022-8 Engine

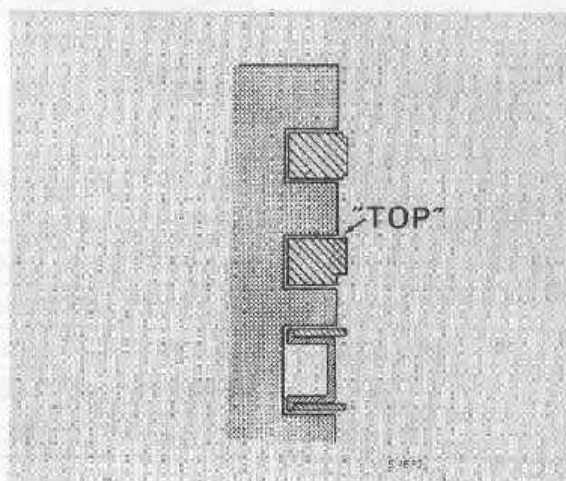
Resulting piston clearances

Earlier classification

Piston/cylinder	Clearance, Schmidt	1/1000 mm Turbo
A/A	20-38	30-50
AB/A	14-30	24-40
AB/B	24-40	35-50
B/A	6-24	14-34
B/B	-	8-34

New classification

Piston/cylinder	Clearance, Non-turbo (Schmidt)	1/1000 mm Turbo Carburettor	Non-turbo (Hepolite)
A/A	12-32	30-50	15-33
AB/A	4-22	22-40	0-25
AB/B	14-32	32-50	19-35
B/A	-	14-32	1-19
B/B	6-24	24-42	11-29
C/B	-	8-34	-



Piston rings

		Top compression ring	Second compression ring	Scraper ring
Width (thickness),	mm (in)	1.73-1.75 (0.0681-0.0689)	1.98-1.99 (0.0780-0.0783)	2.63-2.73* (0.1035-0.1075)
Side clearance in groove	mm (in)	0.050-0.082 (0.0020-0.0032)	0.040-0.072 (0.0016-0.0028)	
Working gap in new cylinder,	mm (in)	0.35-0.55 (0.0138-0.0217)	0.30-0.45 (0.0118-0.0177)	0.38-1.40** (0.0150-0.0551)

* Segment width (thickness): 0.58-0.64 mm
(0.0028-0.0252 in)

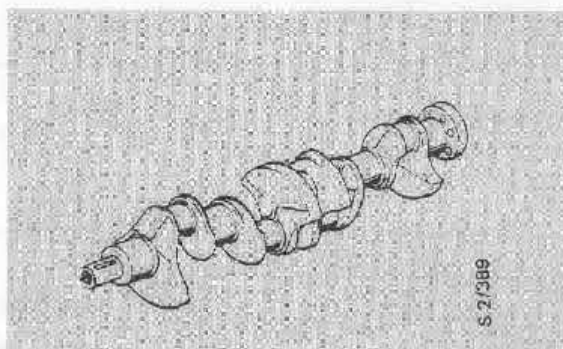
** Applies to segment

Gudgeon pins

Diameter:	mm (in)	23.996-24.000 (0.9447-0.9449)
Fit	mm (in)	0.005-0.014 (0.0002-0.0006) (sliding fit under gentle thumb pressure)

Connecting rods

Diameter of big-end	mm (in)	56.000-56.019 (2.2047-2.2055)
Diameter of small-end bush	mm (in)	24.005-24.010 (0.9451-0.9453) (fitted)
Maximum permissible weight variation per set	g (oz)	9 (0.32)

**Crankshaft**

Maximum variation in straightness	mm (in)	0.10 (0.0039)
End float	mm (in)	0.08-0.28 (0.0031-0.0110)
Maximum journal out-of-round	mm (in)	0.05 (0.0020)
Maximum taper of journals	mm (in)	0.05 (0.0020)
Radius of main journal fillet	mm (in)	2.2-2.5 (0.0866-0.0984)
Main bearing clearance	mm (in)	0.020-0.062 (0.0008-0.0024)
Big-end bearing clearance	mm (in)	0.026-0.061 (0.0010-0.0024)

Colour markings of main bearing and big-end bearing shells

	Thin	Thick
Standard	Red	Blue
First undersize	Yellow	Green
Second undersize	White	Brown

Crankpin diameter:

Standard	mm (in)	51.981-52.000 (2.0465-2.0472)
First undersize	mm (in)	51.731-51.750 (2.0367-2.0374)
Second undersize	mm (in)	51.481-51.500 (2.0268-2.0276)
Third undersize	mm (in)	51.237-51.250 (2.0172-2.0177)
Fourth undersize	mm (in)	50.987-51.000 (2.0074-2.0079)

Main journal diameter:

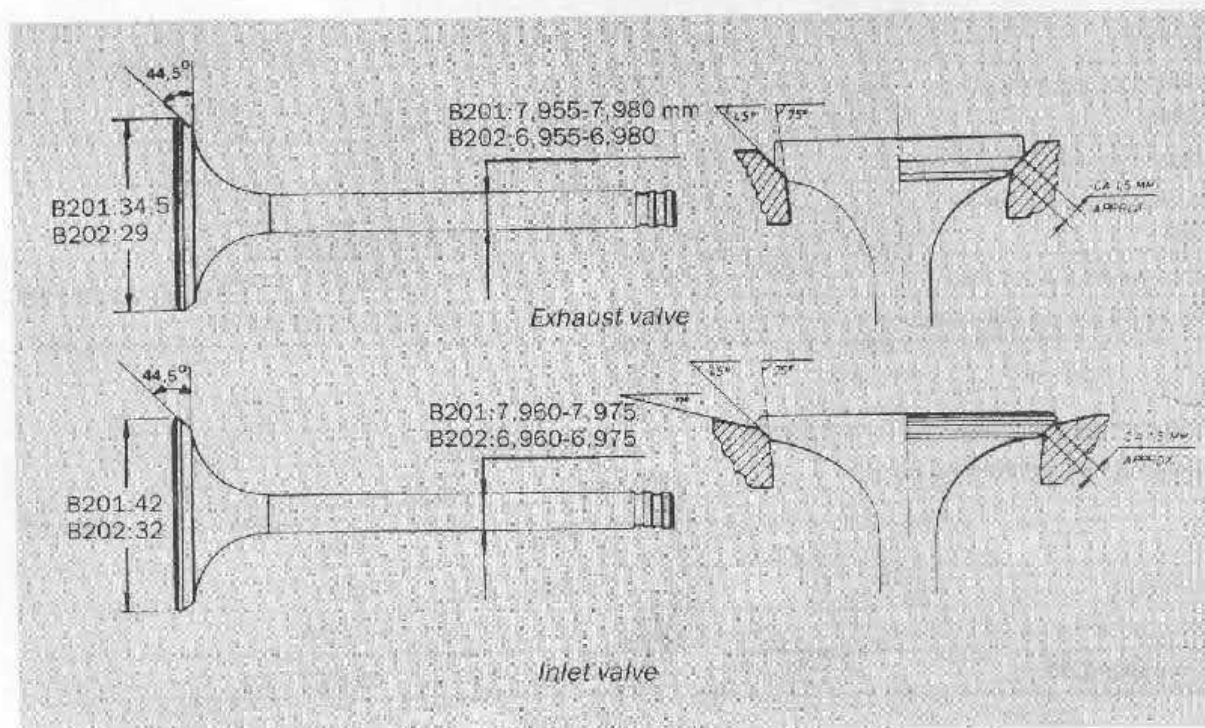
Standard	mm (in)	57.981-58.000 (2.2827-2.2835)
First undersize	mm (in)	57.731-57.750 (2.2729-2.2736)
Second undersize	mm (in)	57.481-57.500 (2.2630-2.2638)
Third undersize	mm (in)	57.237-57.250 (2.2534-2.2539)
Fourth undersize	mm (in)	56.987-57.000 (2.2436-2.2441)

Valve gear

Valve clearance, mm, in engine having stood for 30 min after running at normal temperature

N.B.: B201 engines only.

B201 engines		Turbo	Other engines
On checking:	inlet	0.15-0.30	0.15-0.30
	exhaust	0.40-0.50	0.35-0.50
On adjusting:	inlet	0.20-0.25	0.20-0.25
	exhaust	0.45-0.50	0.40-0.45

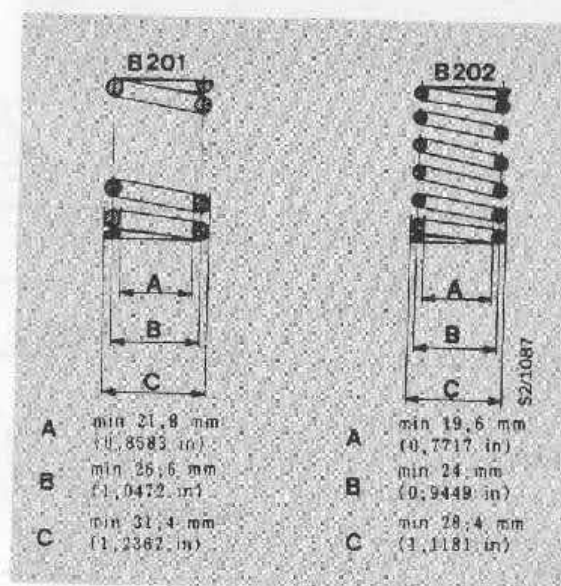


N.B.

The exhaust valves have a stellite coating and should therefore not be machined. Grinding using valve grinding paste is the only recommended method. The exhaust valves in engines with fuel injection are sodium filled and the sodium must therefore be removed before the valves are scrapped.

Valve guides

		B201	B202
Length	mm (in)	46.65 (1.837)	49.0 (1.9291)
Outer diameter	mm (in)	13.040-13.051 (0.5134-0.5138)	12.039-12.050 (0.4740-0.4744)
Bore for valve guides in cylinderhead	mm (in)	13.000-13.018 (0.5118-0.5125)	12.000-12.018 (0.4724-0.4731)
Maximum clearance between valve stem and valve guide	mm (in)	0.5 (0.2) measured on valve head raised 3 (0.2) above seat	

**Valve springs**

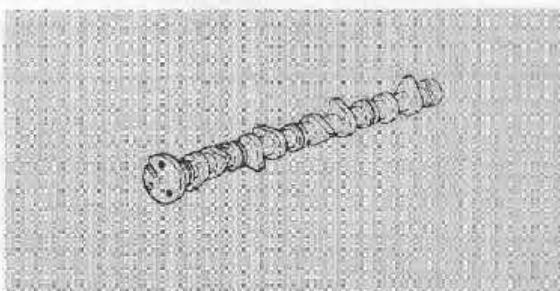
		B201	B202
Length when fitted	mm (in)	39.5 (1.56)	37.0 (1.4567)
Free length	mm (in)	45.7 (1.88)	45 ± 1.5 (1.78 ± 0.05)
Length when under load of 740-800 N (162 - 174 lbf)	mm (in)	29.5 (1.16) Length when under	
load of 595-645 N (131 - 141 lbf)	mm (in)	28.4 (1.12)	

Cam followers

		B201	B202
Diameter	mm (in)	37.87-38.98 (1.4909-1.4953)	32.959-32.975 (1.2976-1.2982)
Height	mm (in)	33 (1.2992)	26 (1.0236)
Bore for cam followers in cylinderhead (camshaft bearing assembly)	mm (in)	38.000-38.016 (1.4961-1.4967)	33.000-33.016 (1.2992-1.2998)

Shims for valve adjustment

Diameter	mm (in)	15.5 (0.6102)
Thickness	mm (in)	1.77-2.89 (0.0697-0.1138) 23 shims available within the range, at intervals of 0.05 mm (0.002 in)

**Camshaft**

		B201	B202
No. of bearings		5	5
Bearing diameter	mm (in)	28.94 (1.1394)	28.922-28.935 (1.1387-1.1392)
End float	mm (in)	0.08-0.25 (0.0031-0.0098)	0.08-0.35 (0.0031-0.0138)

Cam lift at 0 valve clearance

			Inlet Valves	Exhaust Valves
B201 carburettor	1981-	mm (in)	10.8 (0.425)	11.0 (0.433)
B201i	1981-	mm (in)	10.8 (0.425)	11.0 (0.433)
B201 Turbo	-1982	mm (in)	9.1 (0.358)	10.5 (0.413)
B201 Turbo APC	1981-	mm (in)	10.8 (0.425)	11.0 (0.433)
B202 Turbo	-1985	mm (in)	8.65/6.65	8.65
B202 Turbo with cat. converter	-1986		(0.341/0.262)	(0.341)
B202i	1986-			
B202 Turbo	1986-			
B202 Turbo with cat. converter	1987-	mm (in)	8.65 (0.341)	8.65 (0.341)

Valve timing

(at design clearance: 0.35 mm, inlet; 0.55 mm, exhaust)

Engine Model Year	Inlet Valves		Exhaust Valves	
	Open BTDC	Close ABDC	Open BBDC	Close ATDC
B201 Carburettor 1981-	10°	54°	46°	18°
B201i 1981-	10°	54°	46°	18°
B202i 1986-	16°	44°	61°	13°
B201 Turbo -1982	12°	40°	62°	2°
B201 Turbo APC 1981-	10°	54°	46°	18°
B202 Turbo -1985	10°	56°	56°	16°
B202 Turbo 1986-	16°	56°	61°	13°

Tightening torques

		Torque, Nm	Torque, lbf ft	Dimension
Main bearings		110	81	M 12
Big-end bearings		55	41	M 10
Camshaft bearing caps,	B201	15	11	M 8
	B202	15	11	M 8
Valve cover	B201	5	3.7	M 6
	B202	15	11	M 8
Crankshaft pulley		190	141	M 16
Rear engine plate (flywheel end)		20	14.8	M 8
Flywheel		59	44	M 10
Oil pump		8	5.9	M 6
Spark plugs		28	20.7	M 14 x 1.25
Chain tensioner,	B201	12	8.9	M 6
Chain guide,	B201	12	8.9	M 6
Chain tensioner,	B202	63	46.6	M 10
Camshaft sprocket,	B201	20	14.8	M 8
Camshaft sprocket,	B202	63	46.6	M 10
Engine to gearbox		25	18.5	-
Inlet manifold		18	13.5	M 8
Thermostat housing		18	13.5	M 8
Throttle housing		18	13.5	M 8
Exhaust manifold, Turbo		25	19	M 8
allother models		20	14.8	M 8
Timing cover				
Distributor,	B201	5	3.7	M 6
	B202	20	14.8	M 8
Oil filter		10	7.4	3/4"-16 UNF
Oil pressure switch		10	7.4	1/4"-18 NPTF
EGR valve		15	11	M 14 x 1.5
Engine block heater plug		55	40.7	3/8" BSP
Drain plug, coolant		30	22.2	M 14 x 1.5
Knock detector,	M82 earlier	8	5.9	-
	M83 onwards	20	14.8	-

All other bolts should be tightened as follows:

Dimension	Tightening torque	
	Nm	lbf ft
M 5	5	3.6
M 6	10	7.2
M 8	20	14.4
M 10	40	23.8

Technical Description

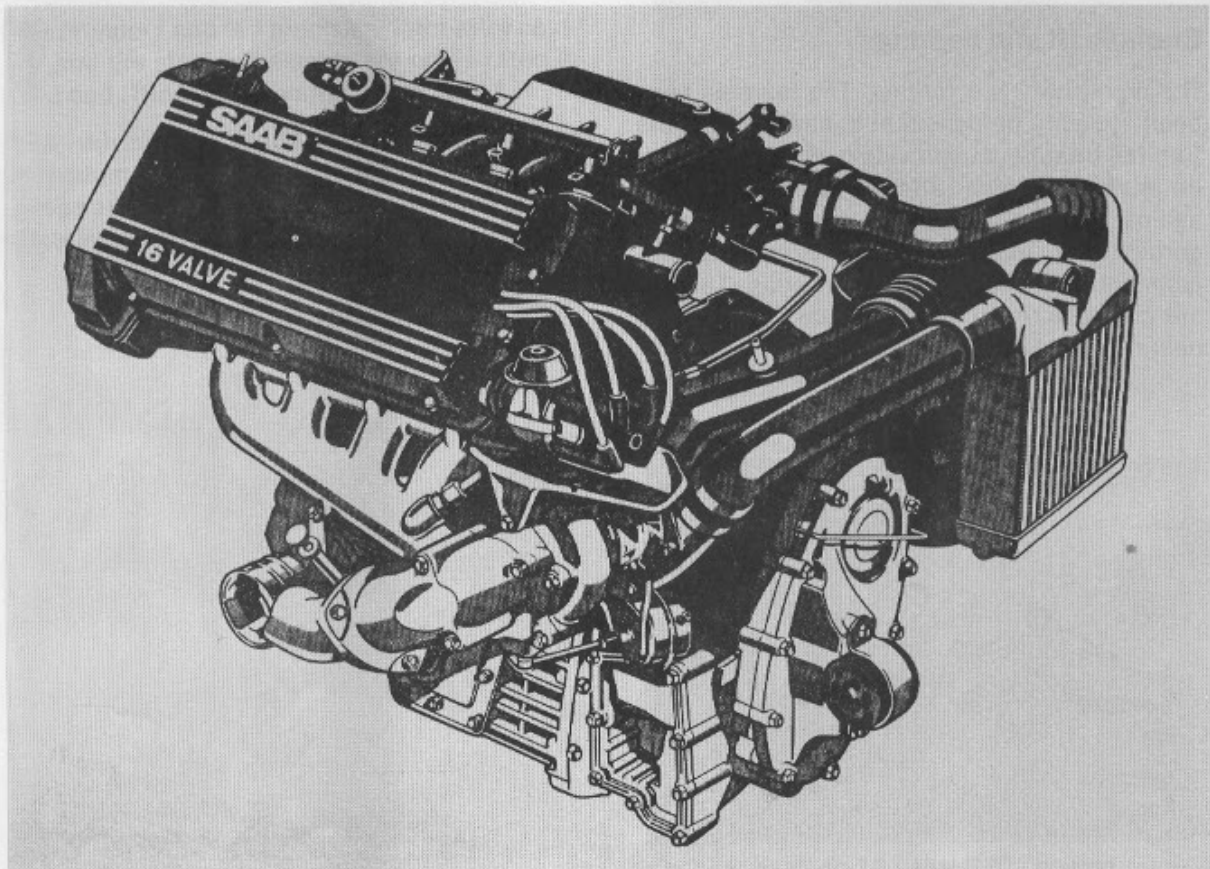
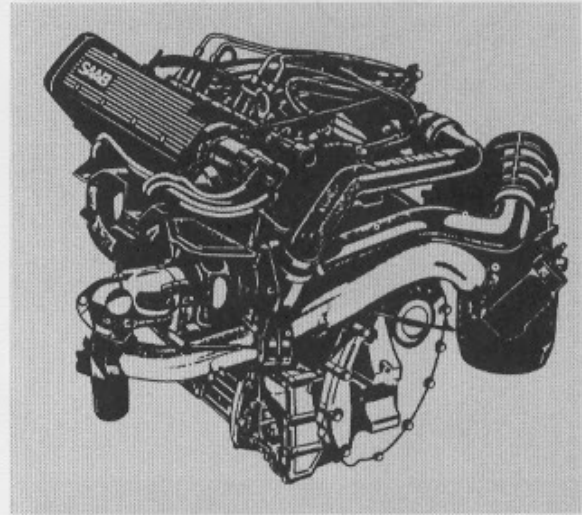
Engine	200-1
Engine mountings B201	200-7

Lubricating system	200-5
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Engine body

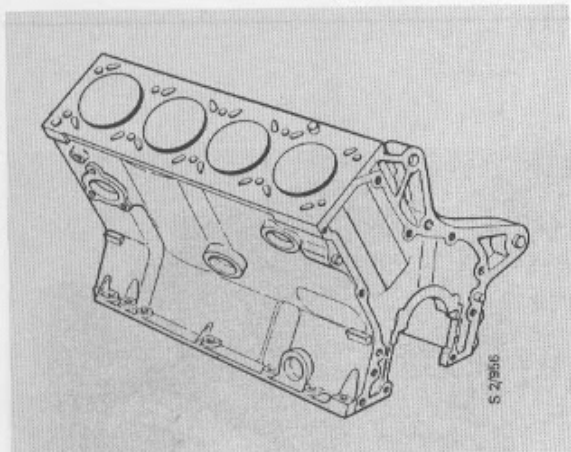
General

The water cooled engine is a four-in-line with either single (B201) or twin (B202) overhead camshafts. The crankcase ventilation is totally enclosed. The cylinder block is inclined at an angle of 45 to the right and the cylinder head is of the cross-flow type, i.e. with the inlet ports on one side and the exhaust ports on the other. The engine is mounted with the clutch towards the front of the car and with the timing chain and the no. 1 cylinder towards the rear. The engine is available in carburettor, fuel injection and turbocharged versions and in 8-valve and 16-valve variants.

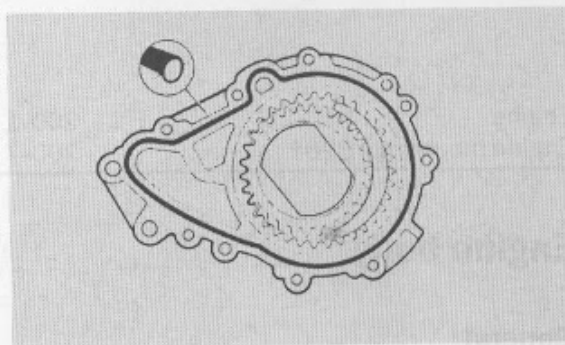


Cylinder block

The cylinder block is made of special cast iron, cast in one piece. The cylinder bores, surrounded by cooling jackets, are drilled straight out of the block. The block also contains oilways for the lubricating system.



The crankshaft drives the oil pump which is interposed between the timing cover and the crankshaft pulley.

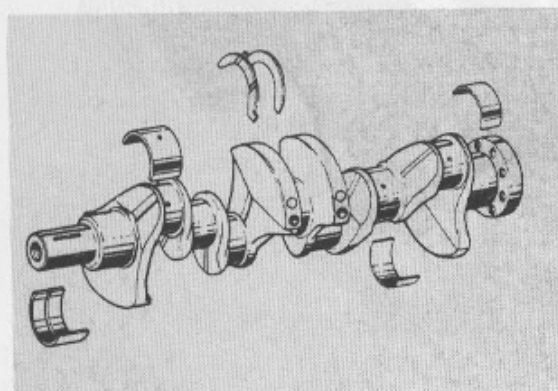


The waterpump and alternator are driven from the crankshaft by a V-belt.

The steering servo pump and AC compressor are also driven by V-belts from the crankshaft pulleys.

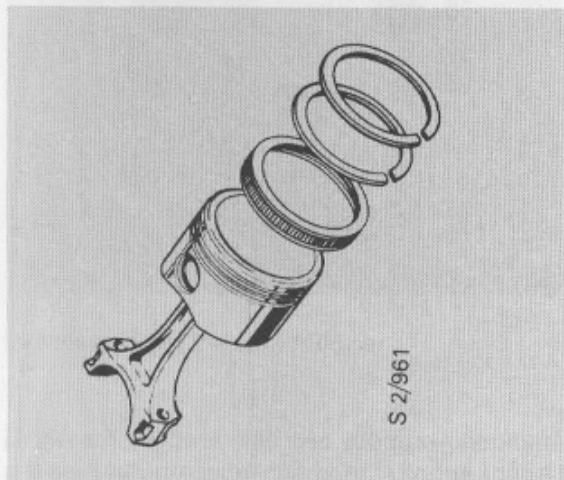
Crankshaft and bearings

The crankshaft is a forging. The journals have been ground, hardened and have undergone 'Tenifer' treatment to provide a hard, non-metallic surface, which affords good protection against bearing seizure. The crankshaft is supported by five main bearings, with end-float adjustment made at the centre bearing. Oilways are drilled in the shaft for lubrication. All main bearing shells are replaceable.



Pistons

The pistons are made of light alloy and are provided with grooves for two compression rings and one oil scraper ring. The top compression ring is flat with a chromium finish. The second compression ring has oil-control properties and is slightly wider than the top ring. The actual oil scraper is a three-piece ring.



Connecting rods

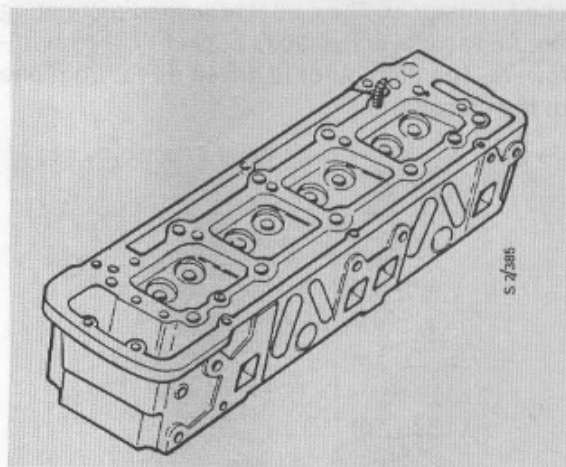
The connecting rods are forged and incorporate bushes for the gudgeon pins. Gudgeon-pin bushes and big-end bearing shells are replaceable.

The gudgeon pins are of the fully-floating type, being free to turn in both piston and connecting rod. Axial movement of the pins is limited by circlips inside the piston boss.

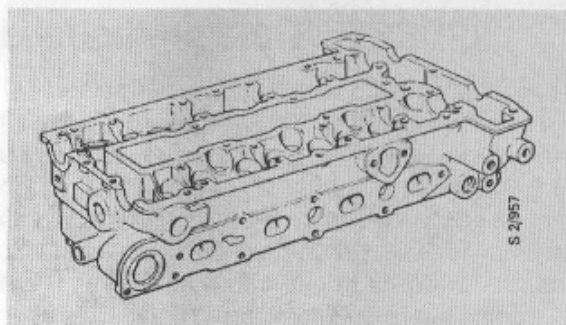
Cylinder head

The cylinder head is a precision, light-alloy casting and the steel valve seats are press-fitted in the head. The head is bolted to the block.

The valves are made of steel and have chromium-plated stems. The heads on the inlet valves are induction hardened and those on the exhaust valves stellite.



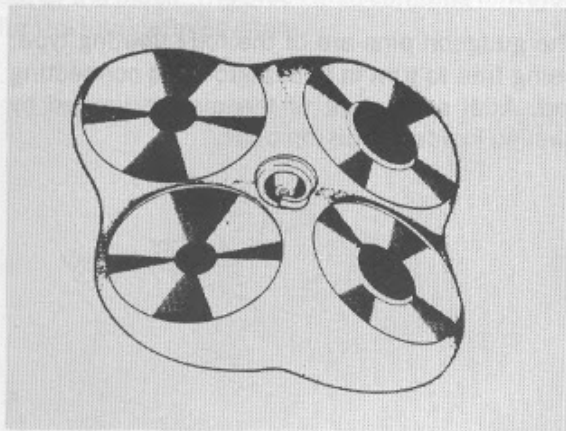
Cylinder head on 8-valve B201 engine



Cylinder head on 16-valve B202 engine

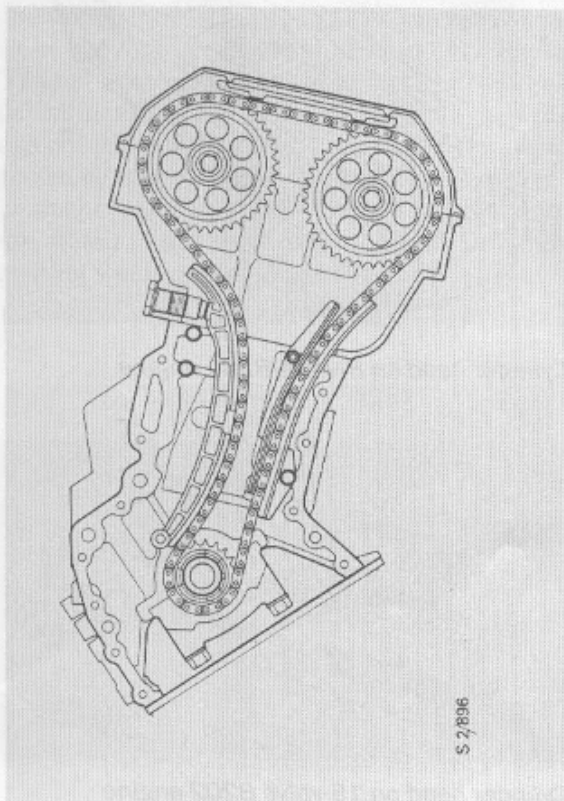
200-4 Technical Description

The combustion chambers are hemispherical and, on the B202 engine, each cylinder has four valves, with the spark plug being located centrally.

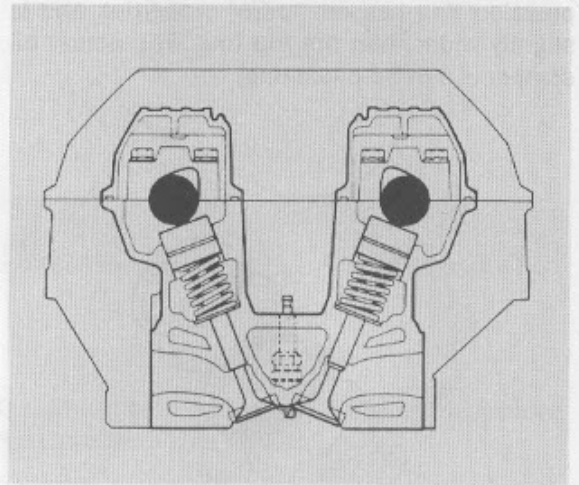


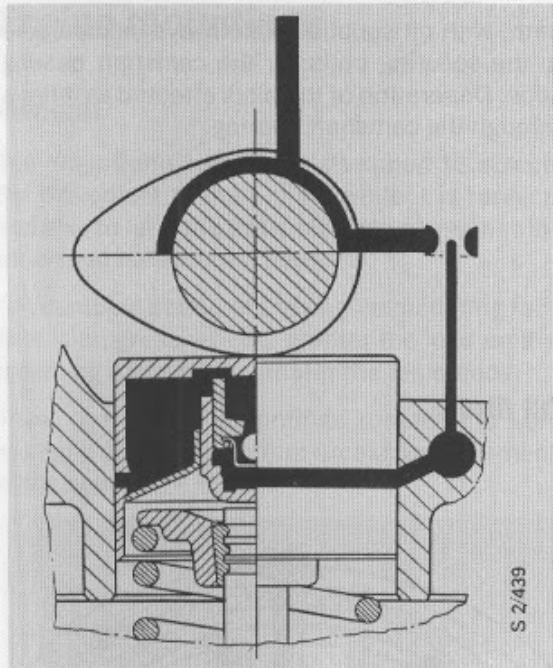
Camshafts and cam followers (B202)

The engine has twin overhead camshafts, each of which is mounted in five bearings. The cams have a wide base circle, which provides a large amount of lift but little stress. The camshafts are driven by a chain with an effective automatic chain tensioner. The camshafts are direct acting on the valves via hydraulic bucket-type cam followers. The distributor is driven direct from one of the camshafts.



The hydraulic cam followers adjust automatically to differences in valve clearance caused by variations in temperature. The main advantage of the hydraulic cam followers is that they operate silently and are extremely reliable.

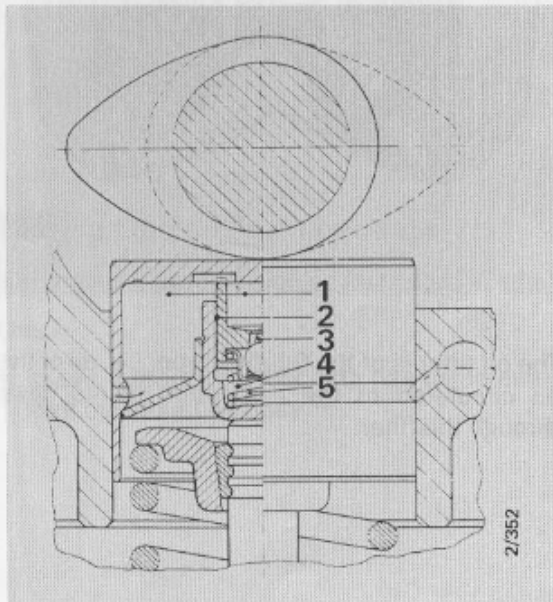
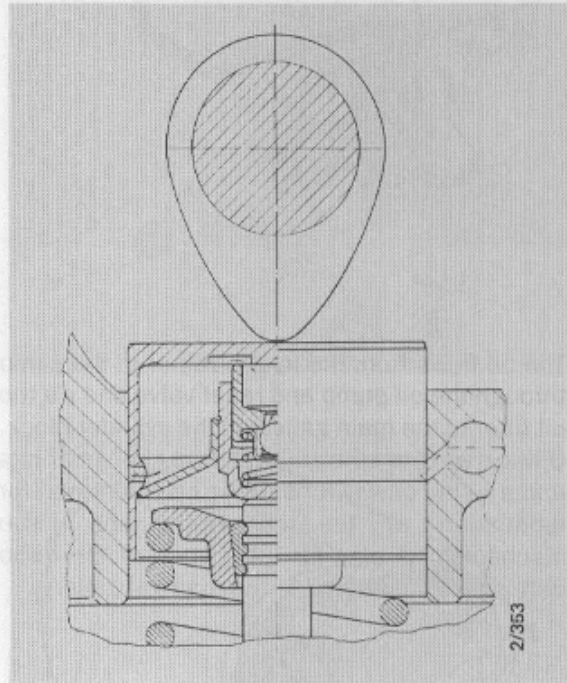




Oil flow through the cam follower

Each cam follower has two storage chambers and one high-pressure chamber. A spring-loaded ball valve seals the orifice between the high-pressure chamber and the adjacent storage chamber. A return spring in the high-pressure

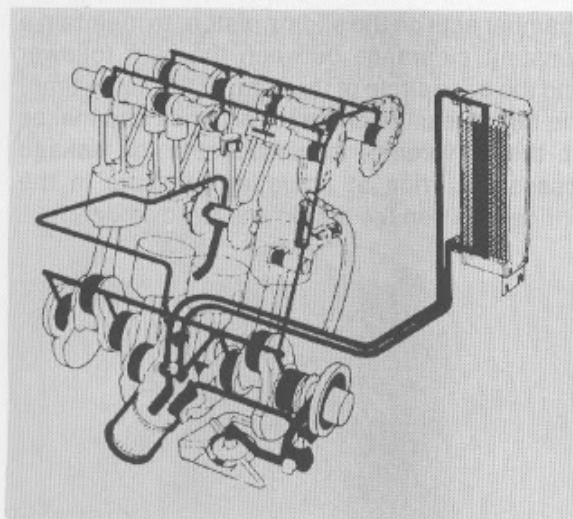
chamber acts on the sliding piston, to maintain a constant clearance between the cam follower and the base circle of the cam. At the same time, the high-pressure chamber expands and makes up the oil volume, to compensate for leakage losses occurring at actuating pressure in the orifice between the piston and the cylinder.



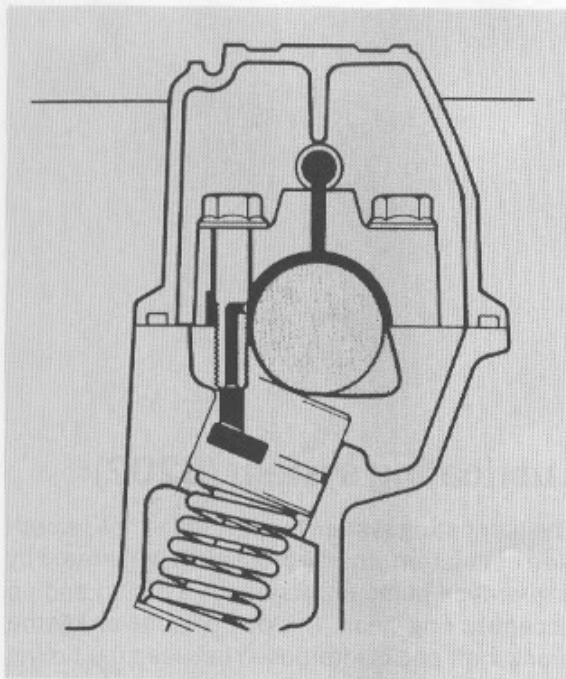
- 1 Storage chamber
- 2 Leakage orifice
- 3 Check valve
- 4 High-pressure chamber
- 5 Spring

Lubricating system (B202)

The lubricating system for the engine has forced-flow circulation. The oil pressure is generated by a gear-type pump consisting of a pinion and an eccentric ring gear. The pump is driven by the crankshaft and is interposed between the timing cover and the crankshaft pulley. A relief valve in the timing cover limits the oil pressure and diverts surplus oil to the inlet side of the pump.



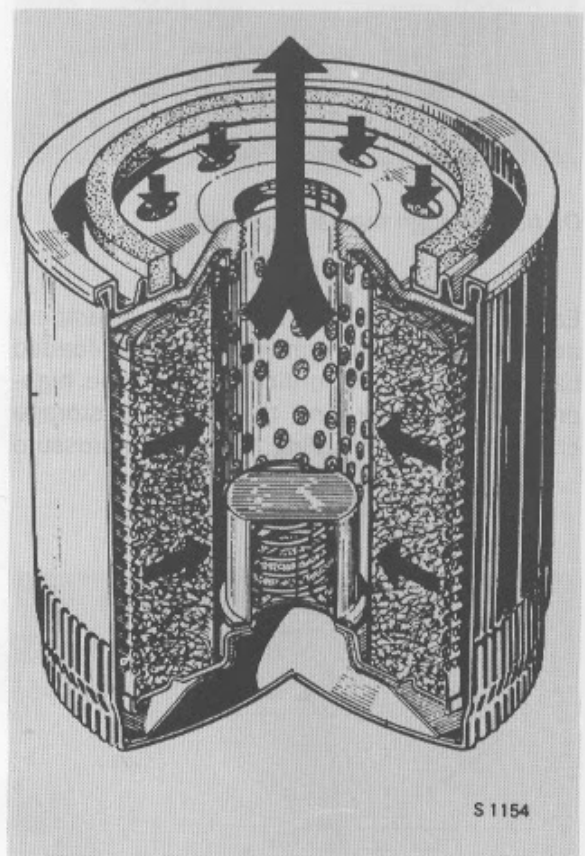
The oil flows from the inlet strainer in the sump through the oil pump and relief valve and via the oil filter to the main gallery in the cylinder block. Oilways run from the gallery to the main bearings and a rising oilway runs to the cylinder head for lubrication of the camshafts and valve mechanism. A pipe for lubrication of the turbo unit is also connected to the main oil gallery.



The hydraulic cam followers operate in an oil

bath, with oil supplied via oilways incorporated in the securing bolts for the camshaft bearing caps. Deaeration of the oil is effected as it flows through the camshaft bearing.

Oil filter



The oil filter is of the full-flow type: i.e. all of the oil circulated to the lubrication points flows through the filter.

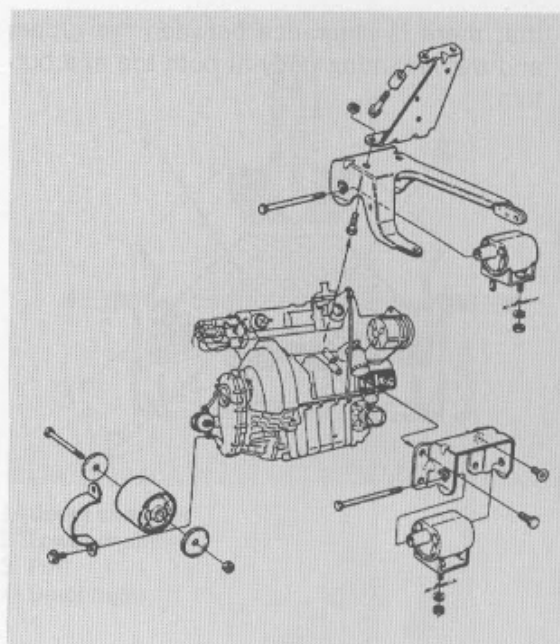
Engine mountings

General

The engine mountings are designed to absorb the movement of the engine while it is running and also to limit the transmittance of engine vibration and noise to the body.

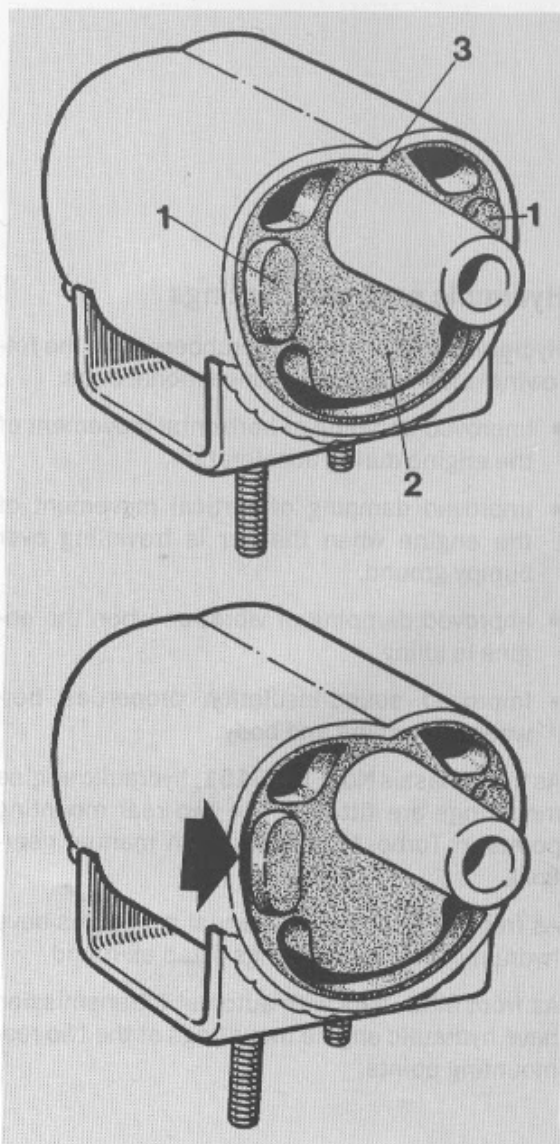
The damping action of the engine mounting rubbers is progressive - the greater the load on the mounting rubbers the greater the resistance.

Thus, the engine mountings protect the surrounding components from excessive movement of the engine.



Engine mounting rubbers

The engine mounting rubbers have two primary modes of operation: under normal driving conditions, only the No. 1 sections of the mountings are operative, providing low damping resistance. However, when the car is accelerating or braking hard, sections 2 and 3 also come into play, providing a considerably greater damping effect.



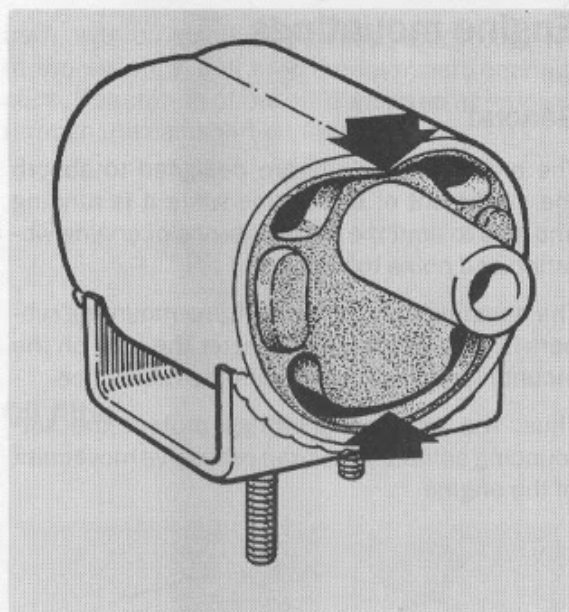
Checking the engine mountings

The engine mountings can be inspected in situ.

Check:

- to see if the rubber bonding has come away from the mounting body.

- that there is clearance between the rubber and the mounting body at both top and bottom.



Hydraulic engine mountings

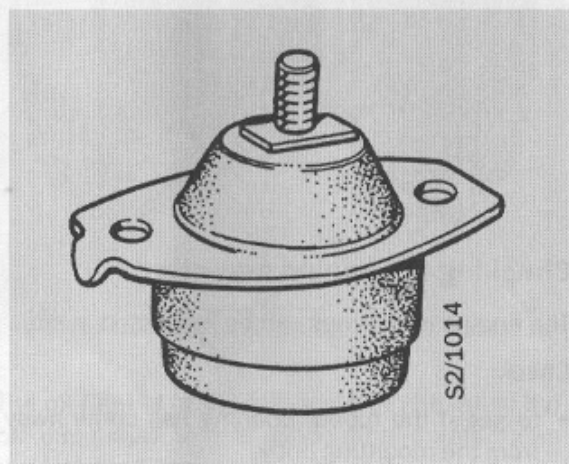
Hydraulic engine mounting rubbers have the following advantages over conventional ones:

- Improved damping of horizontal movement of the engine during acceleration.
- Improved damping of vertical movement of the engine when the car is travelling over bumpy ground.
- Improved damping of vibration when the engine is idling.
- Improved sound-insulation properties between the engine and body.

As from chassis No. F1033151, hydraulic engine mountings are fitted at the two rear mounting points in Turbo 16 models (with manual gearbox).

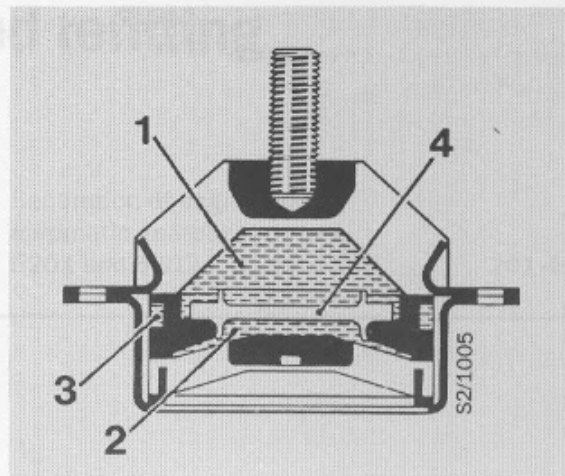
As from M86, cars with manual gearboxes have hydraulic engine mountings fitted all round.

As from M86, cars with automatic transmission have hydraulic engine mountings at the two rear mounting points.



The hydraulic engine mounting has two chambers containing a special damping fluid. Linking the two chambers is a port, and the length and cross-sectional area of this port govern the damping properties of the mounting. The chambers are also separated by a diaphragm which takes up the forces generated by the small movements of the engine occurring under normal conditions.

The capacity of the diaphragm is not sufficient to damp large engine movements; under these conditions, fluid is forced from the upper to the lower chamber, equalizing the pressures. The damping action of the hydraulic mounting is therefore progressive, with the resistance to movement increasing with load.



- 1 Upper chamber
- 2 Lower chamber
- 3 Port
- 4 Diaphragm

To remove

1 Disconnect the linkage for the engine hanger, disconnect the washer hose and remove the bracket.



Removal and refitting, B202

The following procedure for removal and refitting applies to the M88 B202 Turbo engine equipped with intercooler, catalytic converter, AC system, water-cooled turbocharger and manual gearbox.

Various departures from the method described will have to be made on account of differences in different model years and engine variants.

To remove

- 1 Disconnect the linkages for the bonnet hinges, disconnect the washer hose and remove the bonnet.

Fig. 1001: Disconnecting the bonnet hinges

Fig. 1002: Disconnecting the washer hose

Stand the bonnet where it will not be damaged, e.g. leaning securely against a wall.

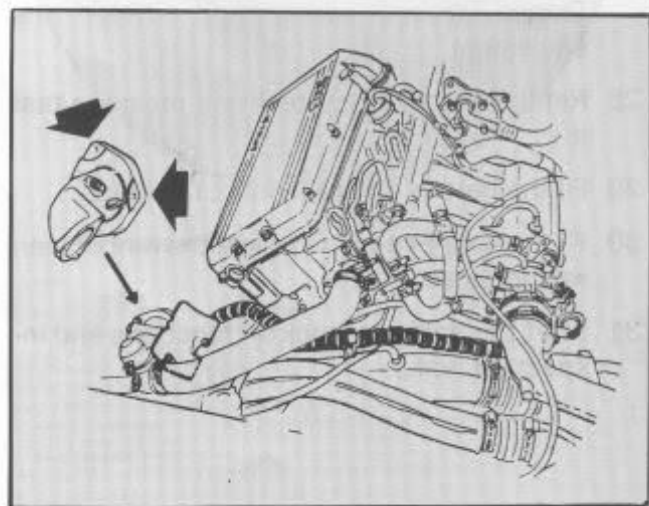
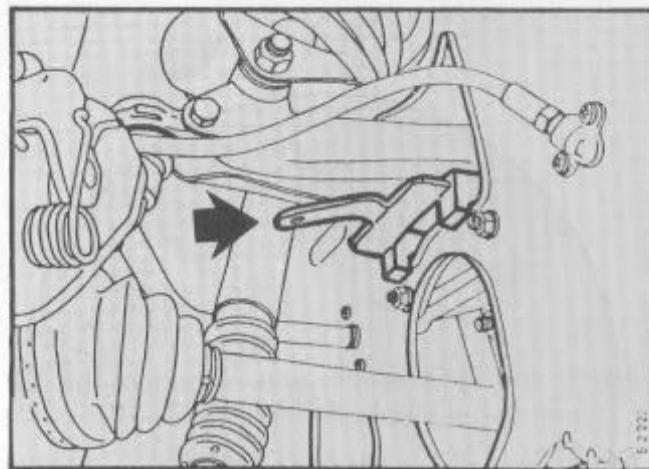
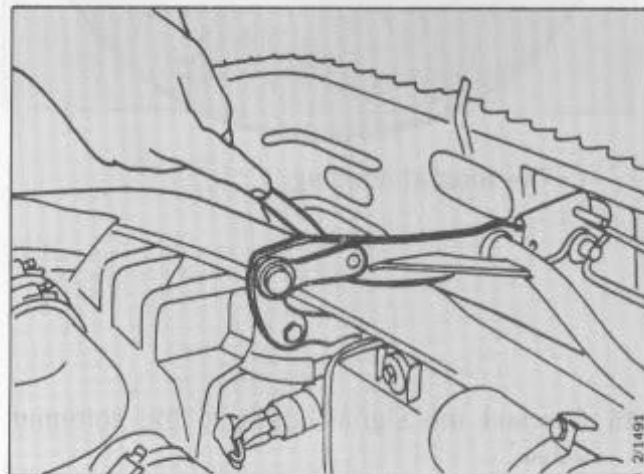
- 2 Insert tool 83 93 209 between the upper wishbone and body on the RH side: turn the wheel to full RH lock and insert the tool from the wheel-arch side.

- 3 Disconnect both battery leads.
Remove the battery.

- 4 Unbolt the exhaust pipe from the exhaust manifold.

Fig. 1003: Disconnecting the battery leads

- 5 Slacken the wheel bolts on the RH wheel.

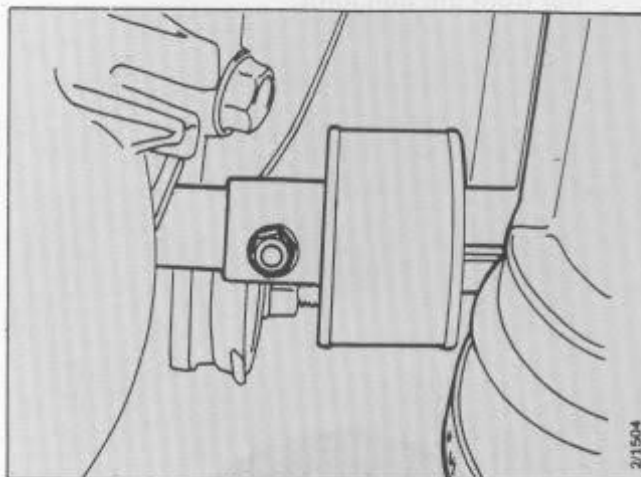


6 Drain the power-steering fluid reservoir.

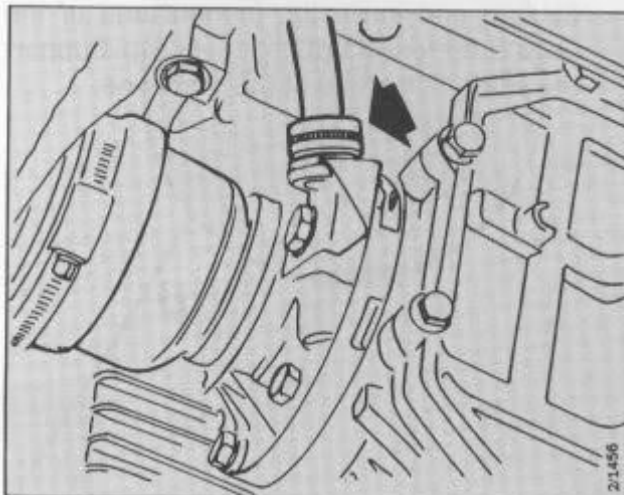
7 Raise the car.

8 From underneath the car:

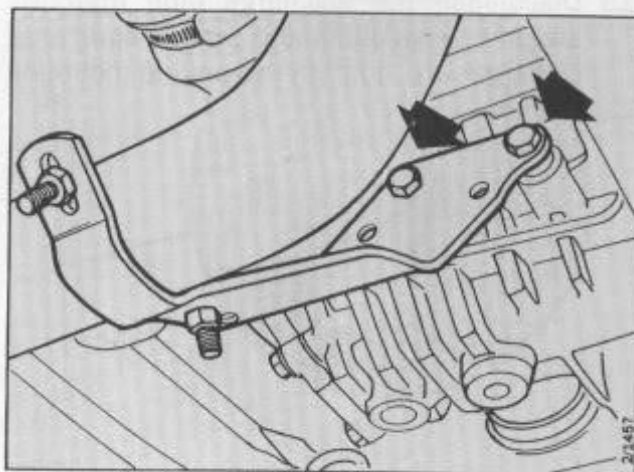
- a Remove the nut and carefully tap the taper pin out of the selector rod. Separate the selector rod from the linkage.



- b Disconnect the speedometer drive.

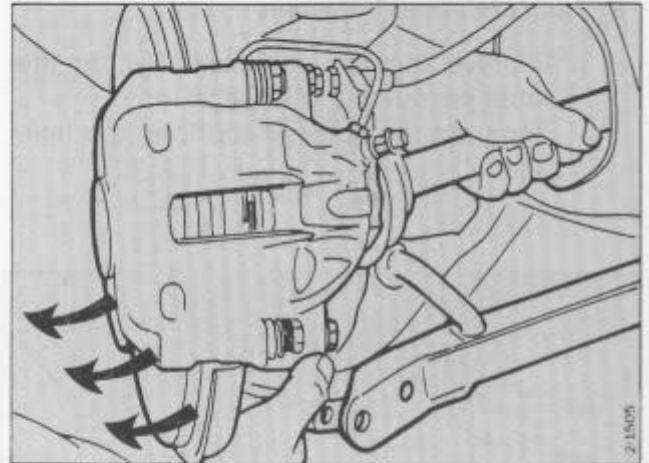


- c Remove the exhaust pipe bracket bolts from the gearbox.

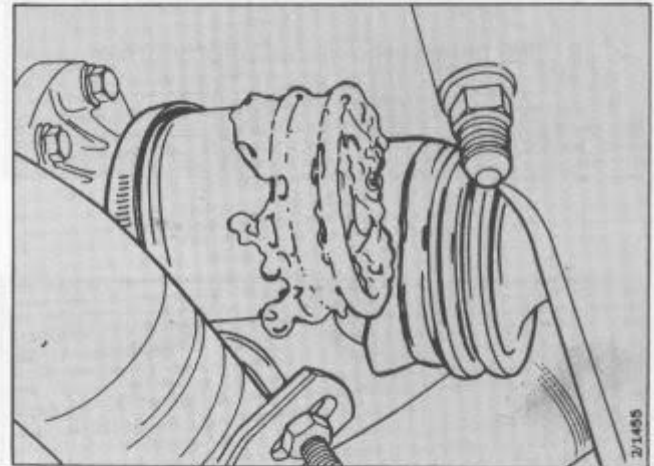


- d Undo the clips on the gaiters over the in-board drive-shaft joints and pull the gaiters off the driver cups.

- 9 Lower the car to a convenient working height.
- 10 Remove the RH front road wheel.
- 11 Separate the lower wishbone and anti-roll bar from the ball joint.



- 12 Separate the inboard drive-shaft joint on the RH side and move the inboard end of the drive shaft forward of the driver cup. Support the shaft on the end of the wishbone.

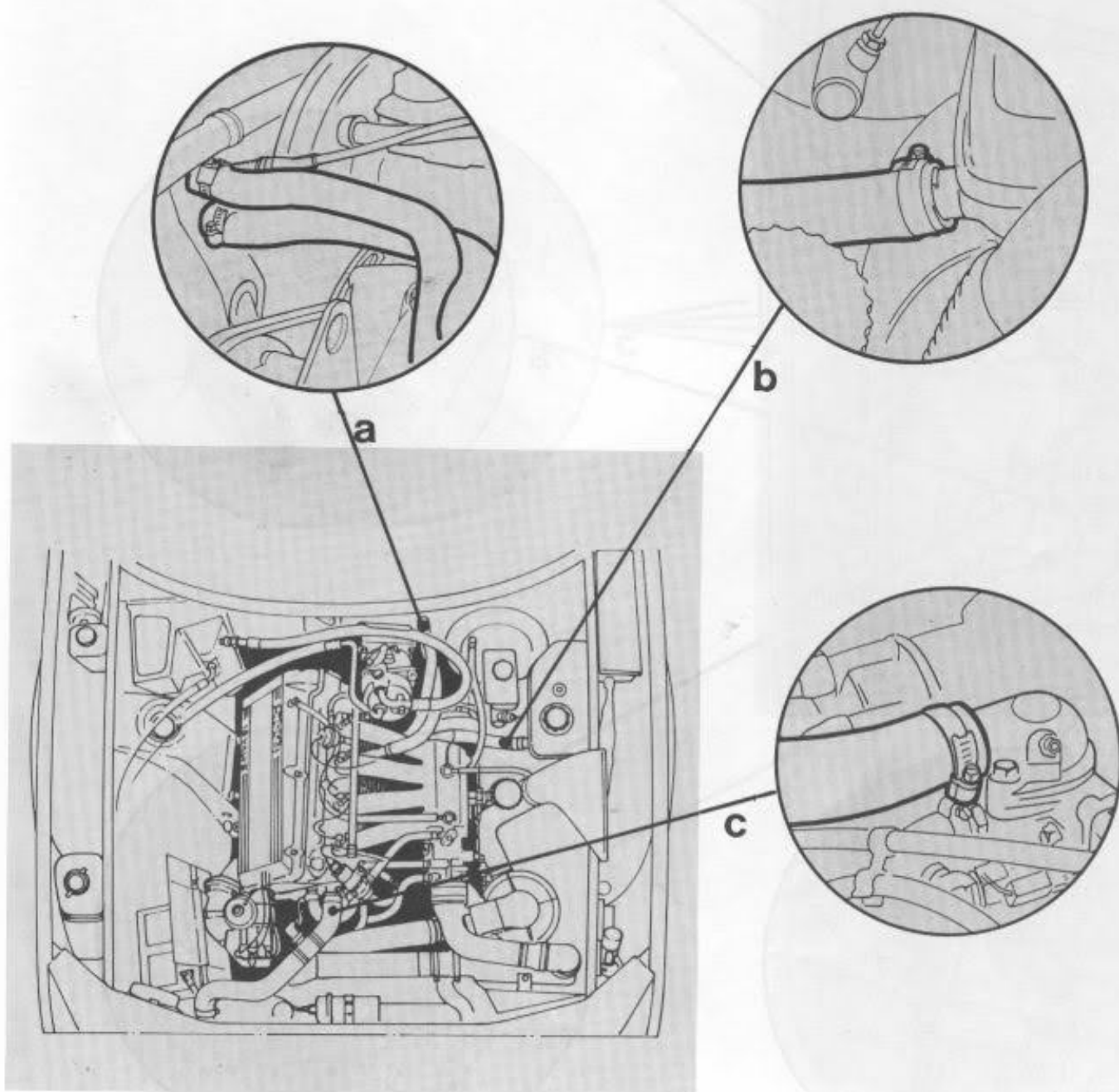


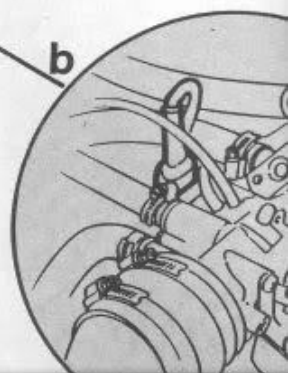
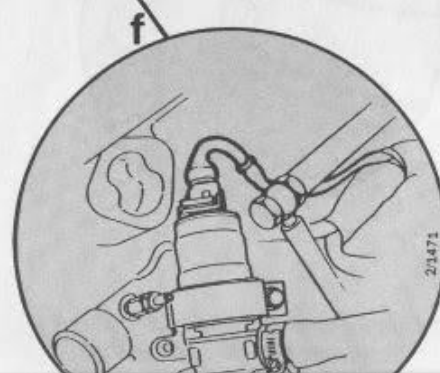
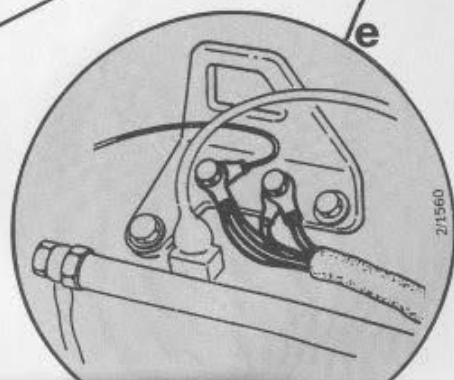
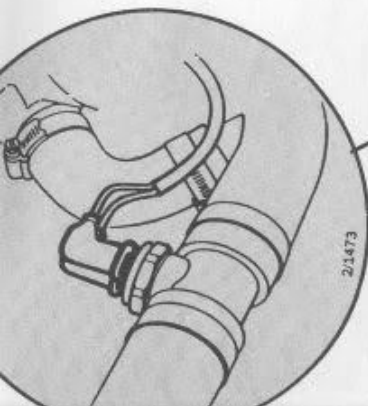
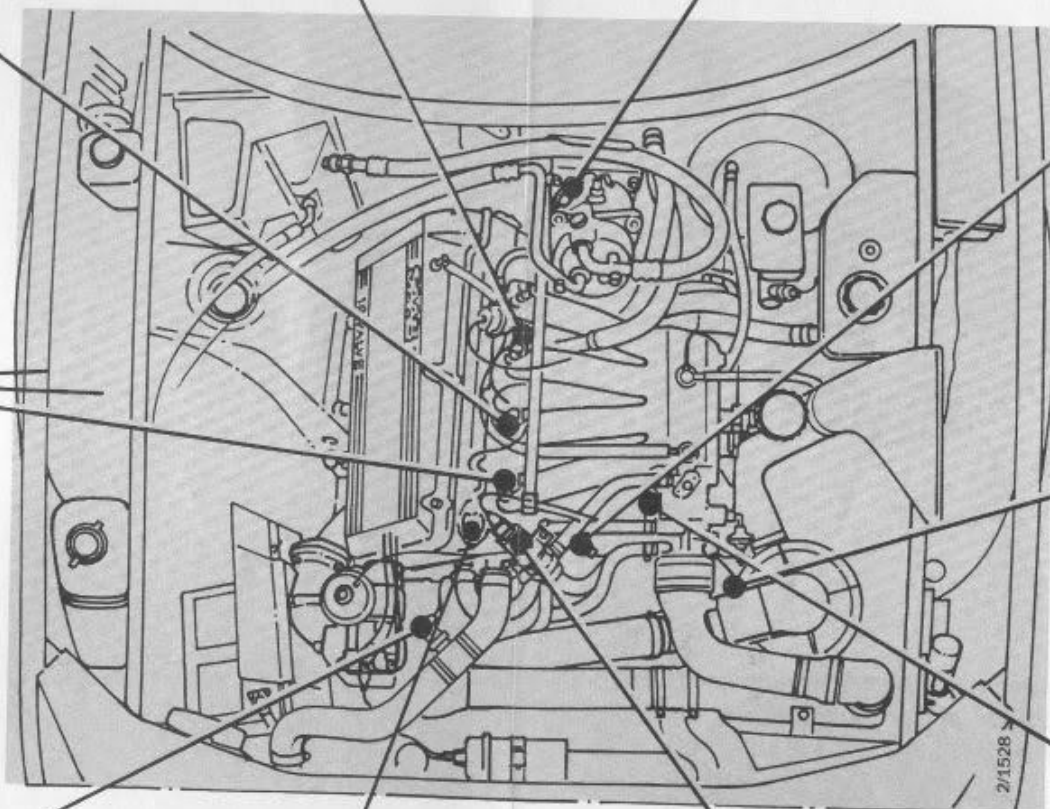
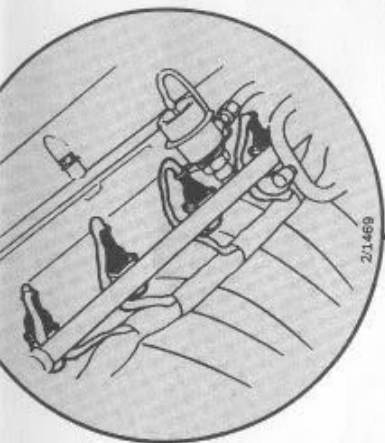
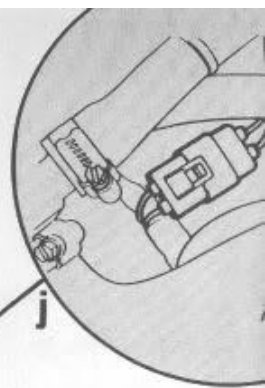
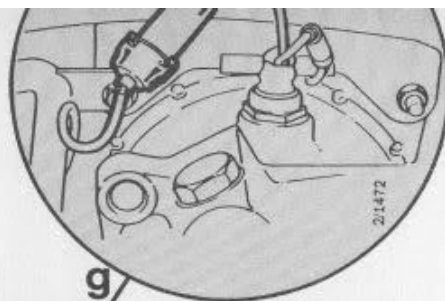
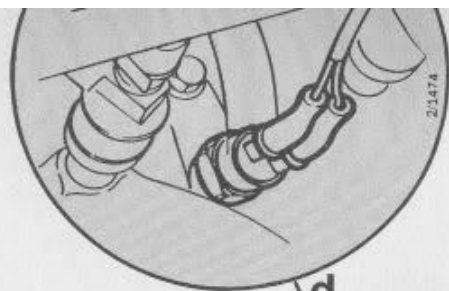
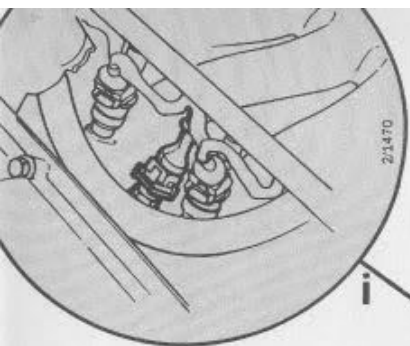
- 13 Disconnect the discharge pipe from the steering servo pump and cap the open end. Don't get any fluid on the engine mounting rubber.



- 14 Slacken the tensioner and remove the drive belt for the AC compressor.
- 15 Drain the coolant through the drain plugs on the block and at the bottom of the radiator. Disconnect the oil filler pipe.

- 16 Disconnect the coolant hoses from the following:
- a Heat exchanger valve
N.B. Label the hoses to ensure they are reconnected properly.
 - b Expansion tank
 - c Thermostat housing



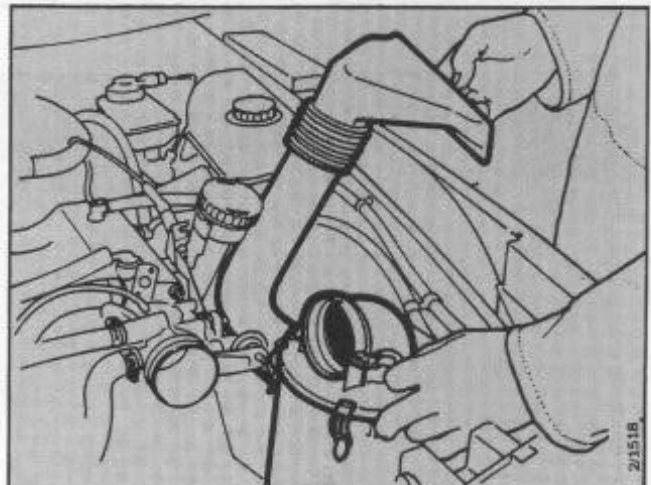


- 17 Disconnect the LH fuel injection system wiring loom at:
- a Air mass meter
 - b Throttle-position sensor
 - c Injection valves
 - d Temperature sensor
 - e Earthing points on engine lifting lug
 - f AIC valve

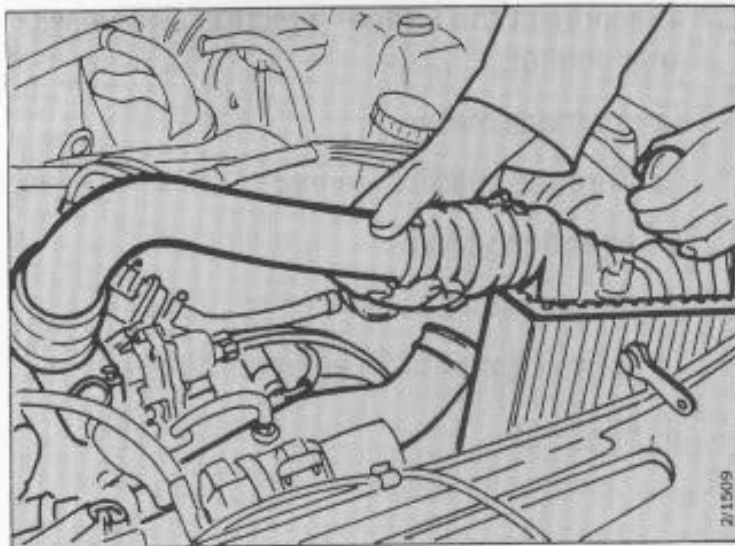
N.B.

If necessary, use a small screwdriver to release the catches on the connectors.

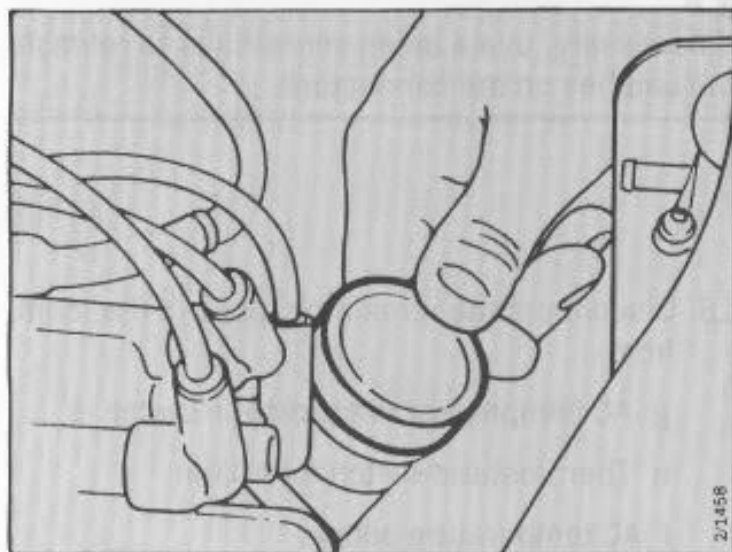
- 18 Disconnect the remaining leads in the loom from:
- g AC compressor thermostatic switch
 - h Thermostatic switch for AC fan
 - i AC temperature sensor
 - j Unplug the connector for the shift-up indicator vacuum switch
- 19 Pull clear all the disconnected leads, lift the loom out of the engine bay and rest it on the AC heat exchanger.
- 20 Remove the turbo discharge pipe.
- 21 Remove the air mass meter complete with rubber socket connector.
- 22 Remove the air cleaner complete with air intake.



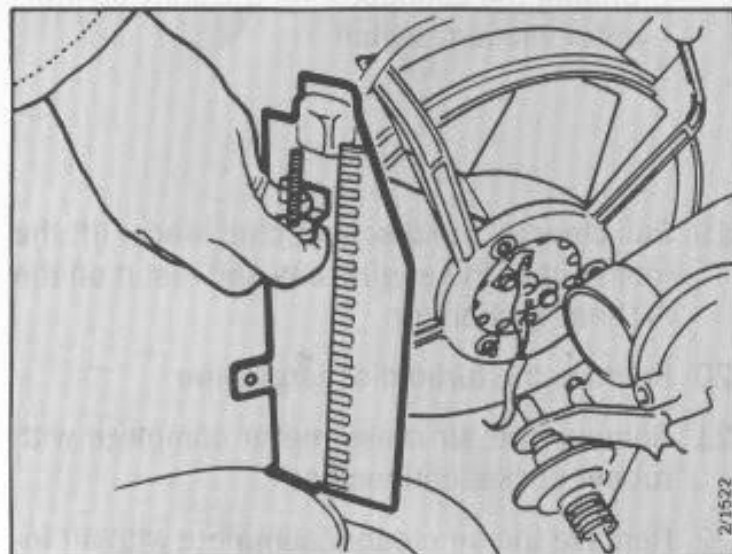
- 23 Remove the intercooler complete with air pipe.



Cap the inlet to the turbocharger.



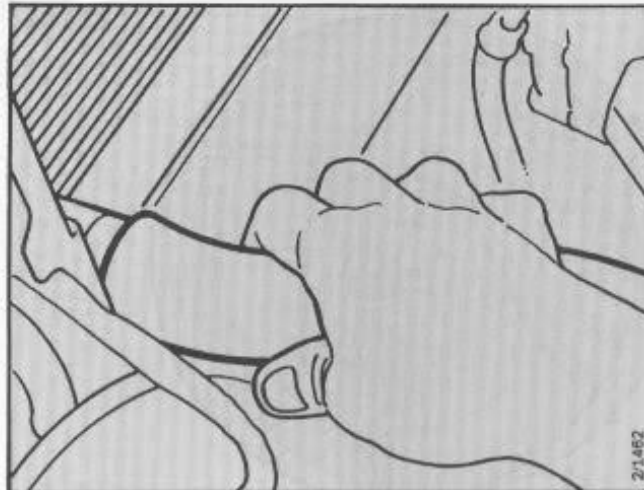
- 24 Remove the baffle plate from the side of the intercooler and the top cover.



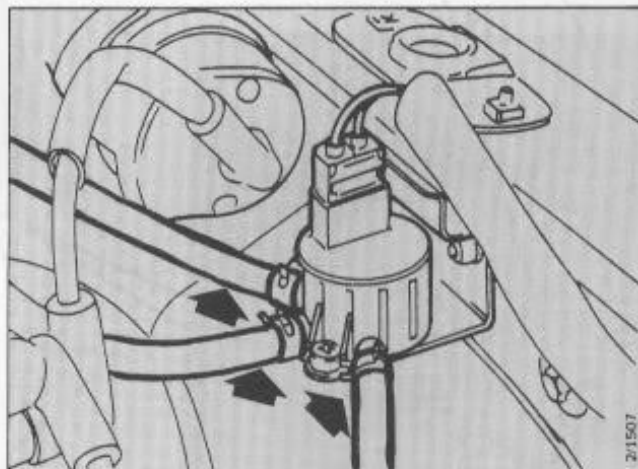
- 25 Remove the ignition coil.

- 26 Remove the AC cooling fan.

- 27 Disconnect the coolant hose from the bottom of the radiator.

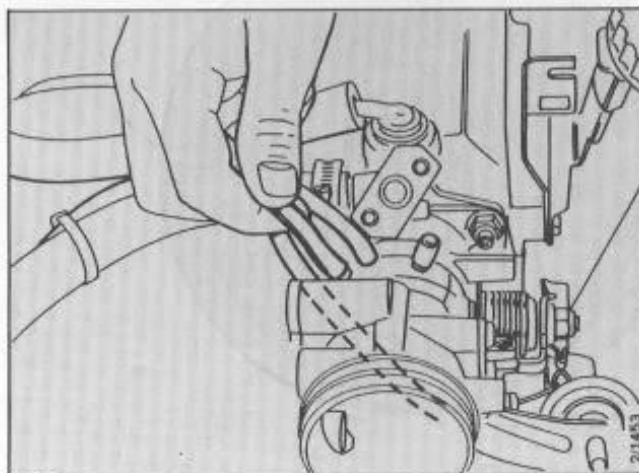
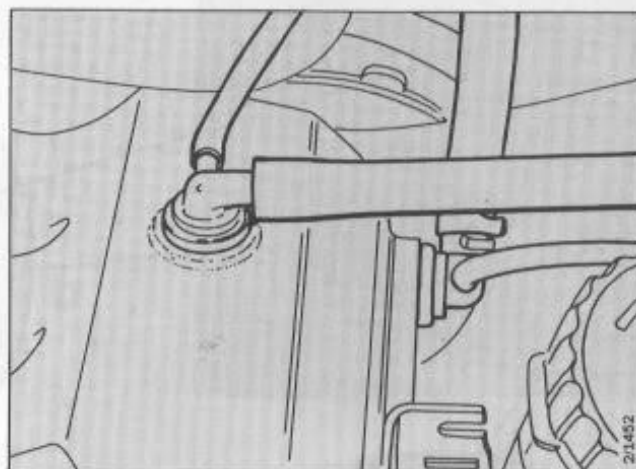


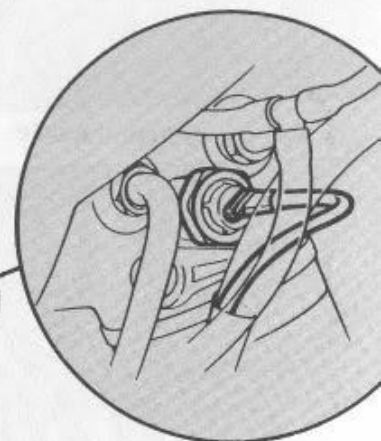
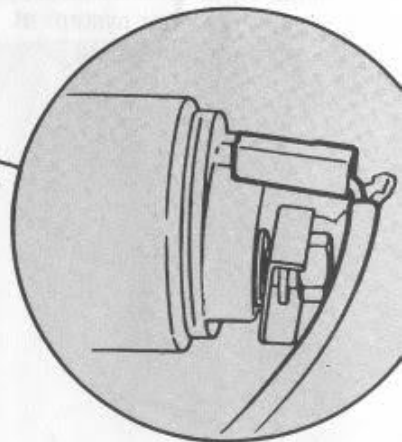
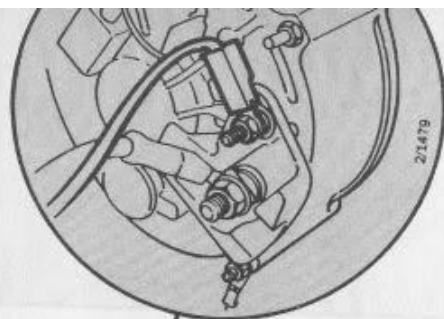
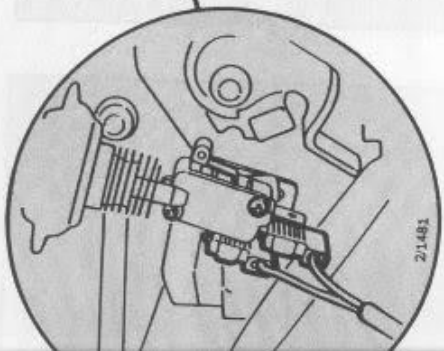
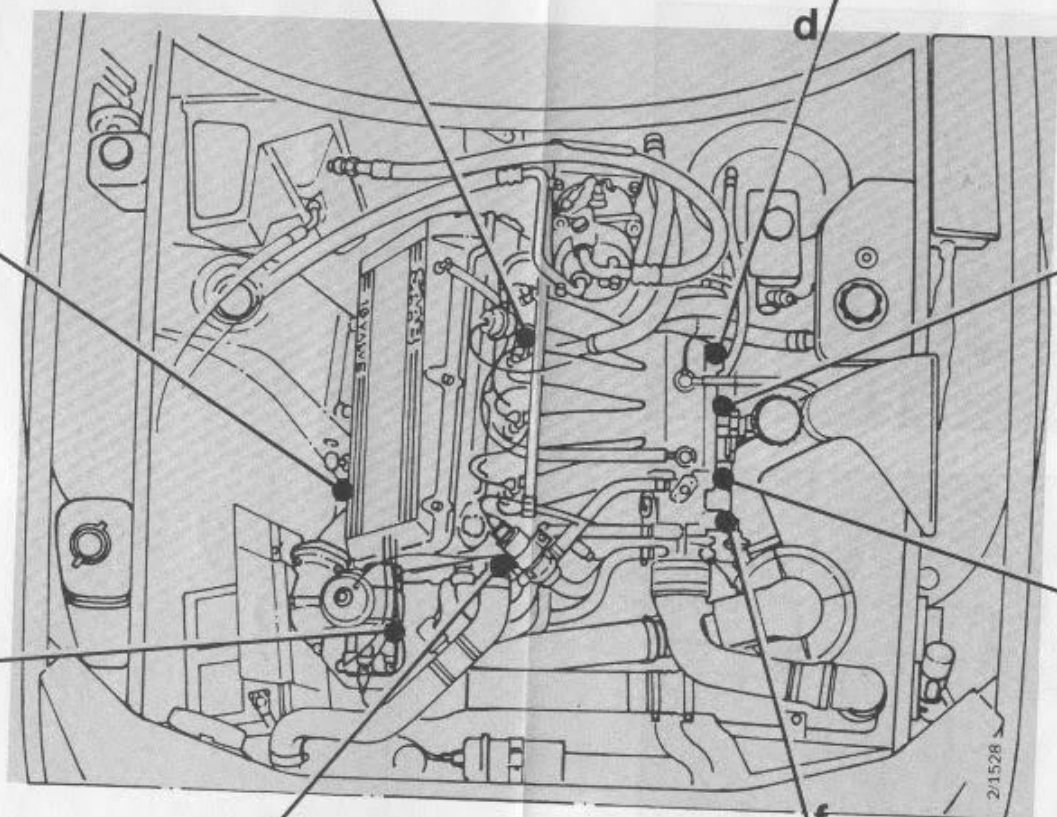
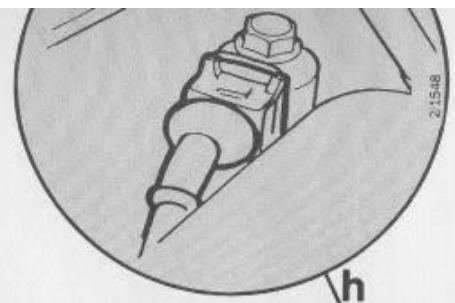
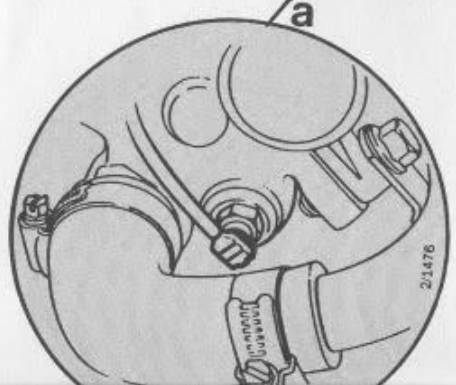
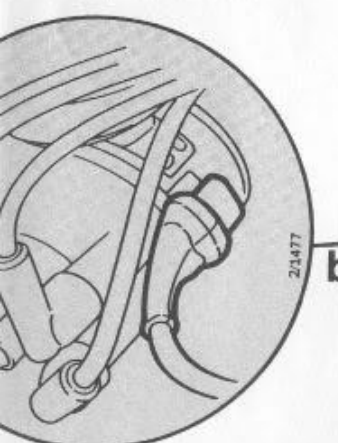
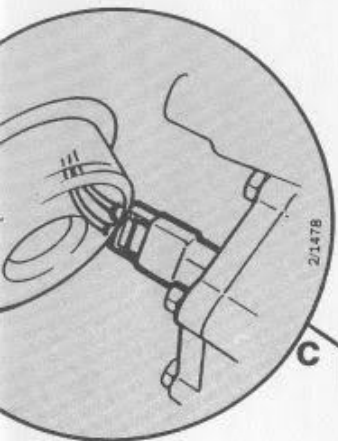
- 28 Disconnect the signal hoses from the solenoid valve.



- 29 Disconnect the throttle cable and sheath.

- 30 Disconnect the vacuum hoses for the brake servo and the fuel tank breather system at the inlet manifold and throttle housing.





31 Snip through the cable ties and release the wiring loom for the starter motor, alternator, temperature sensor, etc., on the left-hand side of the engine.

32 Disconnect the leads in the wiring loom from the following:

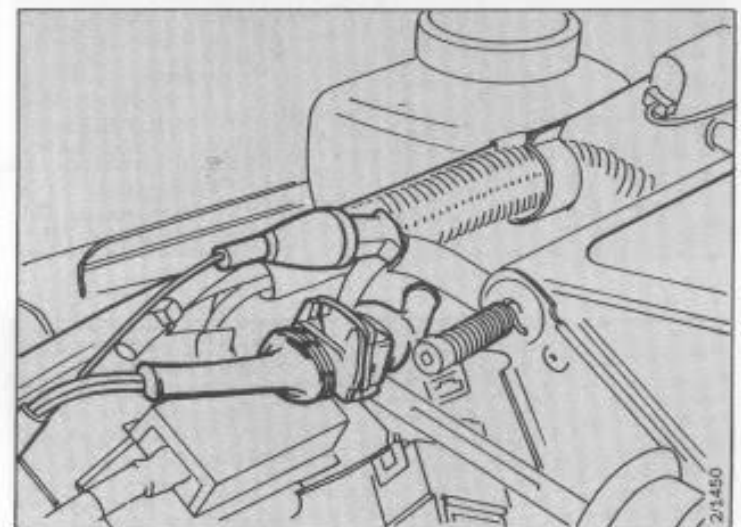
- a Engine temperature sensor
- b Hall generator
- c Shift-up indicator switch
- d Alternator
- e Starter motor
- f Throttle-position sensor (AC)
- g Oil pressure sensor
- h Knock detector

Rest the wiring loom on the radiator member.

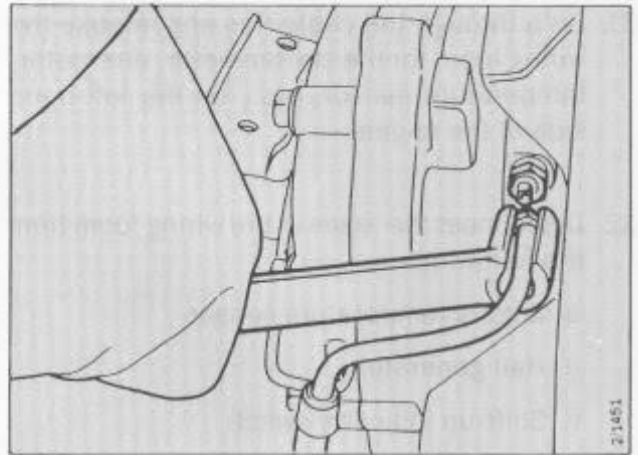
33 Remove the clips for the positive battery lead from the engine. Disconnect the lead from the starter motor and rest it on the battery shelf.

34 Disconnect the earth lead from the earthing point on the timing cover.

35 Unplug the oxygen sensor connector above the RH wheel arch. Release the lead from the clip on the wing and rest it on top of the engine.



- 36 Disconnect the hydraulic hose from the slave cylinder using tool 83 93 571. Plug the end of the hose.



- 37 Disconnect the fuel hoses from the fuel injection manifold and the fuel pressure regulator.

- 38 Unbolt the AC compressor (4 bolts) and stand the compressor on the heat exchanger.

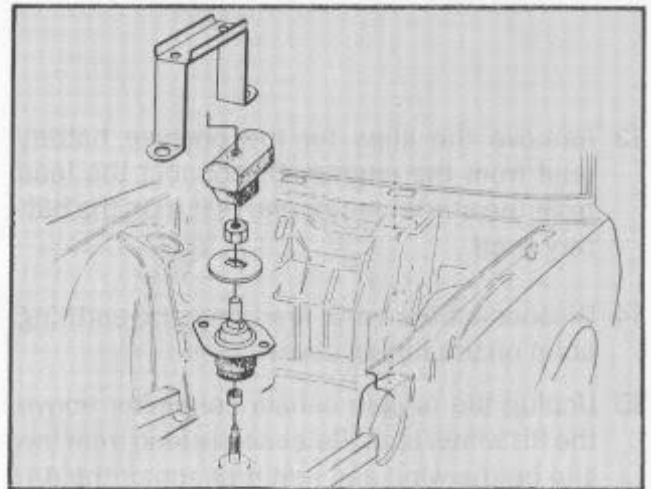
- 39 Undo all engine mounting bolts.

LH engine mounting:

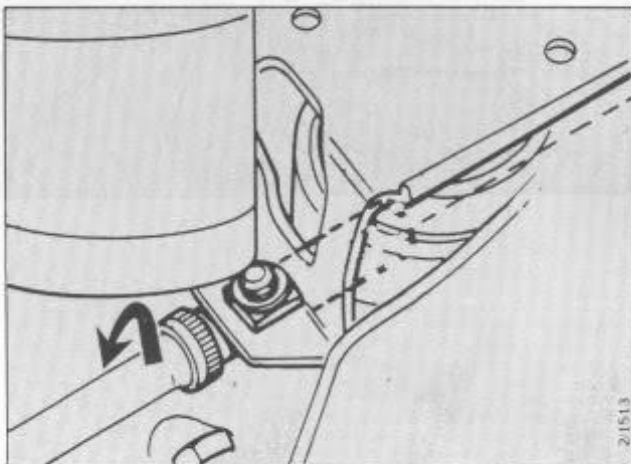
The bolt is a through-bolt and is equipped with a spacer.

Cars to US spec.:

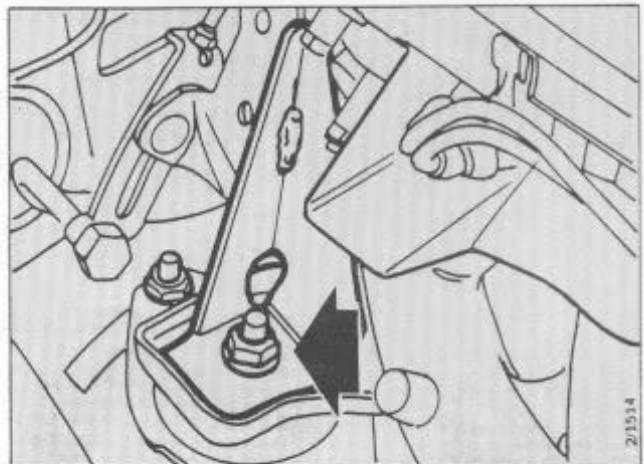
Remove the bump stops on the front and RH mountings.



Front engine mounting



LH engine mounting

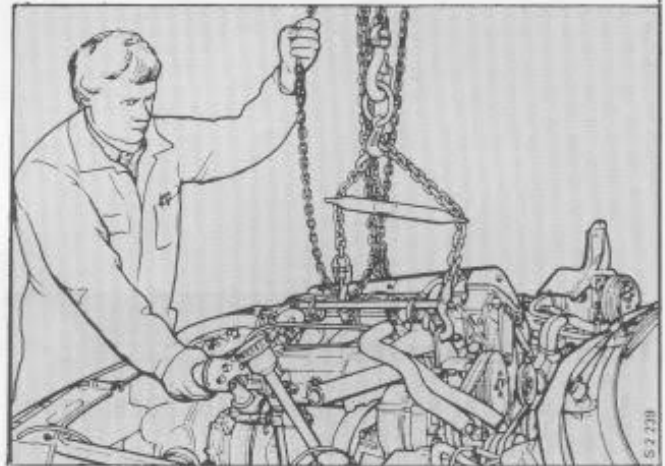


RH engine mounting

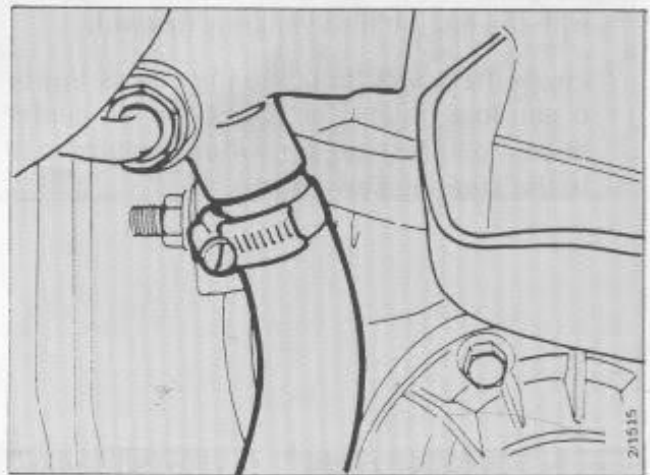
N.B.

Cars with AC: the AC bracket has a hole for attachment of a lifting sling hook. If the bracket has been removed, bolt a separate lifting lug, 93 13 222, onto the water pump cover using the existing bolts.

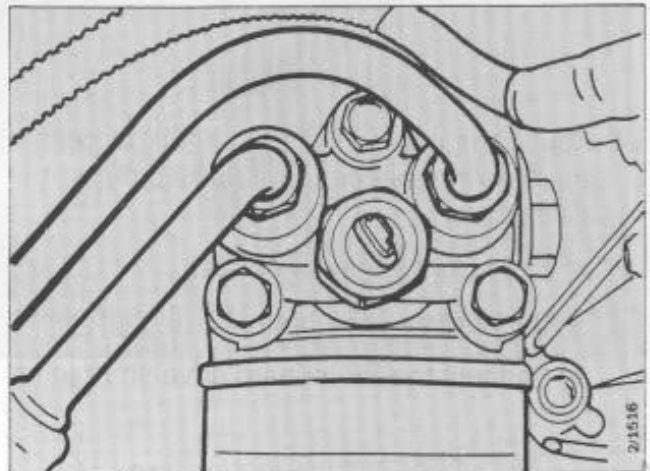
- 40 Attach the lifting sling, raise the engine slightly and separate the inboard drive-shaft joint.



- 41 Disconnect the return line from the steering servo pump.

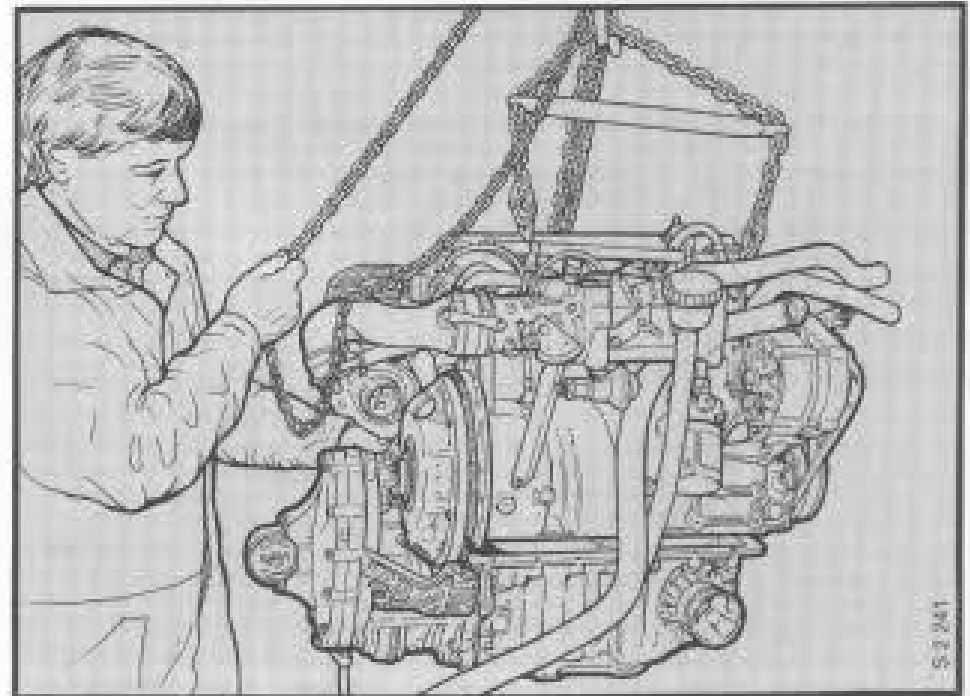


- 42 Remove the oil pressure sensor and disconnect the oil cooler (air cooled) hoses from the oil filter.



-
- 43 Lift the power train out of the car, keeping it close to the bulkhead to avoid damaging the radiator or the solenoid valve.

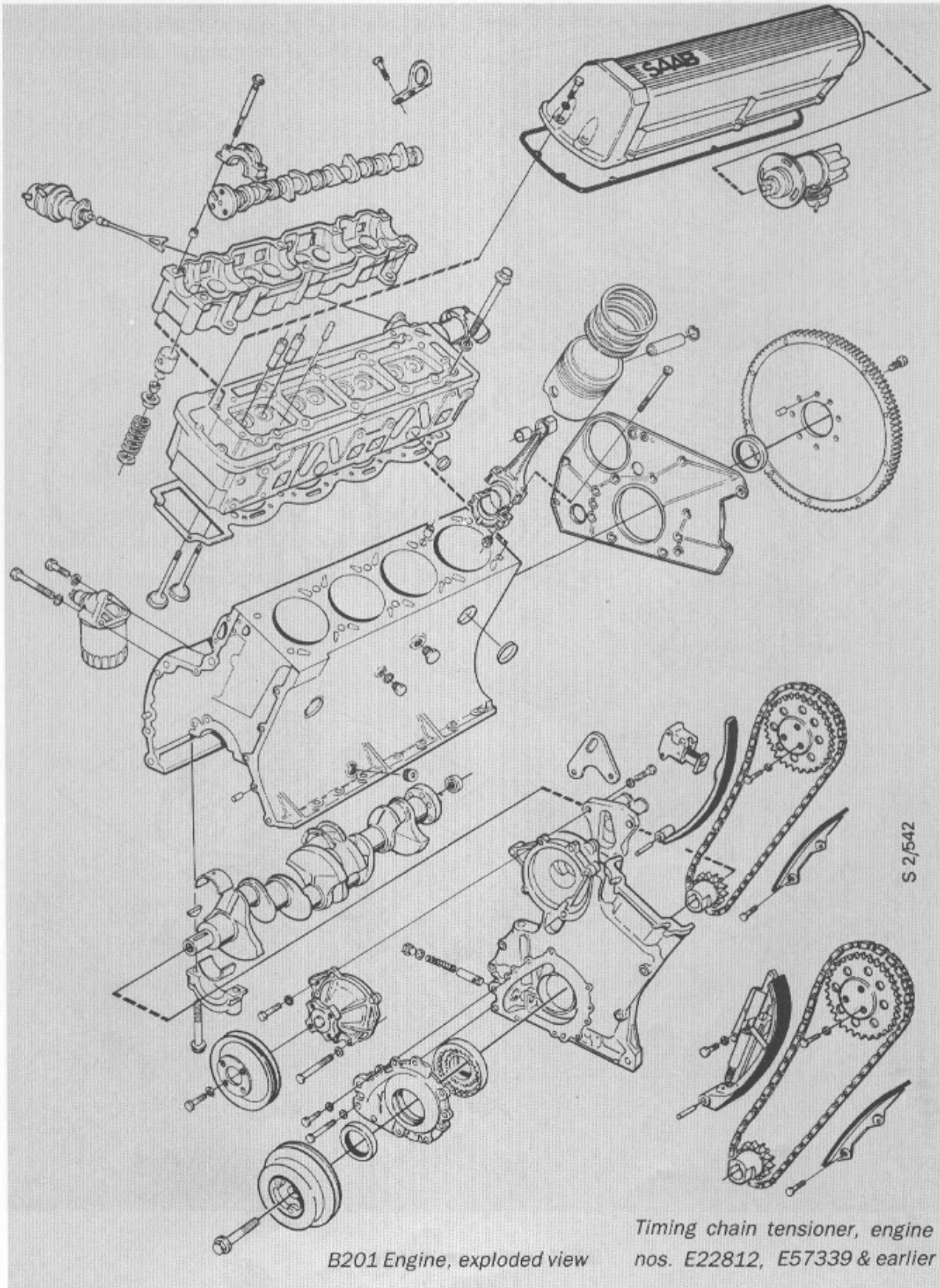
Fit covers to the driver cups.



Engine

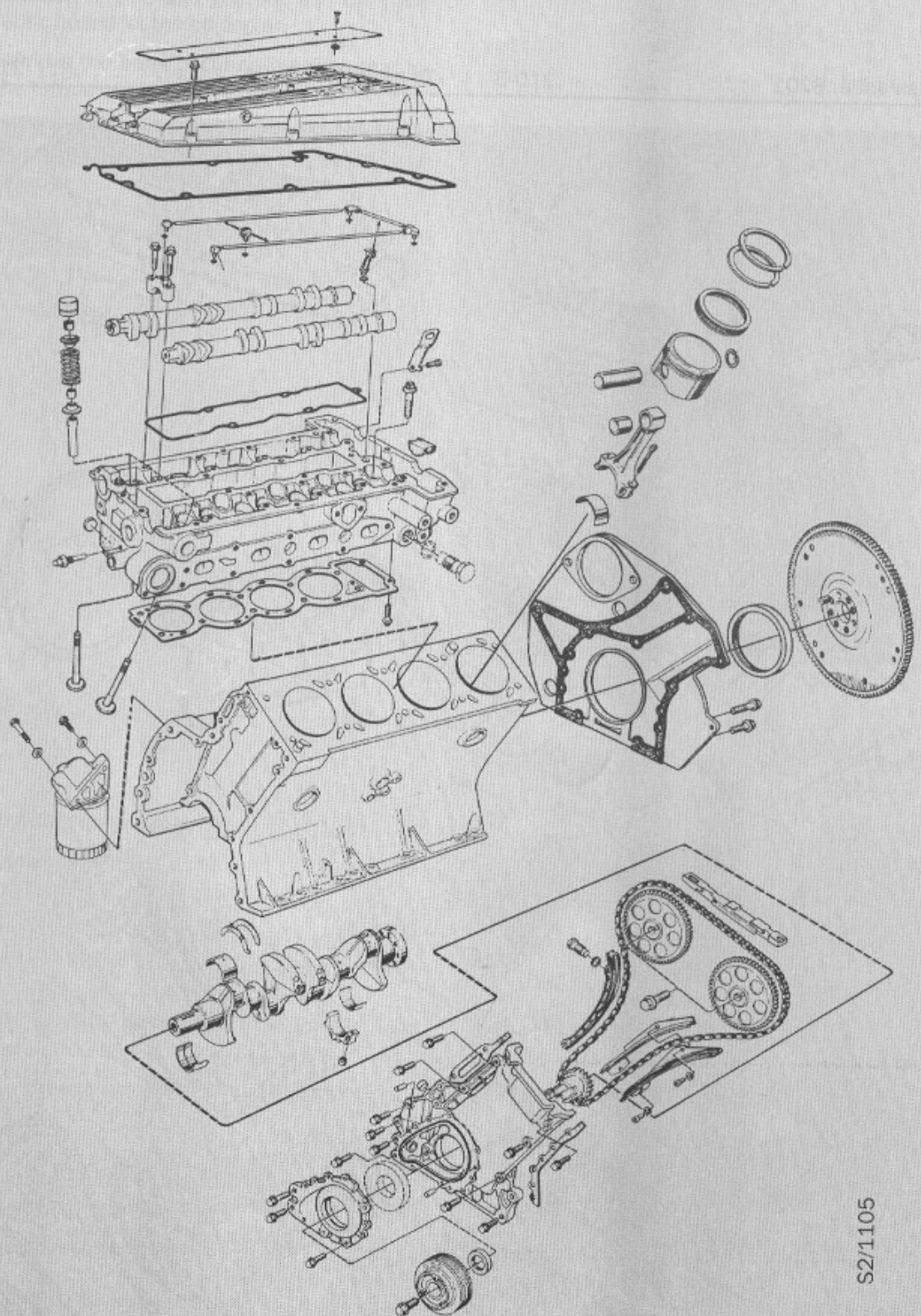
To dismantle, B201 210-3

To assemble, B201 210-8



B201 Engine, exploded view

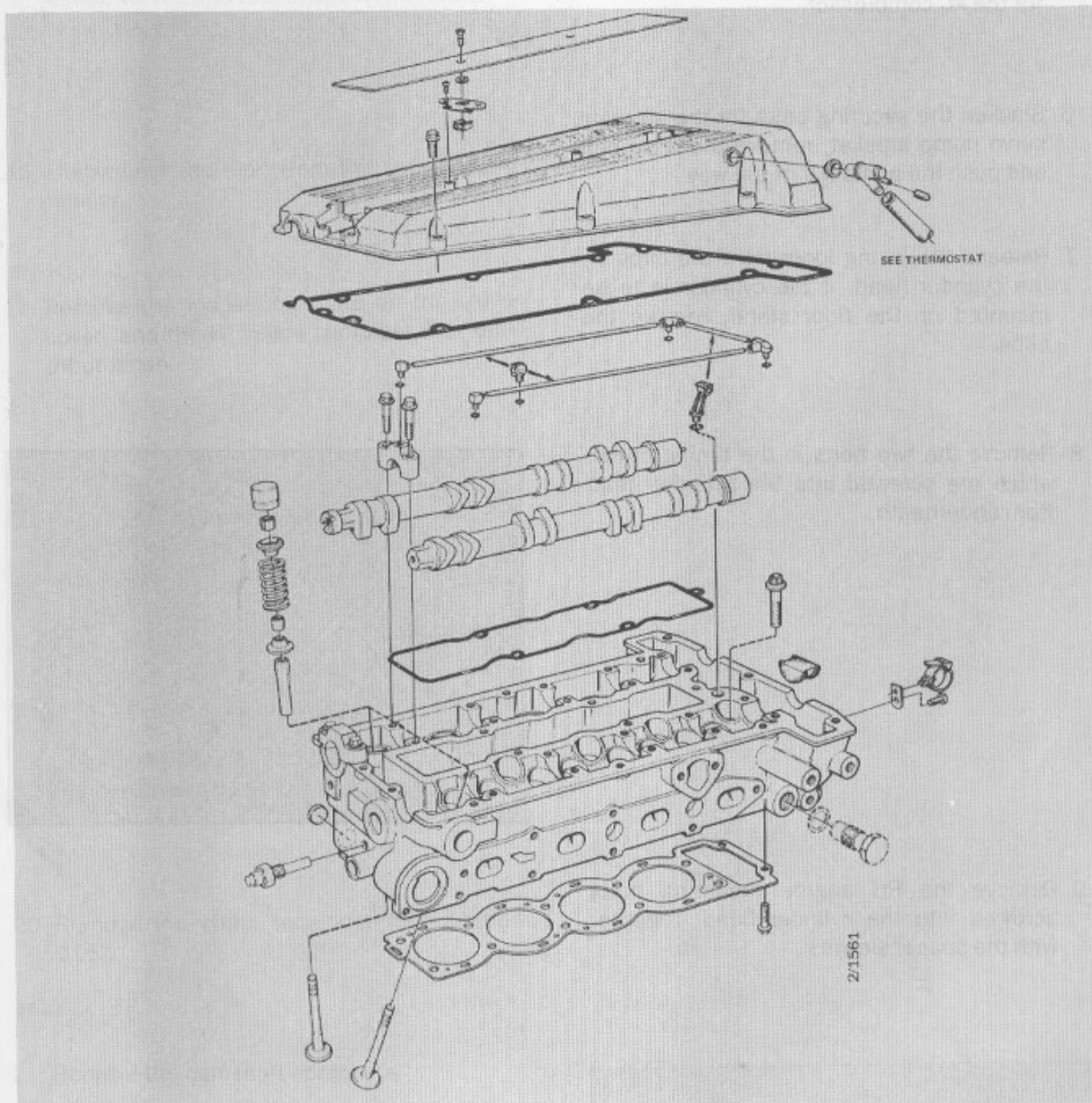
Timing chain tensioner, engine
nos. E22812, E57339 & earlier



S2/1105

B202 Engine, exploded view

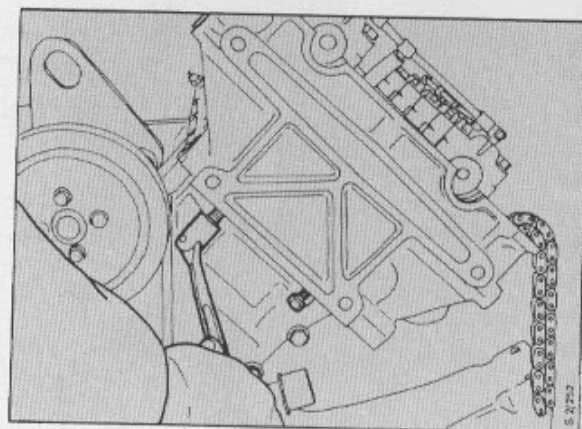
Cylinder head, B202

**To remove (engine in car)**

- 1 Remove the bonnet.
- 2 Remove the battery.
- 3 Drain the coolant from the radiator and block.
- 4 Remove the exhaust manifold and turbo unit.

211-22 Cylinder head

- 5 Remove the tensioning pulley and drive belt for the AC compressor.
- 6 Slacken the securing bolts for the steering servo pump bracket, remove the drive belt and push the pump out of the way.
- 7 Release the wiring loom from the clips on the cylinder head. If the cylinder is to be mounted on the floor stand, remove the clips.
- 8 Remove the two bolts in the timing cover, which are screwed into the cylinder head from underneath.
- 9 Remove the RH engine mounting bolts screwed into the cylinder head, together with the spacer sleeves.
- 10 Disconnect the coolant hose from the thermostat housing.
- 11 Remove the fuel pressure regulator.
- 12 Disconnect the earth connections for the LH fuel injection system.
- 13 Remove the auxiliary air valve (N/A to cars with catalytic converter).
- 14 Unbolt the AC bracket from the cylinder head.



- 15 Remove the inlet manifold complete with injection valves and fuel injection manifold.

- 16 Disconnect the lead from the temperature sensor.

- 17 Remove the inspection plate on the valve cover, and the HT leads complete with distributor cap.

- 18 Remove the valve cover. Disconnect the crankcase ventilation hose and remove the split rubber plugs from the cylinder head.

- 19 Line up the timing marks on the crankshaft and camshafts as detailed in section 214.

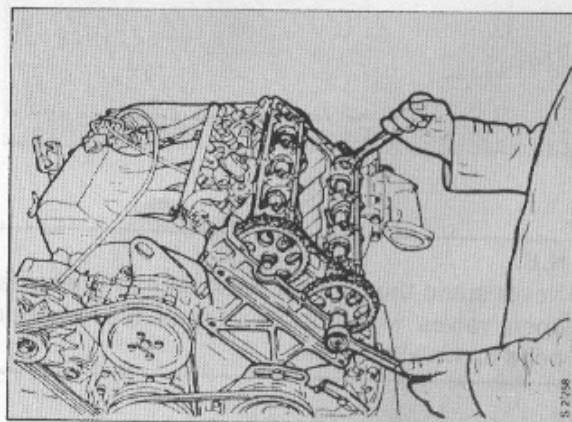
- 20 Remove the chain tensioner (see section 215).

- 21 Remove the camshaft sprockets.

N.B.

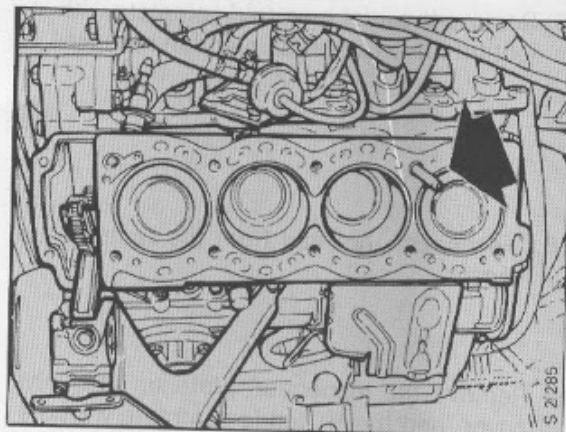
Do not alter the setting of the camshaft or crankshaft after the sprockets have been removed, as rotation of one of the shafts can result in damage to the valves.

- 22 Block up the engine to lift the cylinder head off the engine steady bar. Remove the cylinder head bolts and siphon off the oil from the cylinder head.

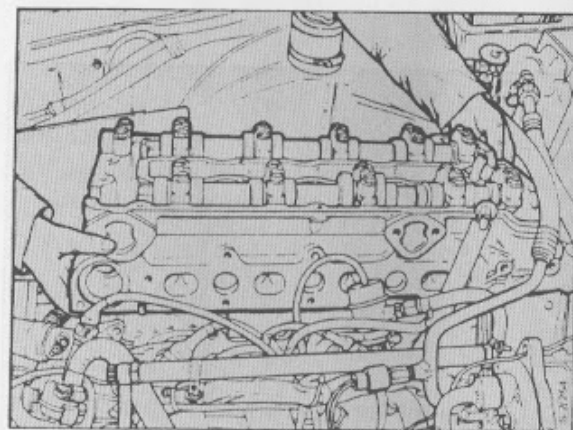


211-24 Cylinder head

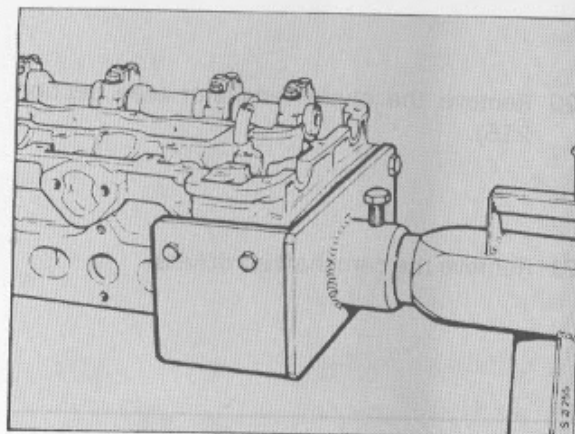
23 Fit a guide pin in one of the bolt holes ...



... (see illustration) and lift off the cylinder head, taking care to ensure that the pivoting and fixed guides for the timing chain are not damaged. Refit the drain plug in the block and close the drain valve on the radiator.



For work on the cylinder head, use the bracket (available as a special tool) for mounting the cylinder head on the engine stand.

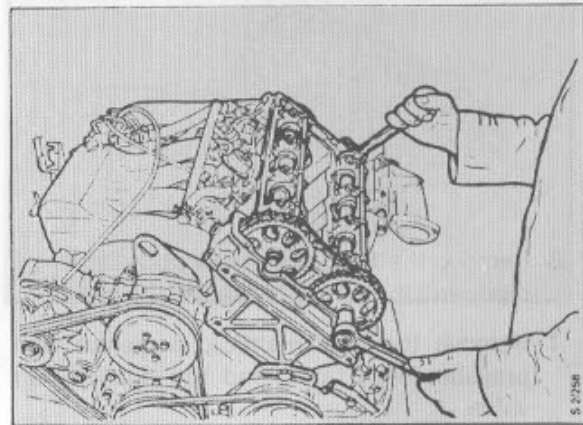
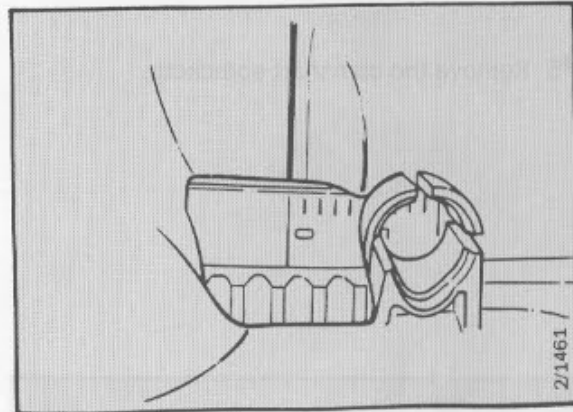


N.B.

Never stand the cylinder head on its flanges as open valves will protrude. Stand the cylinder head on wooden blocks.

Dismantling the cylinder head (engine removed from car)

- 1 Remove the inspection plate on the valve cover. Disconnect the HT leads and vacuum hose and remove the distributor cap complete with leads.
- 2 Remove the valve cover and turn the crankshaft to bring the '0' mark on the flywheel in line with the timing mark on the end plate.
- 3 Remove the centre bolts securing the camshaft sprockets.

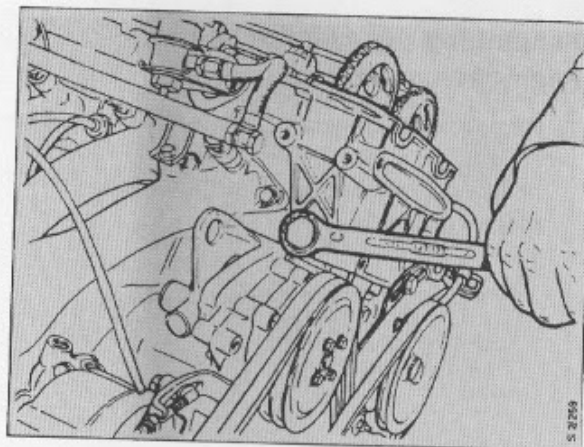


N.B.

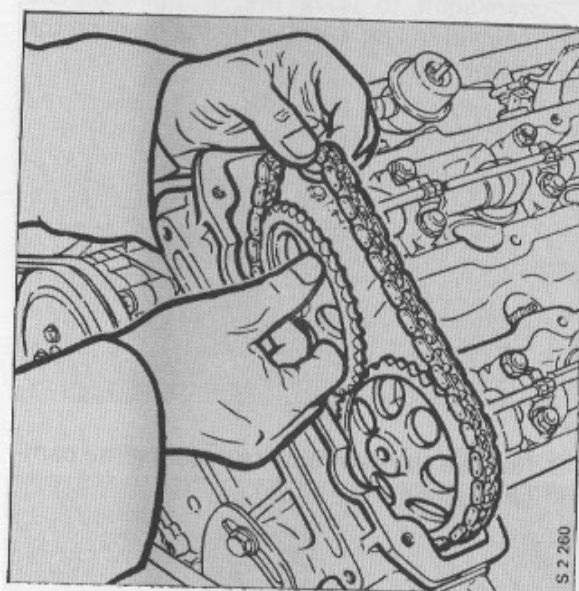
Never move the camshaft or crankshaft with the timing chain removed, as a fully open valve can collide with the piston at top dead centre.

211-26 Cylinder head

- 4 Remove the chain tensioner.

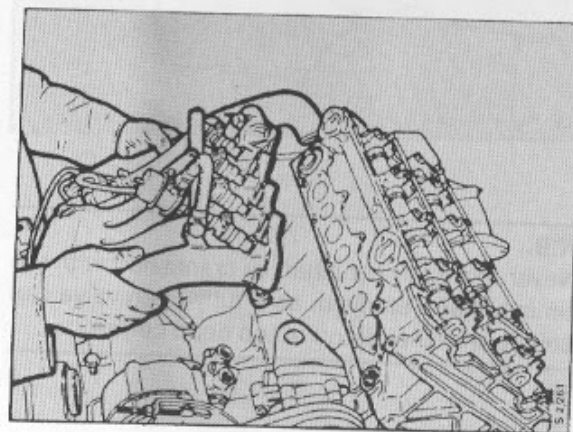


- 5 Remove the camshaft sprockets.



- 6 Remove the EGR pipe, the turbo discharge pipe, and the oil supply and return pipes.

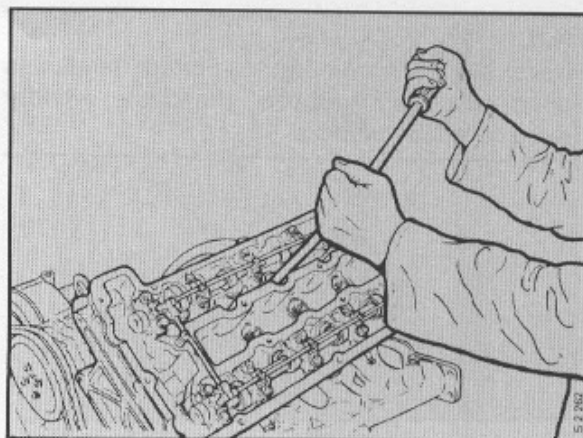
- 7 Remove the inlet manifold complete with pressure regulator, and the auxiliary air valve.



N.B.

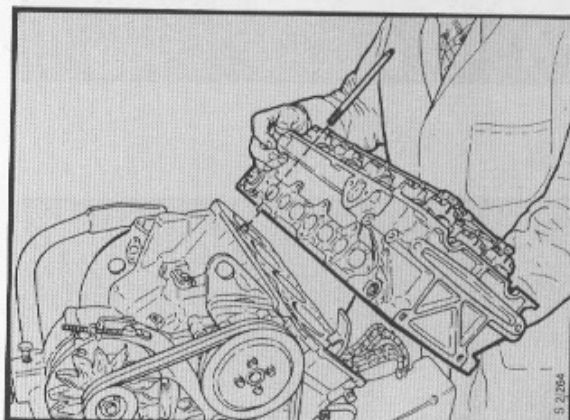
Never stand the cylinder head on its flanges as open valves will protrude. Stand the cylinder head on wooden blocks.

- 8 Remove the cylinder head bolts.



- 9 Arrange the timing chain and the pivoting chain guide to allow the cylinder head to be lifted off.

- 10 Lift off the cylinder head; if necessary, screw guide pin 8392128 into the block, as shown.

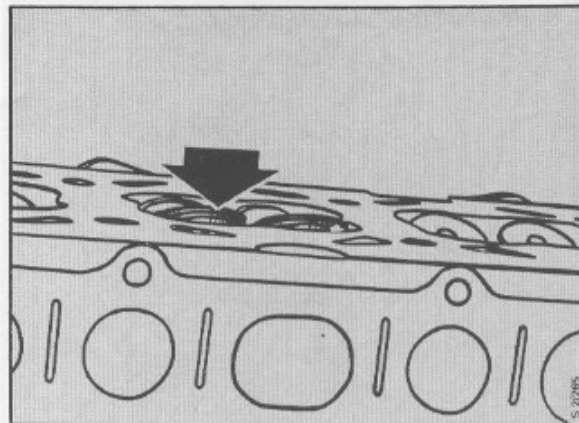


- 11 Remove the exhaust manifold and turbo unit.

211-28 Cylinder head

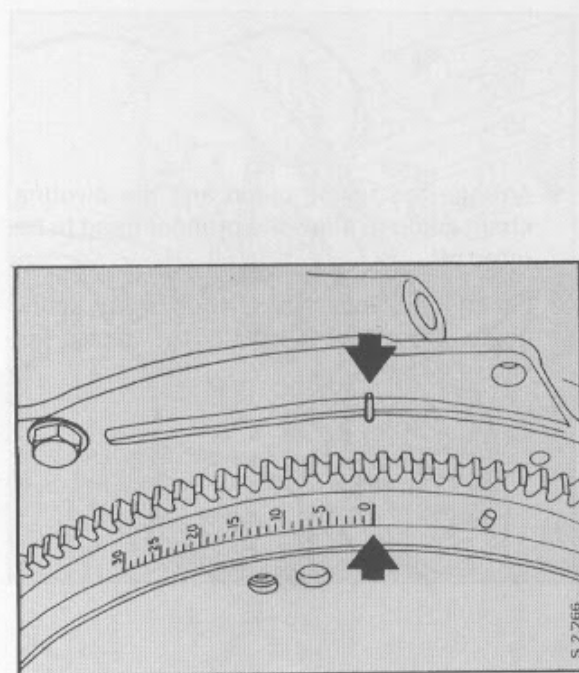
N.B.

Never stand the cylinder head on its flanges as open valves will protrude. Stand the cylinder head on wooden blocks.

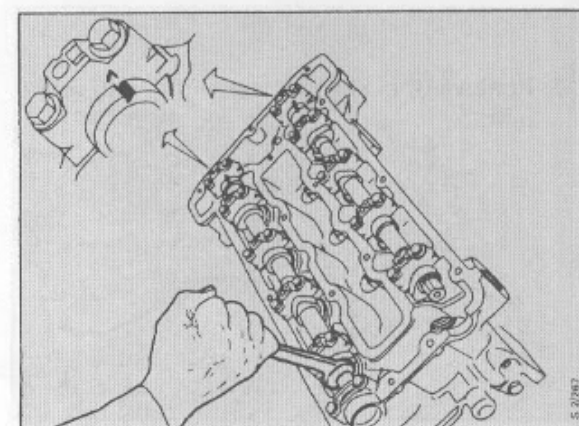


To refit the cylinder head

- 1 Align the 'O' mark on the flywheel with the timing mark on the end plate.

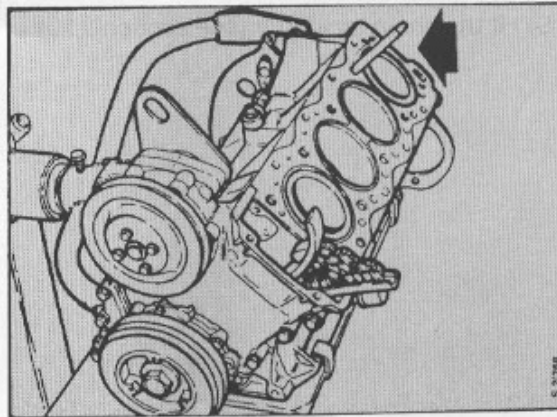


- 2 Line up the marks on the camshafts with their respective timing marks.

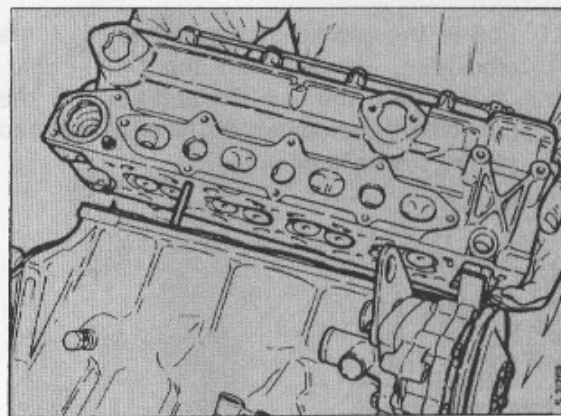


- 3 Fit the cylinder head gasket, making sure that it is held in position by the guide sleeves in the cylinder head flange.

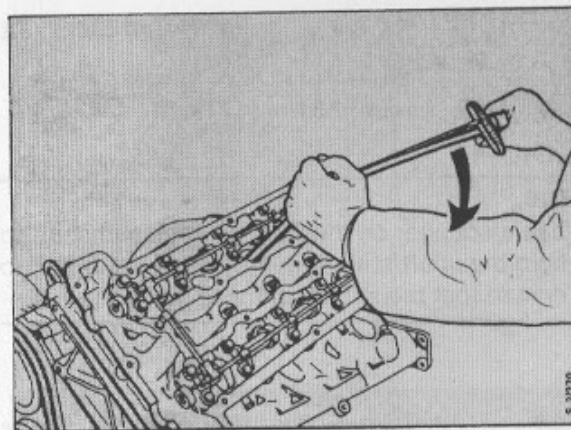
- 4 Fit guide pin 83 92 128 and position the timing chain and pivoting guide as shown.



- 5 Fit the cylinder head. Use the guide pin as a pivot for the cylinder head, which must be swivelled slightly to enable it to pass the pivoting guide. Thereafter, the head will be guided by the sleeves.



- 6 Fit the cylinder head bolts and tighten them to the specified torque (see the 'Technical data' section). Remember to fit the two M8 bolts in the underside of the cylinder head.

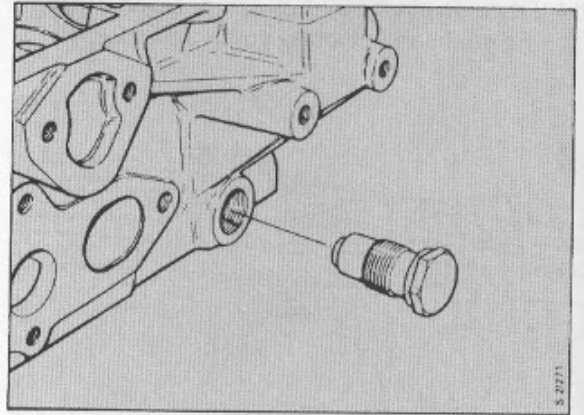


- 7 Fit the camshaft sprockets, fitting the sprocket for the exhaust-valve camshaft first. Make sure that the chain between the crankshaft sprocket and the camshaft sprocket is kept tight and properly located in the guide channel. Next fit the sprocket on the inlet-valve camshaft. Keep the chain tight between the sprockets.

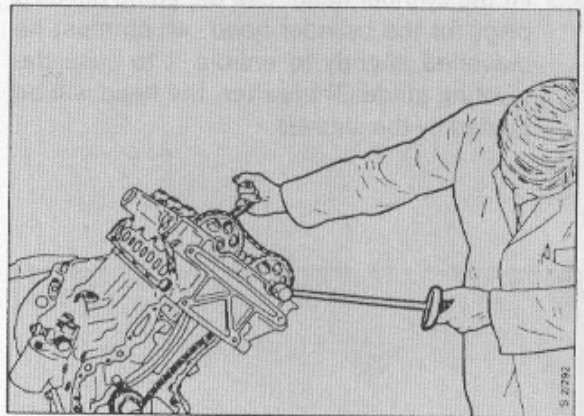
- 8 Lightly tighten the centre bolts securing the camshaft sprockets.

211-30 Cylinder head

- 9 Fit the chain tensioner (see section 215).



- 10 Rotate the crankshaft two complete turns clockwise, viewed from the timing end. Check that the earlier settings of the crankshaft and camshafts have not altered (timing marks lined up).



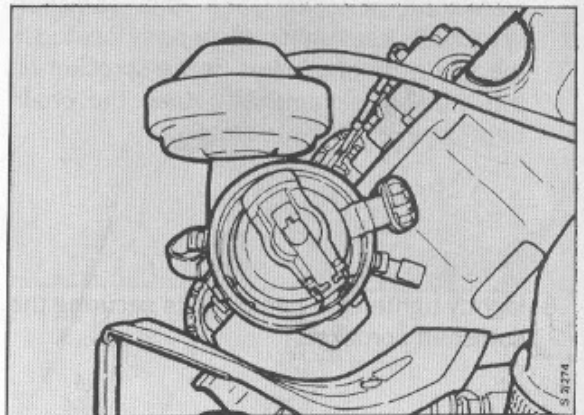
- 11 Tighten the centre bolts for the camshaft sprockets.

Tightening torque: 63 Nm (47 lbf ft)

N.B.

Use a spanner on the flats on each camshaft to hold the shaft still when tightening the bolts, to ensure that the set positions do not alter.

- 12 Refit the valve cover. Make sure that the seals and split rubber plugs are properly seated in their grooves.



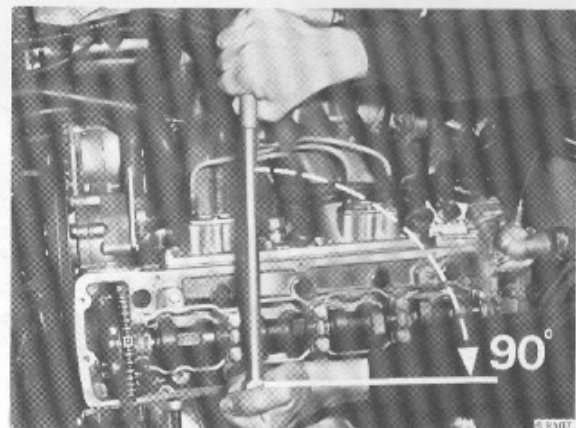
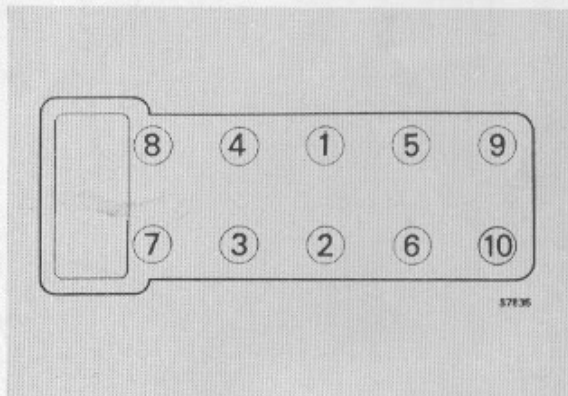
- 13 Fit the distributor cap and reconnect the HT leads and vacuum hose.
- 14 Fit the inspection plate on the valve cover.
- 15 Fit the exhaust manifold and turbo unit, and connect the EGR pipe, the turbo discharge pipe, the oil supply pipe and the oil return pipe.
- 16 Fit the inlet manifold, the auxiliary air valve, the pressure regulator and the lifting lug. Connect the vacuum hose to the distributor.

Retightening the cylinder head

(Applies to bolts 15-mm across flats and Torx M12 bolts.)

The cylinder head bolts must be tightened down at the following times (does not apply to heads fitted with the new, special gasket that eliminates the need for retorquing):

- a At the 600-mile (1000-km) Warranty Service.
 - b After refitting the cylinder head in conjunction with engine overhaul or repair. After fitting the head, run the engine to normal temperature, allow to cool for 30 min and then retighten the head.
- 1 In the sequence shown, slacken and retorque each bolt to **80 Nm (59 lbf ft)**.
 - 2 In the same sequence, tighten the bolts through a further 1/4-turn (90°).

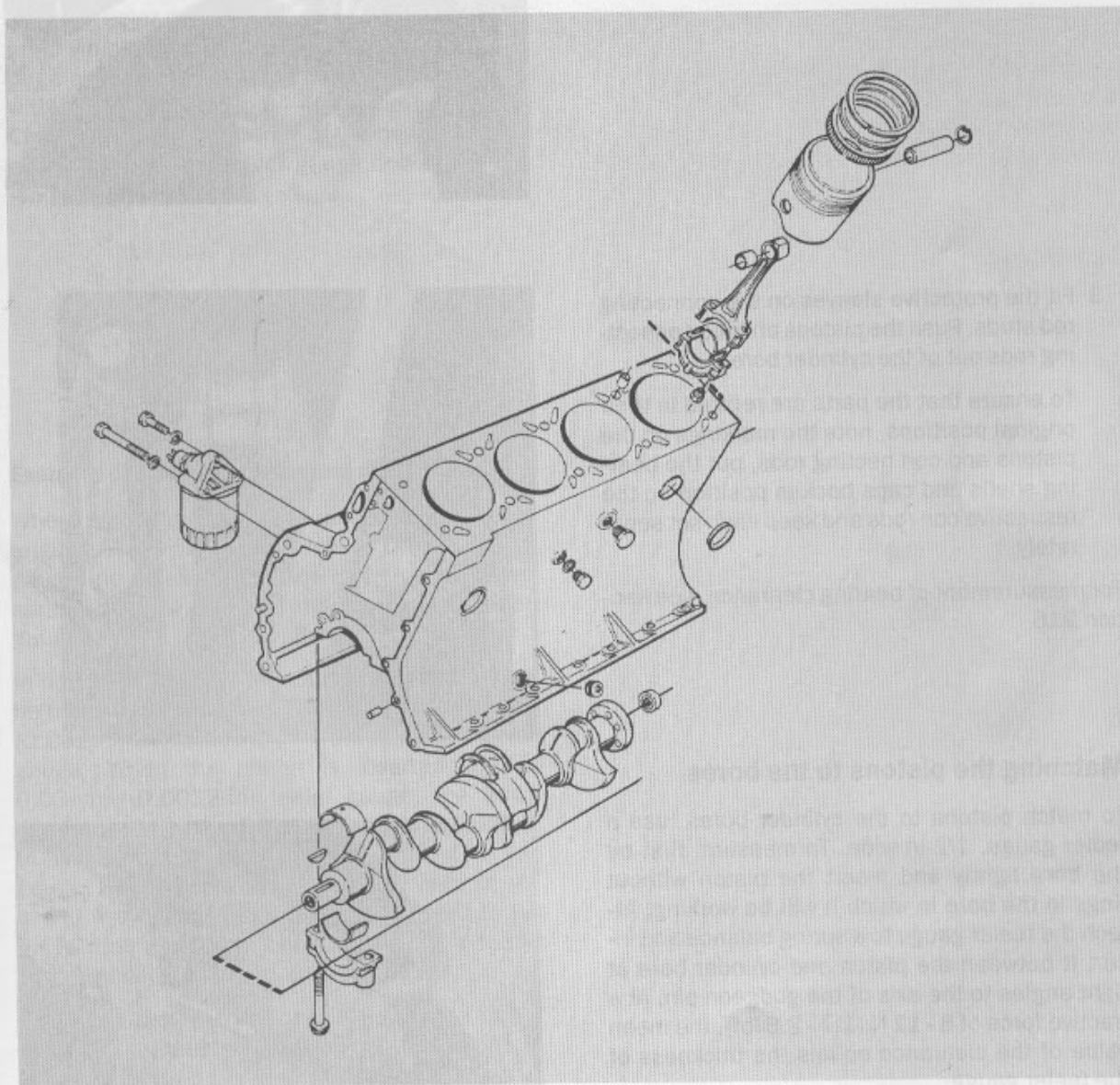


Stage 1 Tightening torque: 80 Nm (59 lbf ft)
Stage 2 Tighten through further 1/4-turn (90°)

Pistons, connecting rods and cylinder bores

To replace pistons, piston rings
and big-end bearings 212-1

Classification of pistons
and bores 212-4



To renew pistons, piston rings and big-end bearings

(Engine mounted in workstand, cylinder head re-
moved)

212-2 Pistons, connecting rods and cylinder bores

To remove

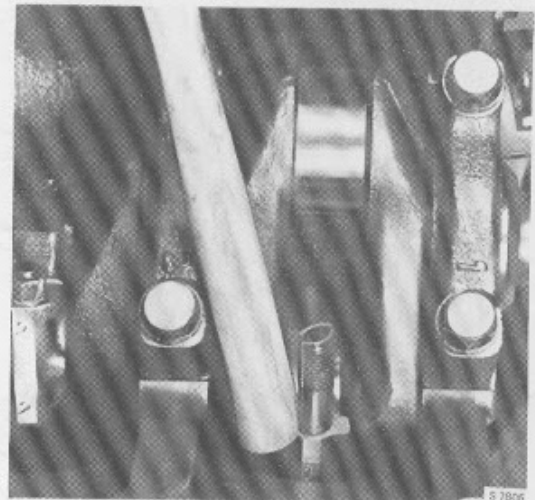
- 1 Remove any burrs or carbon deposits from the tops of the cylinders.
- 2 Remove the big-end bearing caps.



- 3 Fit the protective sleeves on the connecting rod studs. Push the pistons and the connecting rods out of the cylinder bores.

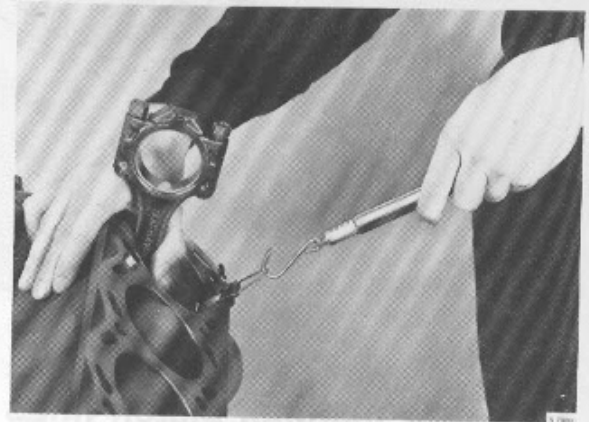
To ensure that the parts are refitted in their original positions, note the markings on the pistons and connecting rods, put the bearing shells and caps back in position on the respective con rods and keep each set separately.

For measurement of bearing clearance, see section 216.



Matching the pistons to the bores

To match pistons to the cylinder bores, use a feeler gauge, 1/2-in wide. To measure, first oil the bore lightly and insert the piston without rings in the bore in which it will be working. Attach the feeler gauge to a spring balance and insert it between the piston and cylinder bore at right angles to the axis of the gudgeon pin. At a tractive force of 8 - 12 N (1.7 - 2.6 lbf), the mean value of the clearance equals the thickness of the feeler gauge.



Repeat the test with the piston at several different depths. For piston clearances, see the 'Technical data' section.

Spare pistons are stocked in both standard and oversize diameters. Where the latter are used, the cylinder bore must be honed or rebored to obtain the correct piston clearance.

Carry out the matching as follows:

Using a feeler gauge and spring balance, determine which piston (or pistons) has abnormally large clearance. Replace the piston (or pistons) with a piston (or pistons) of the next oversize. Check the piston clearance of the new piston (or pistons), using the feeler gauge and spring balance.

Example of class A cylinder and class A piston

When the piston clearances are measured in the engine by means of a 0.05-mm (0.002-in) feeler gauge, no measurable force is recorded on the spring balance when withdrawing the feeler gauge from no. 2 and no. 3 cylinders.

In no. 1 and no. 4 cylinders, the pistons cannot be fitted into the cylinder bores with a 0.05-mm (0.002-in) or 0.04-mm (0.0016-in) feeler gauge. When the piston is inserted with a 0.03-mm (0.0012-in) feeler gauge, the force necessary to pull out the feeler gauge is 20 N (4.4 lbf) and, with a 0.02-mm (0.0008-in) feeler gauge, 6 N (1.3 lbf). The piston clearance in no. 1 and 4 cylinders is therefore estimated to be 0.032 mm, (0.0013 in), and the pistons in these cylinders need not be replaced.

Since the piston clearance in no. 2 and no. 3 cylinders is greater than 0.05 mm (0.002 in), it is estimated that the diameter in these bores at maximum tolerance is 90.010 mm (3.5437 in); allowing a further +0.003 mm (0.0001 in) for bedding-in, this gives a bore of 90.013 mm (3.5438 in).

212-4 Pistons, connecting rods and cylinder bores

Assume a standard B piston.

The theoretical piston clearance will then be 0.009-0.017 mm (0.0004-0.0007 in). Allowing a further 0.02 mm (0.0008 in) for bedding-in, this gives a maximum clearance of 0.037 mm (0.0015 in), which should be sufficient to eliminate unacceptable piston slap. Choose standard B pistons for these bores and check with a feeler gauge

N.B.

Pistons of different makes must not be used in the same engine. The name of the piston manufacturer is cast-in on the inside of the piston. Pistons of the following makes are fitted in production:

Mahle

Karl Schmidt

Hepolite

The weight difference between the various piston classes is negligible.

Classification of Pistons and cylinder bores

The piston class is stamped on the piston crown. The piston classes for service are:

AB

B

C

The cylinder class is stamped on the cylinder plane and is specified for each cylinder.

The cylinder class may be A or B, and both classes may occur in any cylinder block.

Classification of pistons

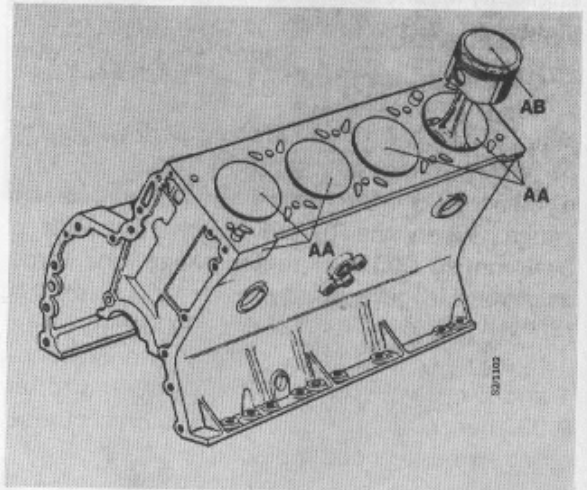
See "Technical data".

Cylinder block

See "Technical data".

Resulting piston clearances

See "Technical data".



Matching piston rings to a new or re-bored cylinder

- 1 Push the piston rings down into the cylinder one at a time, using an inverted piston head to position them correctly.
- 2 Measure the ring gap with a feeler gauge, as shown. Correct gap sizes are given in the 'Technical data' section. If necessary, widen the gap with a special file.
- 3 Try the piston rings in their respective grooves by rolling. Measure the clearance at a few points too.



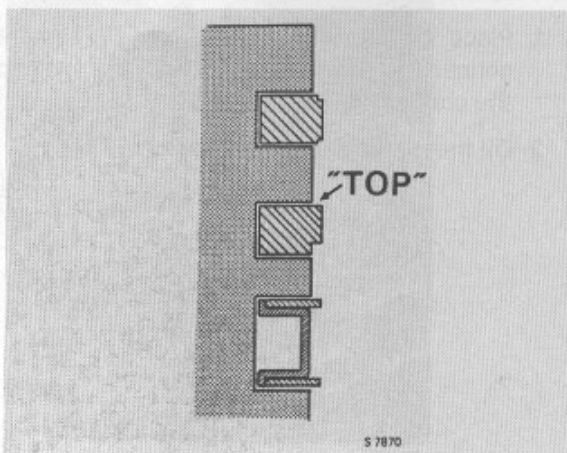
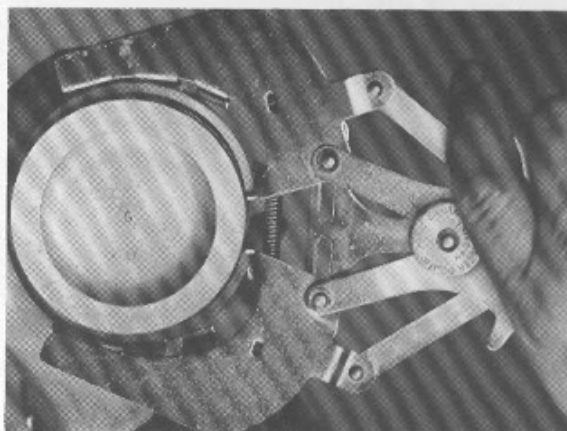
Fitting piston rings in a worn cylinder

Rings to be fitted in a worn cylinder must be tried at the lower limit of travel of the piston (BDC), as the bore is narrowest at this point.

To fit piston rings to pistons

Use the piston ring clamp (special tool) to fit the rings as shown. The lower compression ring must be fitted with the side marked "TOP" uppermost.

Oil the piston and rings before assembly.



212-6 Pistons, connecting rods and cylinder bores

Position the compression rings so that the gaps

The freedom of piston clearance will be 0.009-0.012 mm (0.0004-0.0007 in) in the first 12 mm (0.0008 in) to the in, this gives a maximum clearance of 0.0015 mm (0.0001 in) at the rate unaccompanied by the gauge

N.B.

Pistons of the same size and the same material is used for the pistons of the same engine.

Make

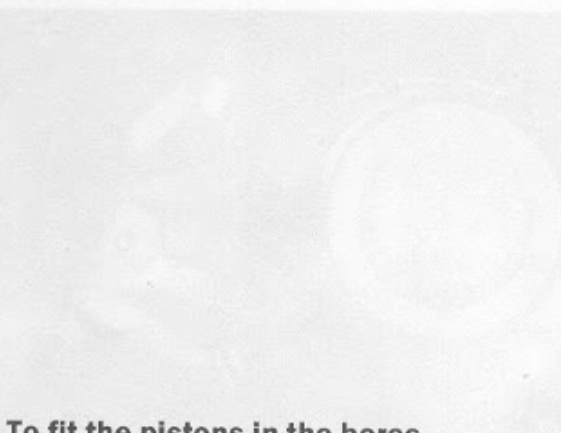
and Schmidt

Hopkins

The main difference between the various pistons

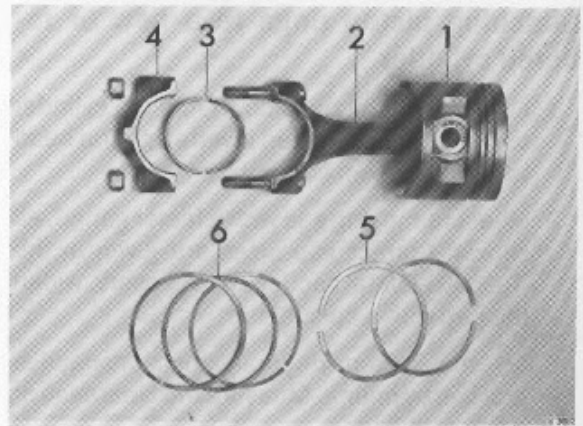
are at approx. 180° to each other, each positioned above one of the gudgeon pin holes. Make sure, that the gaps in the oil scraper ring are equally spaced out round the piston, and not in line with one another.

Installation of Pistons and cylinder bores



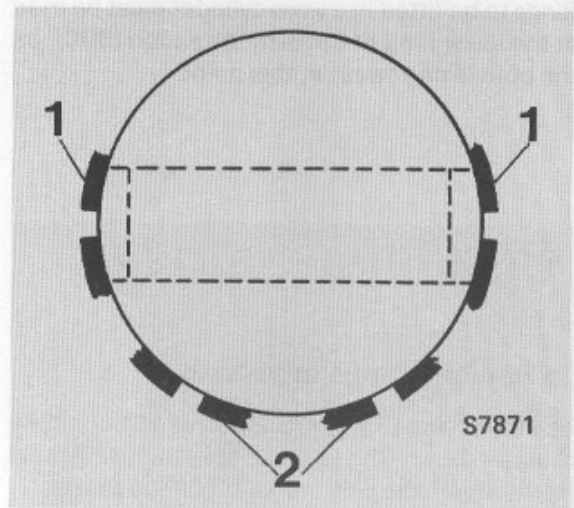
To fit the pistons in the bores

- 1 Place the bearing shells in position in the connecting rods and fit protective sleeves to the connecting rod studs.
- 2 Oil the piston rings and bearings.

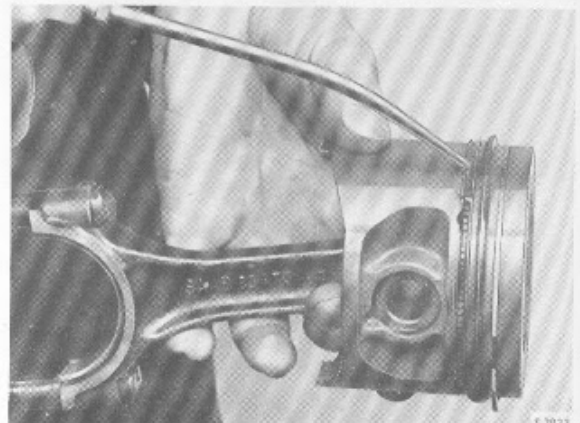


Piston and connecting rod with bearings and piston rings

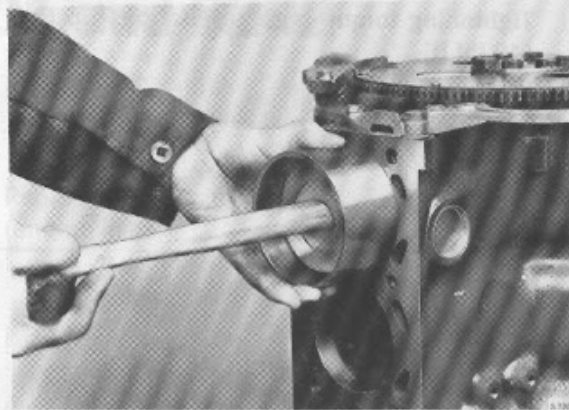
- 1 Piston
- 2 Connecting rod
- 3 Bearing
- 4 Bearing cap
- 5 Compression rings
- 6 Oil scraper ring



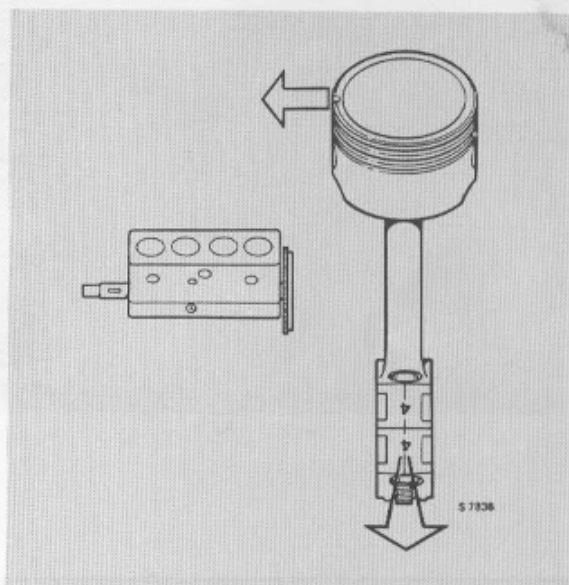
- 1 Compression rings
- 2 Scraper ring



- 3 Refit the pistons using piston ring compressor 78 62 287.



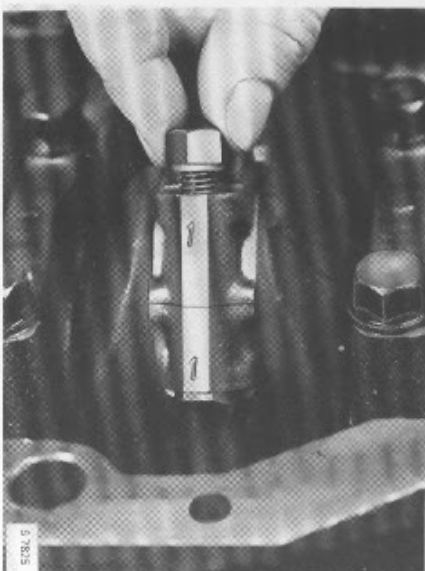
Ensure that the notch in the piston crown points towards the timing cover and that the numbers on the connecting rod face the exhaust side.



To remove the valve cover:

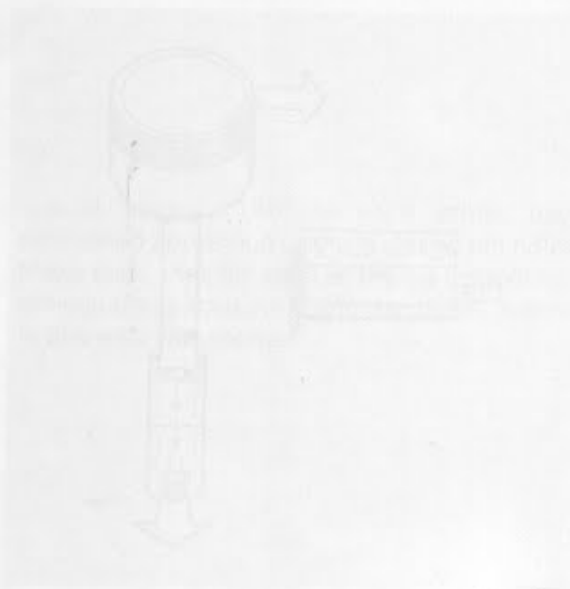
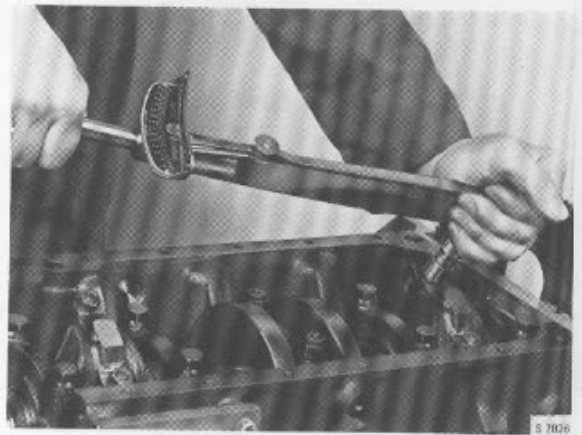
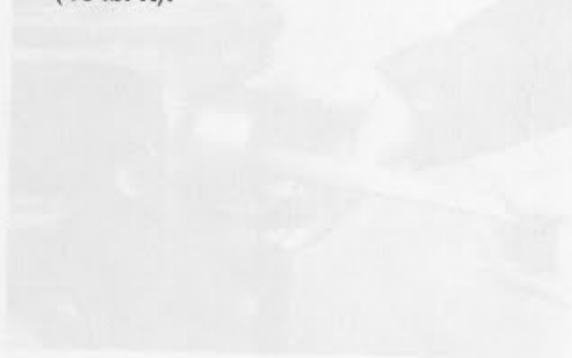
1. Remove the distributor to line up the 12° mark with the timing mark (top dead centre) for the 1 and 4 cylinders.

- 4 Refit the big-end bearing caps with bearing shells (the big-end bearing and big-end bearing cap identifying numbers should coincide). The big-end bearing nuts should be fitted with the flanges towards the connecting rods.



212-8 Pistons, connecting rods and cylinder bores

**Tightening torque big-end bearings 55 Nm
(40 lbf ft).**



and one tighten the big-end bearing and the
big-end bearing.

Figure 2
Ensure that the notch in the piston crown
points towards the timing belt and marks the
number of the cylinder. Put the piston
into the cylinder.

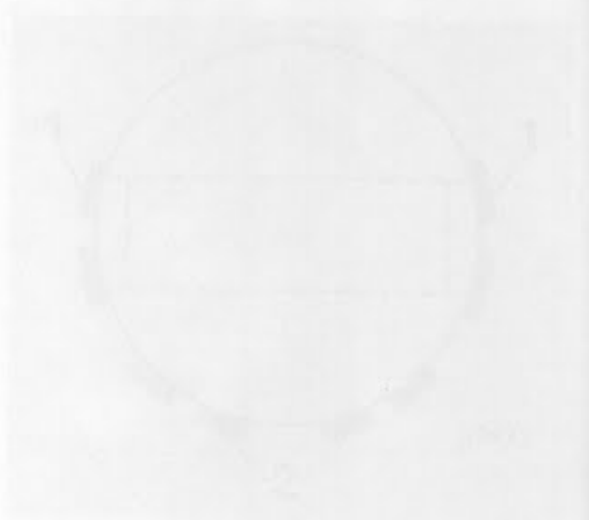


Figure 3
To fit the big-end bearing onto the piston
crown, the big-end bearing and big-end
bearing cap should be placed on the
piston crown. The big-end bearing should
be fitted with the number towards the
cylinder head.



Valve gear, B202

General

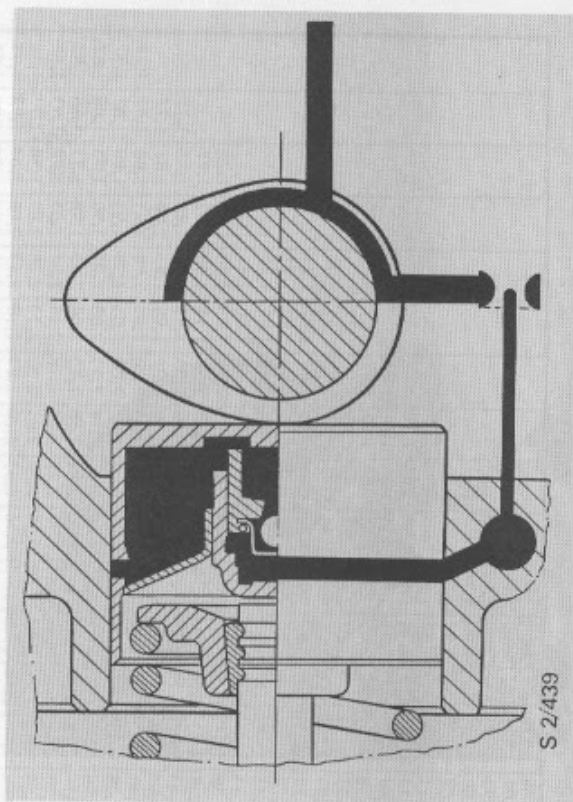
The valve gear incorporates hydraulic cam followers, which keep the valve clearance within a limited working range of 2.05 mm (0.081 in). This range lies between 18.75 and 20.8 mm (0.738-0.819 in) from the camshaft to the end of the valve stem.

Each cam follower has two storage chambers and one high-pressure chamber. The opening of the port between the high-pressure chamber and the adjacent storage chamber is controlled by a spring-loaded ball valve. A return spring in the high-pressure chamber acts on the sliding piston, to eliminate any clearance between the cam follower and the cam. At the same time, the high-pressure chamber expands and makes up the oil volume, to compensate for leakage losses occurring at actuating pressure in the passage between the piston and the cylinder.

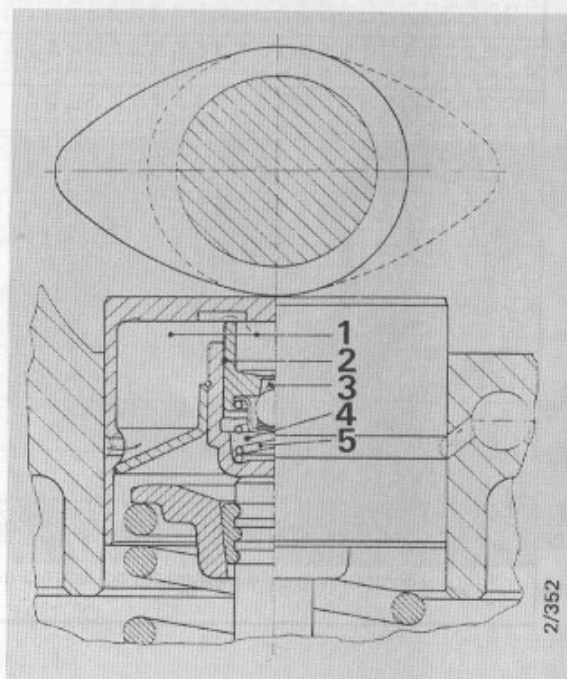
The hydraulic cam followers are sealed units; if defective, they cannot be repaired but must be replaced. Under various conditions, the hydraulic cam followers may give rise to a tapping or chattering noise. In most cases, the noise will be short-lived and remedial action will not be required. The following list details the commonest times that chatter is likely to be heard and what initial action, if any, should be taken to eradicate it.

- 1 Valve chatter on starting the engine after an oil change.

If the noise from the valves did not occur before the oil change, the noise will disappear of its own accord as soon as the oil in the engine has reached normal working pressure.



Oil flow through the cam follower



- 1 Storage chamber
- 2 Leakage passage
- 3 Check valve
- 4 High-pressure chamber
- 5 Spring

2 Initial noise on starting a cold engine.

This noise is perfectly normal and will disappear of its own accord as soon as the oil in the engine has reached normal working pressure.

3 Valve chatter on starting after work on the car that has involved cranking the engine by hand or on the starter motor.

The noise is due to one or more of the cam followers having been drained of oil and will therefore disappear after the engine has been running for a while. At worst, it may take fifteen minutes at between 2000 and 3000 rpm for the noise to disappear. At lower engine speeds, it will obviously take considerably longer to expel the air. Do not run the engine at a speed greater than 3000 rpm as this may damage the cam followers.

4 Noise after fitting new cam followers. Same cause as item 3 above.

5 Noise occurring after a short period of idling with a hot engine (hot oil).

If the engine is run at 1500 rpm or more, the noise will disappear after a while.

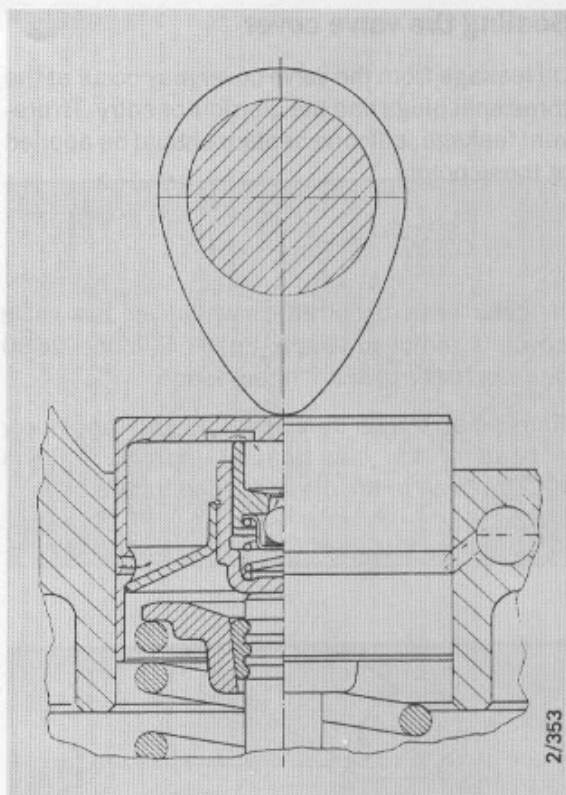
The noise is due to low oil pressure in the hydraulic cam followers when the engine is idling. Check the oil feed pipe, connectors and 'O' rings for leaks.

6 Noise occurring at high engine speeds and disappearing after the engine has been left idling for some time.

This noise is due to an excessive amount of air in the oil at high engine speeds. The ingress of air is caused by leakage on the suction side of the oil pump, a poorly sealing 'O' ring in the suction pipe or a leak in the suction pipe caused, for instance, by a porous weld.

7 Noise from an individual cam follower regardless of how the car is being driven.

The most likely cause is that a particle of dirt has become trapped in the check valve for the cam follower. Fit a new cam follower. The defective cam follower (or followers) can be identified most readily by switching off the engine, removing the valve cover and using a screwdriver to depress the cam followers while they are at rest. If the follower feels light or spongy, it is defective.

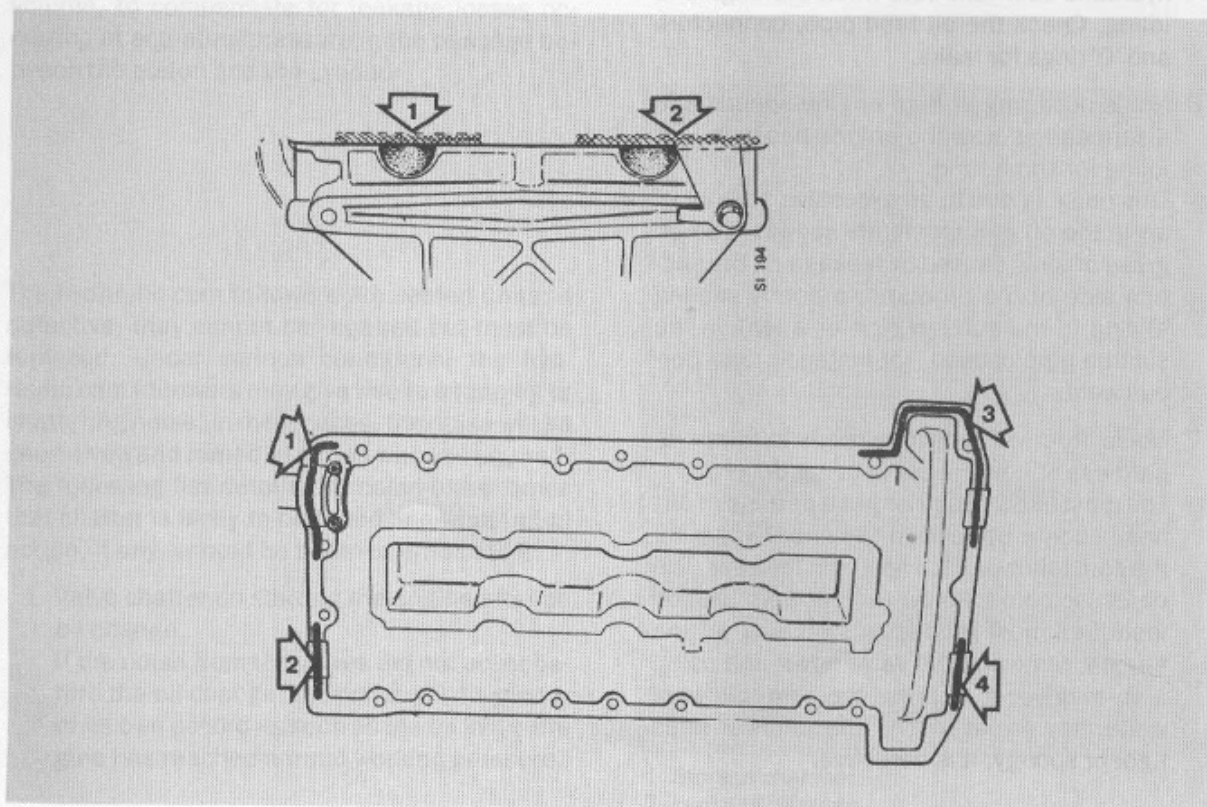


Sealing the valve cover

Oil leakage from the valve cover may occur at the three split plugs and the distributor entry. To prevent leakage, silicone sealant should be applied at these points.

If leaks have occurred or whenever the valve cover is removed, apply Bostik Silicone 2680 sealant to the cylinder head flange.

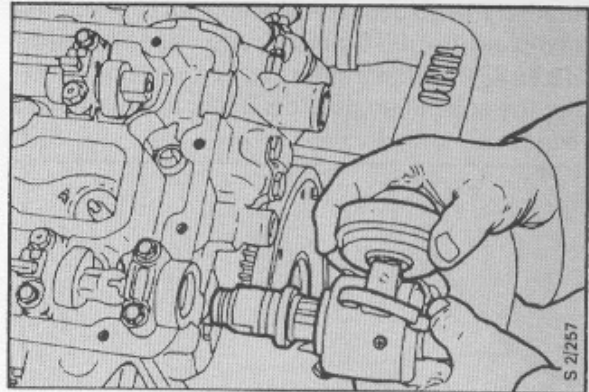
Remove all traces of old sealant and then apply a bead of the new sealant, approx. 4.5 mm (0.2 in) thick to the cylinder head flange.



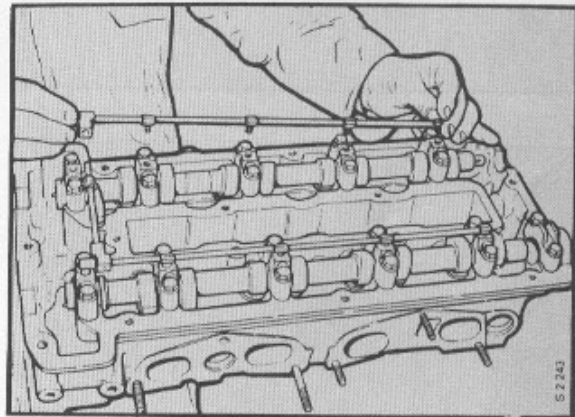
Apply sealant at these points

**To dismantle the valve gear
(cylinder head removed from car)**

- 1 Remove the distributor.



- 2 Remove the oil pipes and the camshaft bearing caps and lift out the camshafts.



N.B.

Do not twist the pipes when removing them as this is liable to damage the contact surfaces between the pipes and fittings.

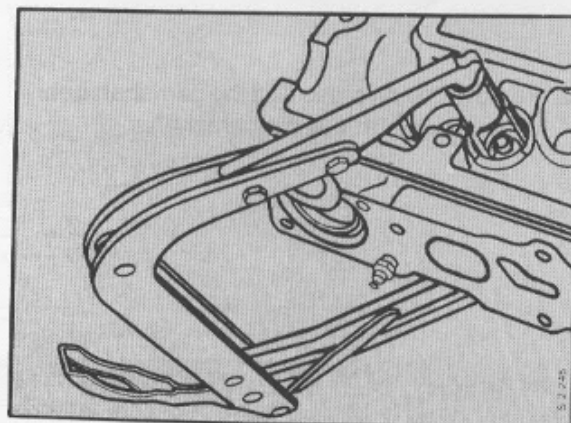
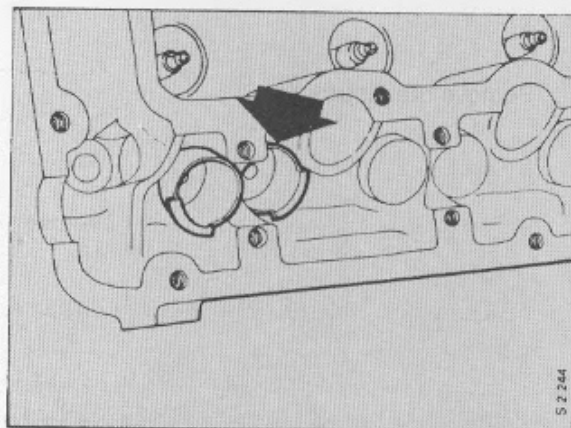
- 3 Remove the cam followers and place them in stand 83 93 787 to ensure they will not be confused when refitted.
- 4 Remove the valves. Place the valves in stand 83 93 787 to ensure they will not be confused when refitted.

Tightening torque: 15 Nm (11 lb ft)

214-20 Valve gear, B201 and B202

N.B.

The cylindrical tappet guides around the valve springs constitute the sealing surfaces for the cam followers. These surfaces must not be scratched or scored, so use a plastic sleeve to protect the guides. Use the special valve spring compressor, 83 93 761, and special anvil 83 93 779. Withdraw the plastic sleeve by inserting the special angled tool under the reinforced edge.



Assembling the valve gear

- 1 Fit the valves and springs. Use plastic sleeves to protect the tappet guides.

N.B.

Prior to assembly, thoroughly lubricate all the parts. Replace any defective valve stem seals before fitting the valves.

- 2 Check the valve adjustment, following the procedure described in this section.
- 3 Fit the cam followers.

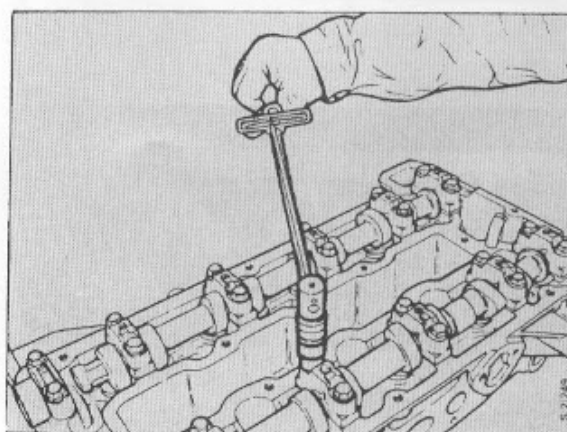
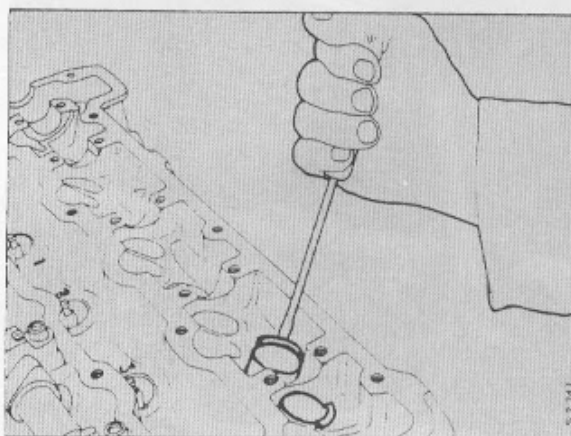
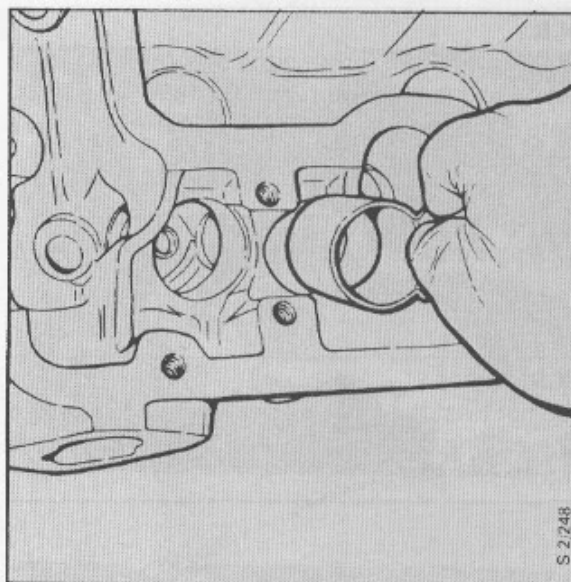
N.B.

Stand the cylinder head on wooden blocks to avoid bending the valves as the camshafts are tightened down.

- 4 Fit the camshafts and bearing caps.
Bearing cap markings:
1 - 5 = Inlet-valve camshaft
6 - 10 = Exhaust-valve camshaft.

Tighten the bearing caps to the specified torque.

Tightening torque: 15 Nm (11 lbf ft)



214-22 Valve gear, B201 and B202

- 5 Refit the distributor and the lubricating oil pipes. Check the condition of the 'O' rings in the fittings.

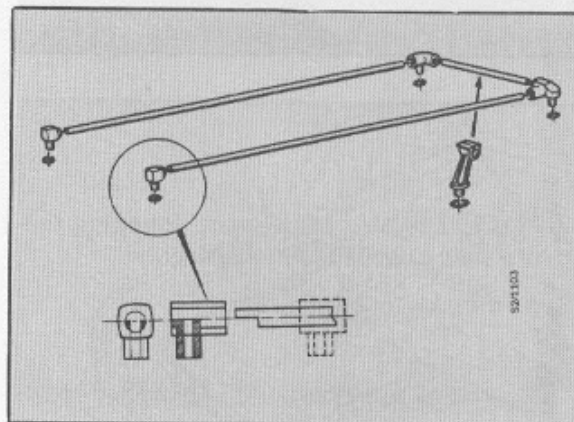
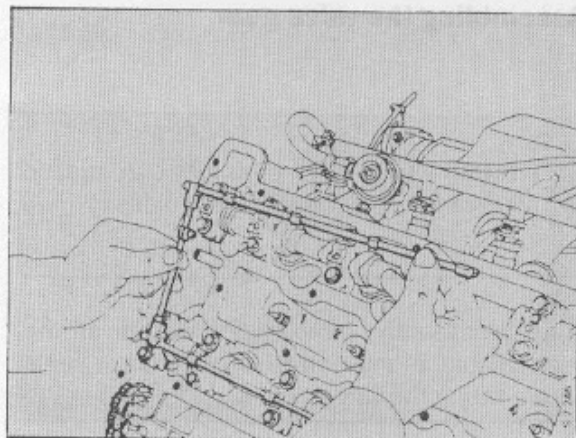
N.B.

Make sure when refitting the pipes that the outlet holes face the right way. The longer pipes locate in the straight couplings and the shorter ones in the elbows.

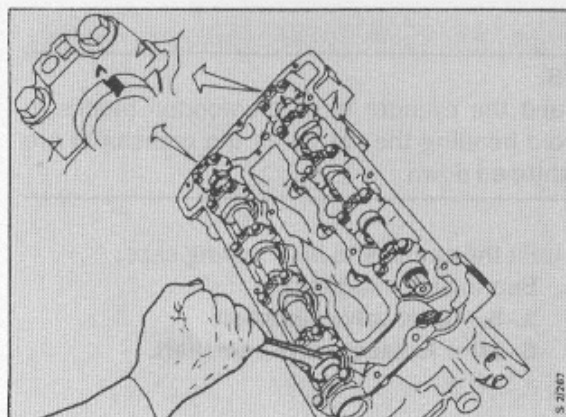
After reassembling the pipes, reconnect the pipework to the oilways in the bearing caps and cylinder head.

N.B.

Do not twist the pipes as this is liable to damage the mating surfaces between the pipes and the fittings.



- 6 Line up the marks on the camshafts with the respective timing marks.



Valve stem oil seals

To change (in situ)

Follow the same procedure as that detailed for the replacement of valve springs, valve heads or collets.

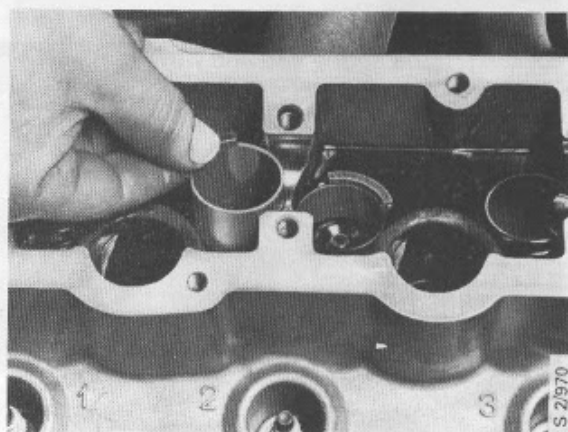
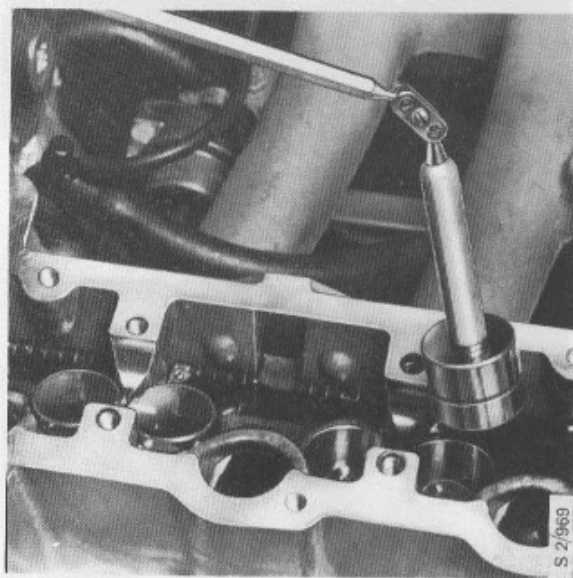
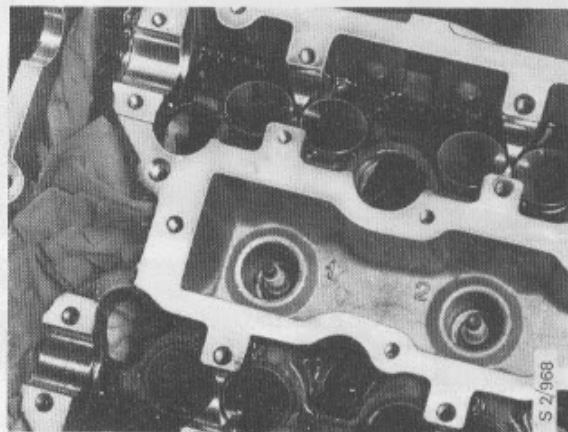
- 1 Rotate the crankshaft, line up the 0° mark with the timing mark (top dead centre for no. 1 and no. 4 cylinders) and remove the camshafts (all valves are closed in this position). Place a cover over the timing cover aperture to prevent collets or seals falling inside.

- 2 Using magnetic tool 83 91 401, lift out the cam followers.

N.B.

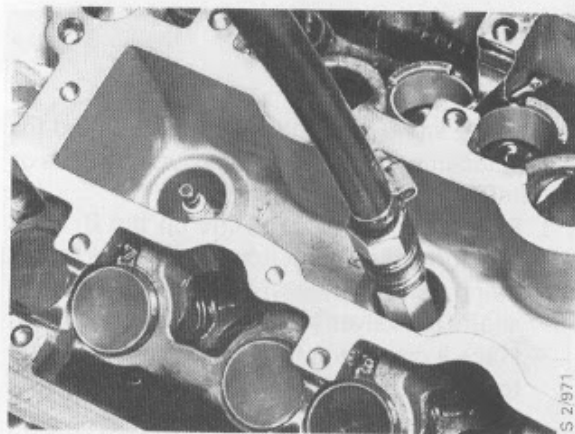
Set aside the parts carefully to avoid confusing them on refitting.

- 3 Fit plastic sleeves (special tool 83 93 746) to the valve springs to prevent the tappet-guide bores from scoring or scratching. Note the way in which the sleeves are oriented.

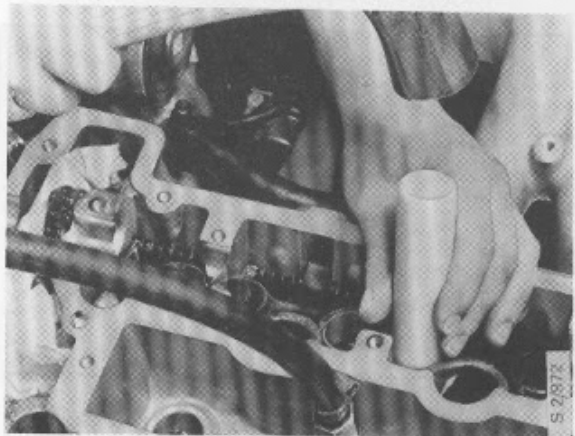


214-24 Valve gear, B201 and B202

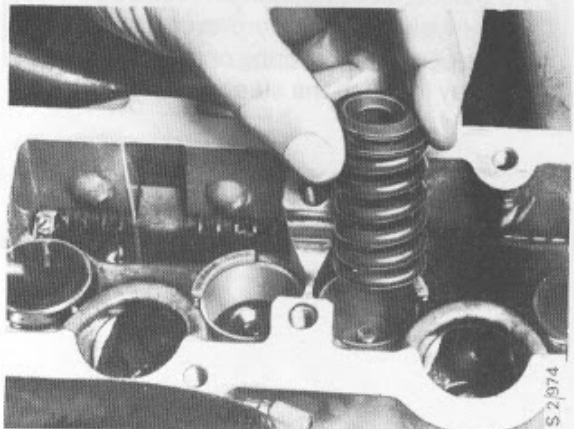
- 4 Unscrew the spark plug for the cylinder concerned and fit compressed-air adaptor 83 92 326. Connect the adaptor to an air line and raise the pressure on the piston and valves.



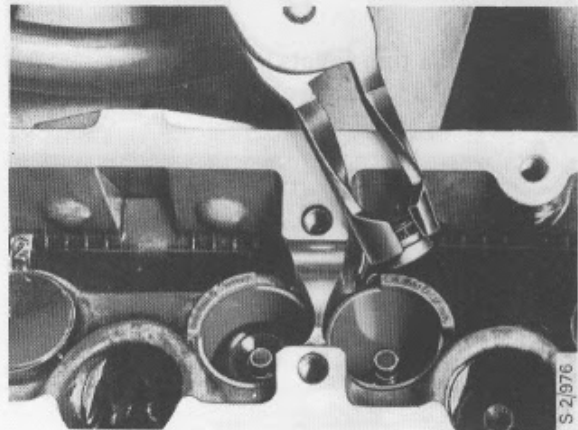
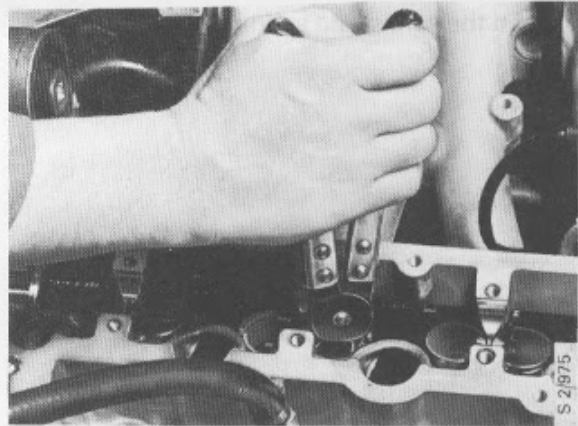
- 5 Position tool 83 94 181 on the valve head, direct in line with the valve stem. Using a hammer, tap the tool firmly once, whereupon the collets should come free from the valve and follow the tool out.



- 6 Lift out the spring cap and valve spring.

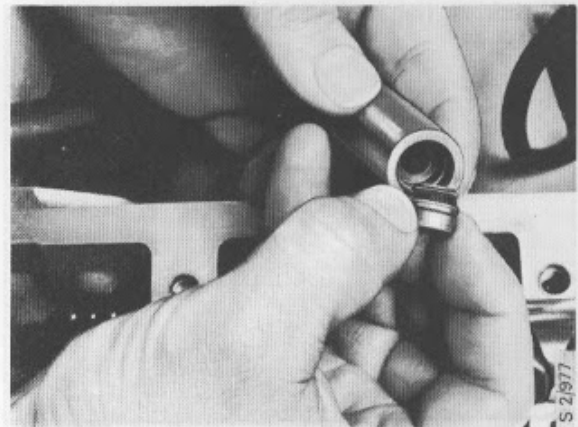


- 7 Remove the valve seal using tool 83 94 157.

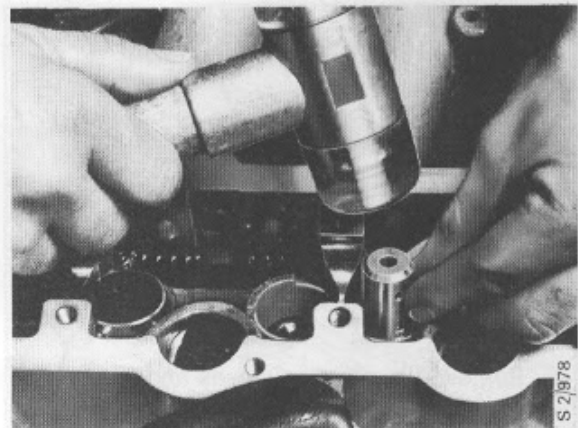


To refit

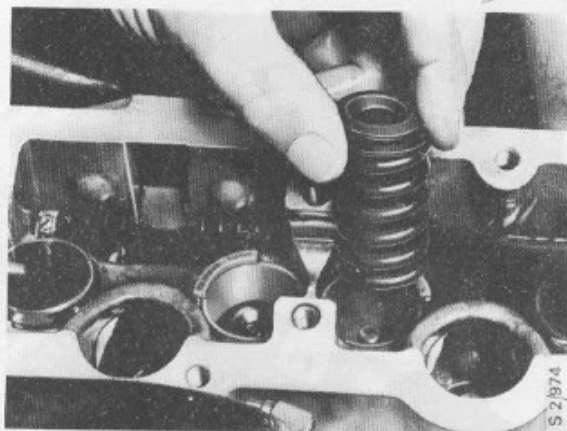
- 1 Remove the shank from tool 83 93 803 and fit the valve seal in the tool with the taper facing inwards (away from the valve head).



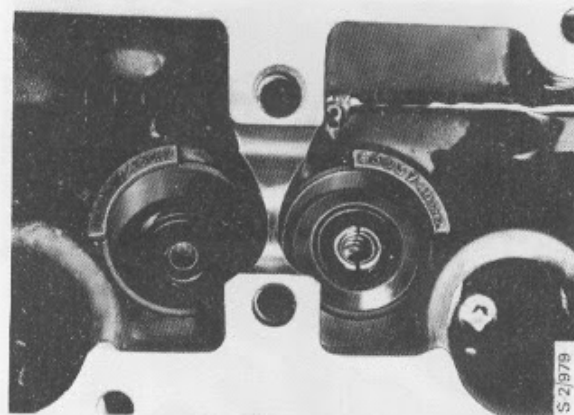
- 2 Fit the seal on the valve stem. Use a plastic-faced mallet to tap the seal carefully into position.



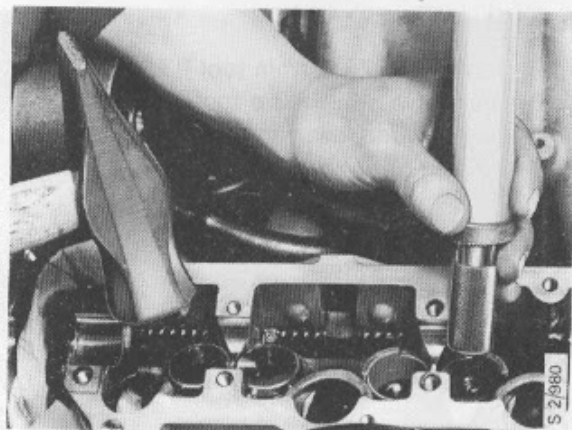
- 3 Fit the spring and spring cap.



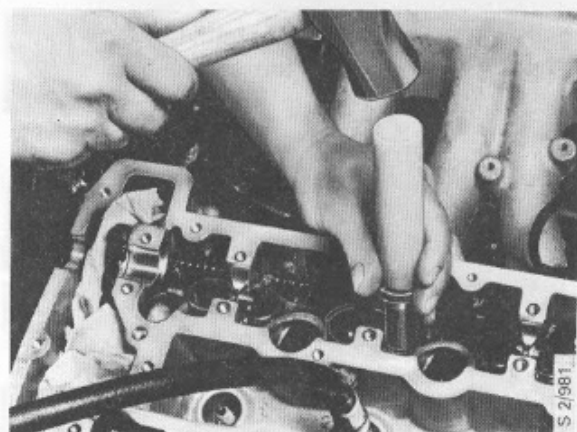
- 4 Position the collets in the groove in the spring cap as shown.



- 5 Using tool 83 94 181 with sleeve 83 94 207 and a hammer, carefully tap the collets home.



- 6 Remove the plastic sleeves and fit the cam followers.



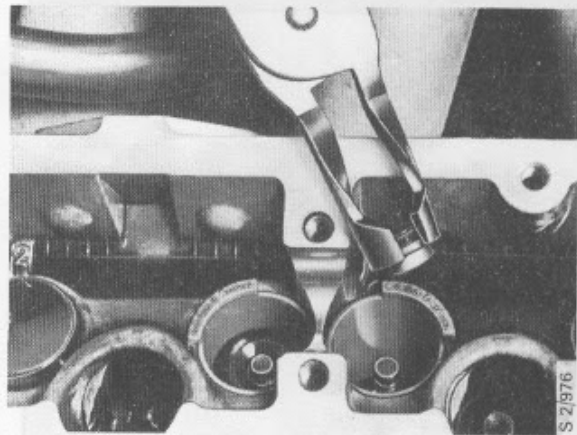
Overhaul of valves, valve guides and valve seats and replacement of valve stem seals (cylinder head removed)

Remove the valves, see "To dismantle the valve gear".

Valve stem seals

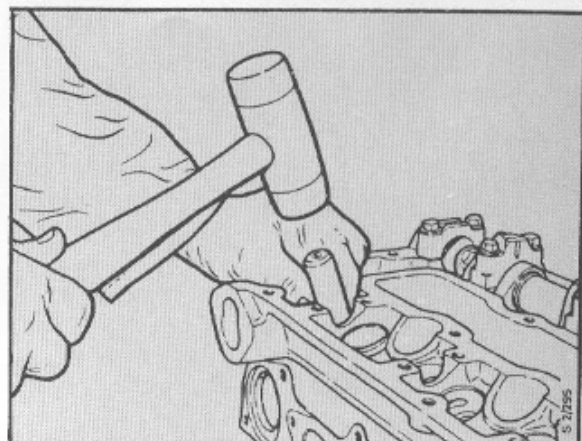
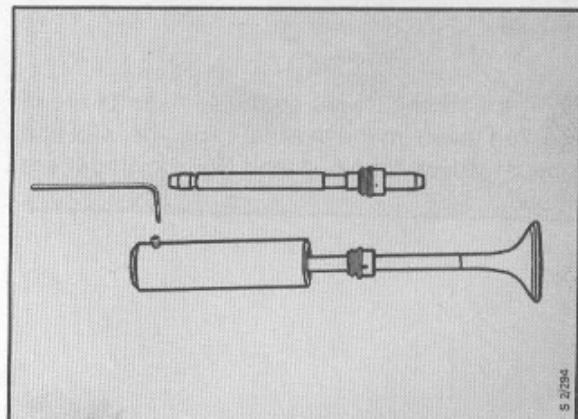
To remove

Remove the seals from the valve guides using tool 83 94 157. If the guides are to be replaced, remove the guides and seals together.



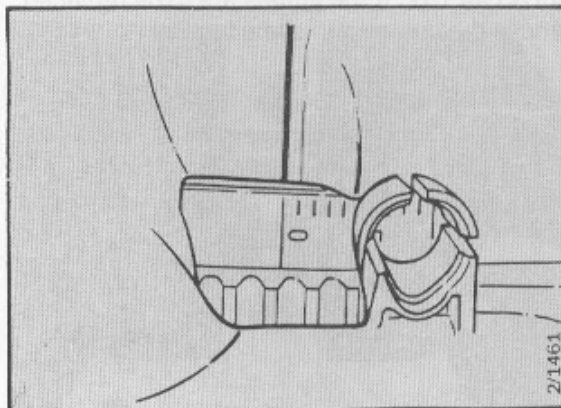
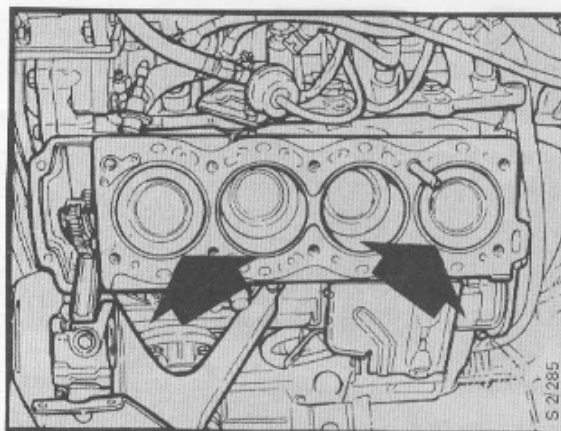
To refit

Refit the seals using special tool 83 93 803. Place the seal in the tool and then allow the tool to be guided by the valve guide. If the valve is fitted, use the stem as a guide. Tap the seal into position using a plastic-headed mallet.

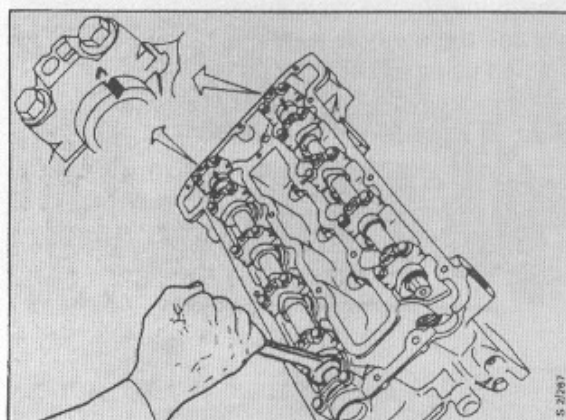


Setting the valve and crankshaft

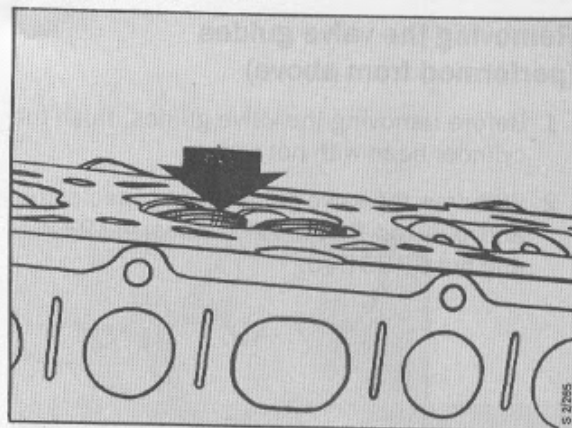
When the pistons in No. 1 and No. 4 cylinders are at top dead centre, the 0° mark on the flywheel must be in line with the timing mark on the clutch cover (or end plate if the clutch cover has been removed).



When the timing marks on the camshafts are in line with those on the bearing caps, the inlet and exhaust valves for No. 1 and No. 4 cylinder are closed.

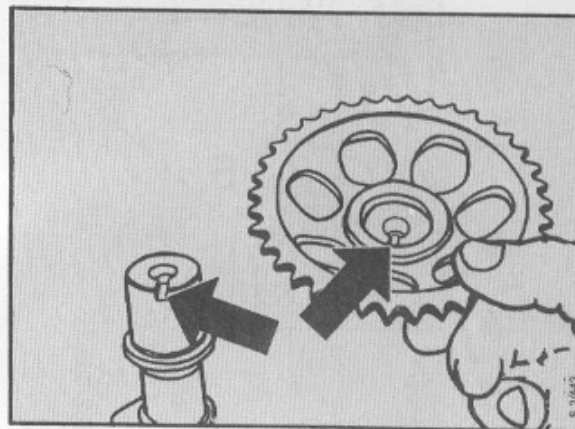


As the valves open, they extend beyond the cylinder head and into the zone in which the pistons move (combustion chamber). Consequently, an alteration in the setting of the crankshaft and valve gear may result in the valves and other vital components in the engine being damaged.



The timing gear comprises sprockets and a chain. The chain has two guides, one fixed and one pivoting. The pivoting guide maintains the tension in the chain, assisted by an hydraulic chain tensioner.

The camshaft sprocket is guided by means of a dog on the shaft. Each sprocket has 38 teeth and is secured to the camshaft by a centre bolt.

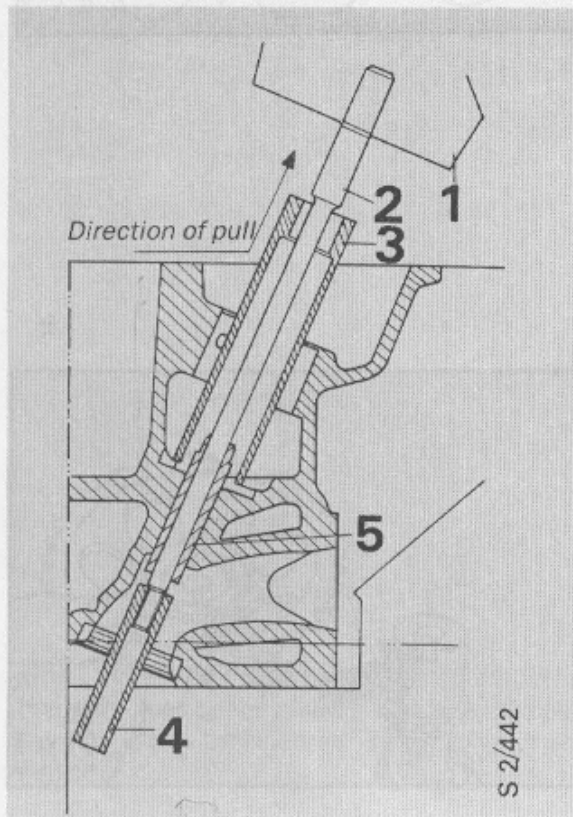


The crankshaft sprocket incorporates a keyway to locate it on the crankshaft. The sprocket, which has 19 teeth, is secured by the centre nut for the crankshaft pulley.

The chain is an endless, single chain with 126 links. The diameter of the rollers is 6.35 mm (0.25 in).

Removing the valve guides (performed from above)

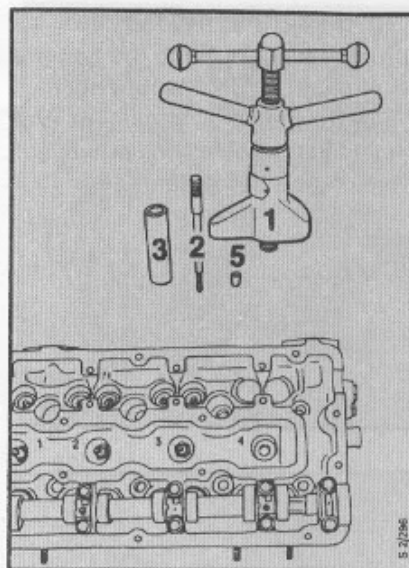
- 1 Before removing the valve guides, flush the cylinder head with hot water.
- 2 Withdraw the valve guides using special tool and pull rod 8393811, spacer 8393829 and nut 8393845.



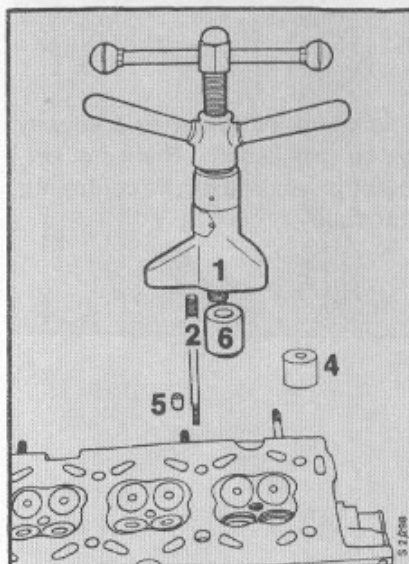
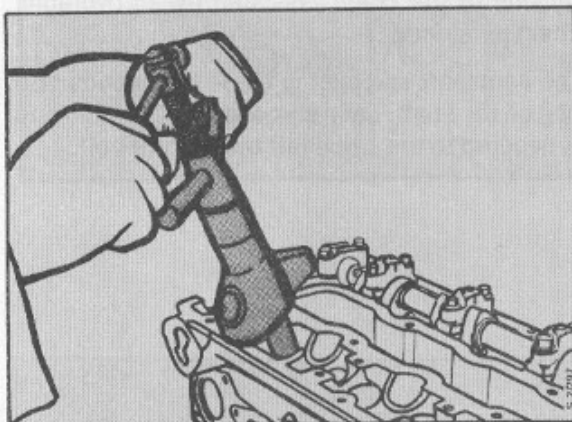
- 1 Jackscrew
- 2 Pull rod
- 3 Spacer sleeve
- 4 Nut
- 5 Valve guide

To refit

- 1 Insert the valve guide from above and apply the tool from below.
- 2 Before fitting the guides, flush the cylinder head with hot water and cool the guides by immersing them in cold water.



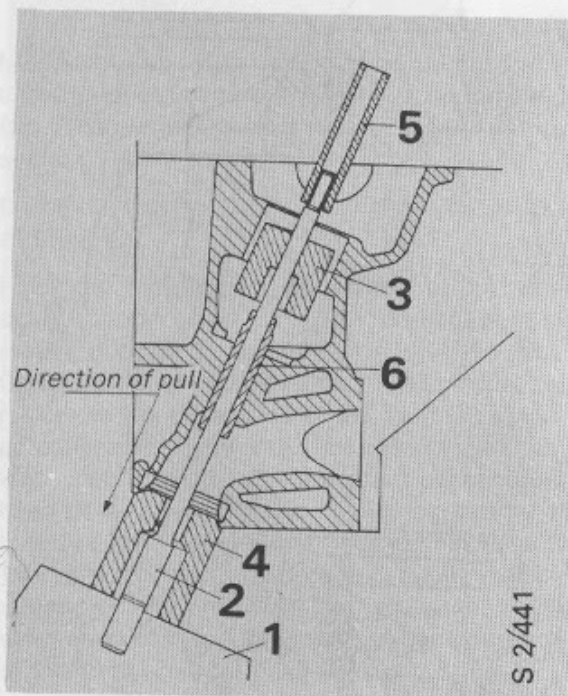
- 1 Jackscrew
- 2 Pull rod
- 3 Spacer sleeve
- 5 Nut



- 1 Jackscrew
- 2 Pull rod
- 4 Stop
- 5 Nut
- 6 Valve guide

- 3 Fit the guides using special tool and pull rod 83 93 811, stop 83 93 837, 83 90 379 and nut 83 93 845.

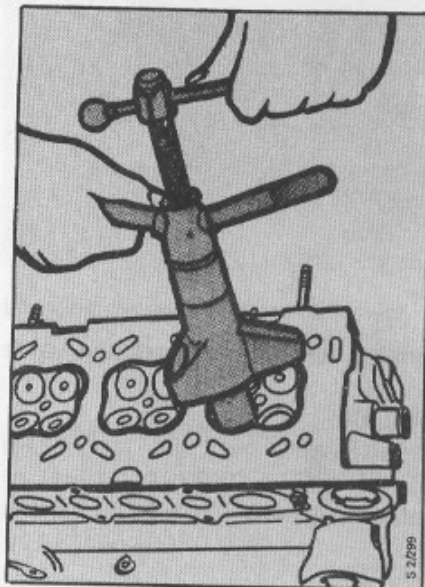
- 4 Centre the tool in the valve seat and, using the tool, draw the guide into its correct position, as shown.



- 1 Jackscrew
- 2 Pull rod
- 3 Stop
- 4 Centring sleeve
- 5 Nut
- 6 Valve guide

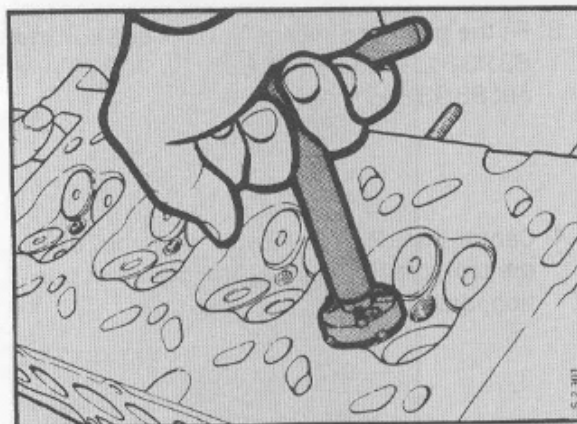
- 5a Run the 7.0-mm undersize reamer, 83 93 944, through the guide.

- b Follow up with the 7.0-mm H7 valve guide reamer.



Valve seats

For recutting the valve seats, use the cutter kit comprising a T-wrench, pilot 83 93 928 and cutters 83 93 936, Neway types 286 45° and 270 60°.



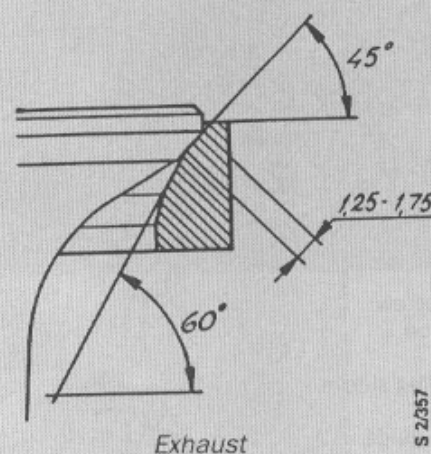
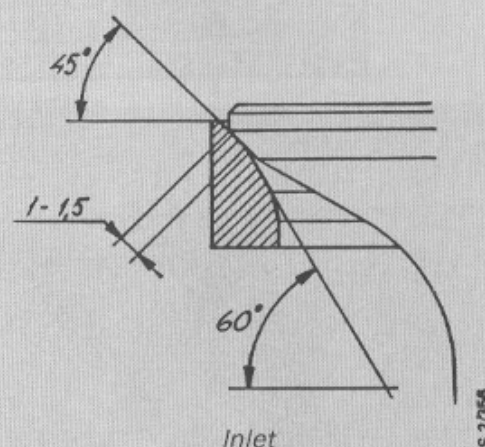
Valve seat angles for inlet and exhaust valve seats: 45°.

Recutting angle: 60°.

Width of inlet valve seat: 1 - 1.5 mm
(0.0394 - 0.0591 in)

Width of exhaust valve seat: 1.25 - 1.75 mm
(0.0492 - 0.0689 in)

(See drawing)



Valves

Inlet valve face angle: 44.5°

Valve head diameter: 32 ± 0.1 mm
(1.26 ± 0.004 in)

Exhaust valve face angle: 44.5°

(The contact surface of the valve has a 0.006-mm (0.0002-in) coating of stellite.)

Valve head diameter: 29 ± 0.1 mm
(1.14 ± 0.004 in)

N.B.

Only a limited amount of material can be removed from exhaust valve seats, since the stellite coating must be preserved as far as possible. Consequently, if the valve seat is badly pitted, the valve should be replaced.

Checking the valve clearance (Cylinder head removed)

The valve clearance is checked relative to the working range of the cam follower.

The **checking values** for the valve clearance are 19.5 ± 0.05 mm (0.77 ± 0.002 in) minimum, and 20.5 ± 0.05 mm (0.81 ± 0.002 in) maximum.

The **setting values** are 20.0 mm (0.78 in) minimum, 20.4 mm (0.80 in) maximum, with a nominal value of 20.2 mm (0.79 in).

The valve clearance is equivalent to the distance between the end of the valve stem and the camshaft bearing seat. It is checked using tool 83 93 753 (measuring head).

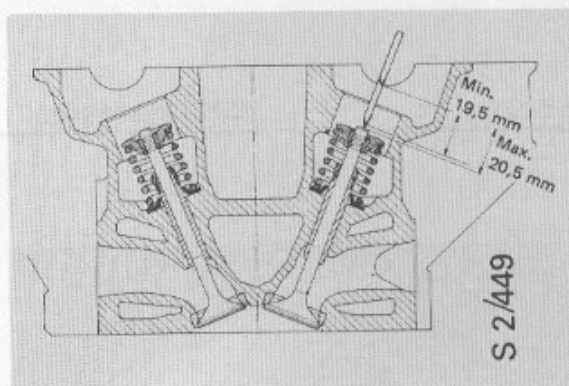
Before the valve clearance can be checked, the camshafts and cam followers must be removed (see 'Dismantling the valve gear' earlier in the section).

Check the valve clearance using tool 83 93 753 as follows.

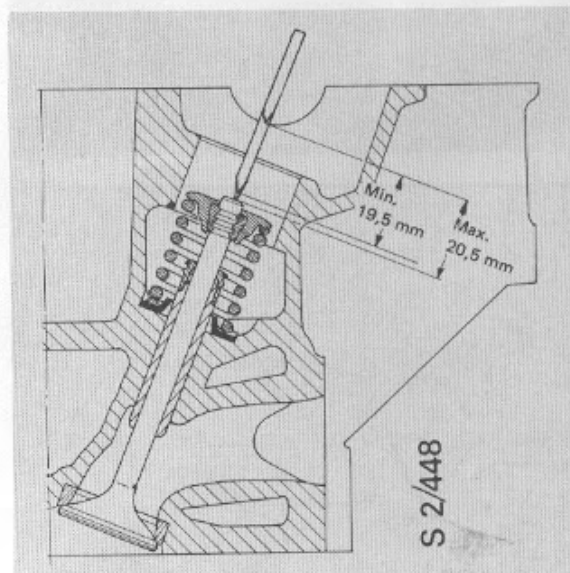
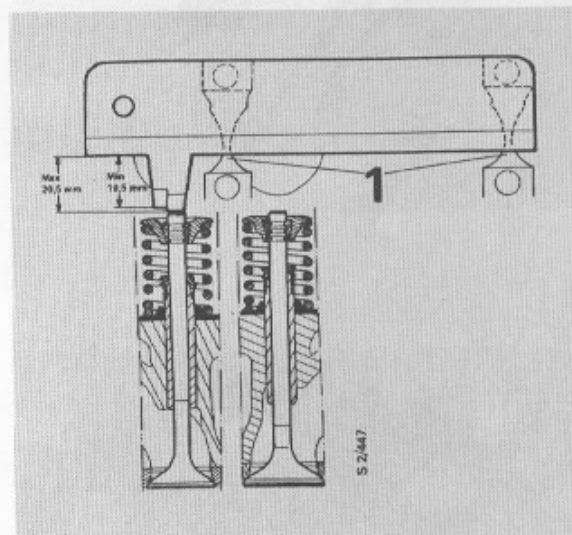
Place the measuring head on two of the camshaft bearing seats. Line up the instrument to read the depth to the end of the valve stem. Check that when the instrument is displaying the maximum depth reading of 20.5 mm (0.8 in) it actually reaches the end of the valve stem, which will be confirmed by the fact that the measuring head does not make contact with the bottom of the bearing seat closest to the instrument. Thereafter, check that the contact point of the instrument does not touch the end of the valve stem when showing the minimum depth reading of 19.5 mm (0.77 in).

The valve clearance is correct when the reading obtained is between the minimum and maximum values.

If the valve clearance deviates from the specified checking values, adjustment must be made to the valve stem or the valve seat: if the value is lower than the minimum value then the length of the valve must be reduced; if the value is greater than the maximum value, then the valve seat must be milled. The nominal value for adjusting the position of the valve is 20.2 mm (0.79 in).



Working range of the cam follower



Timing chain, B201 and B202

Timing chain, B201 215-1

Timing chain, B202 215-5

Timing chain, B201

M84 and earlier

CM CA: Engine No. E22812 and earlier

IM IA: Engine No. E57339 and earlier

SM SA: Engine No. E57339 and earlier

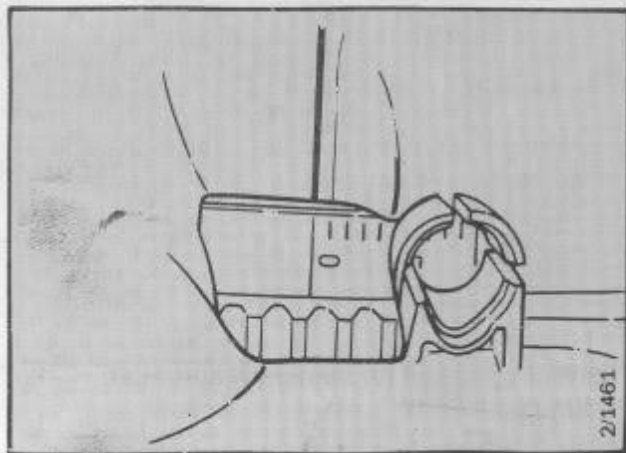
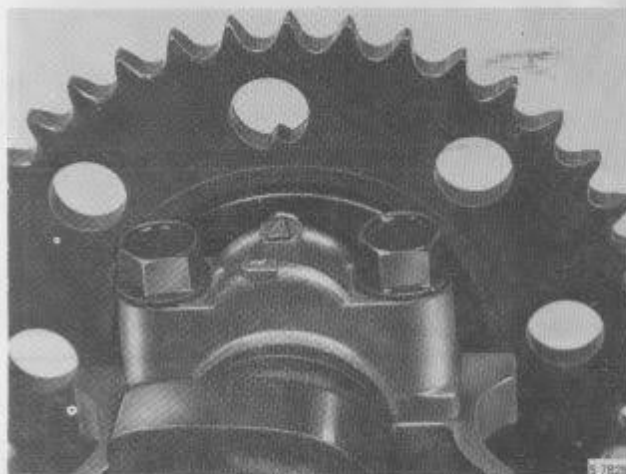
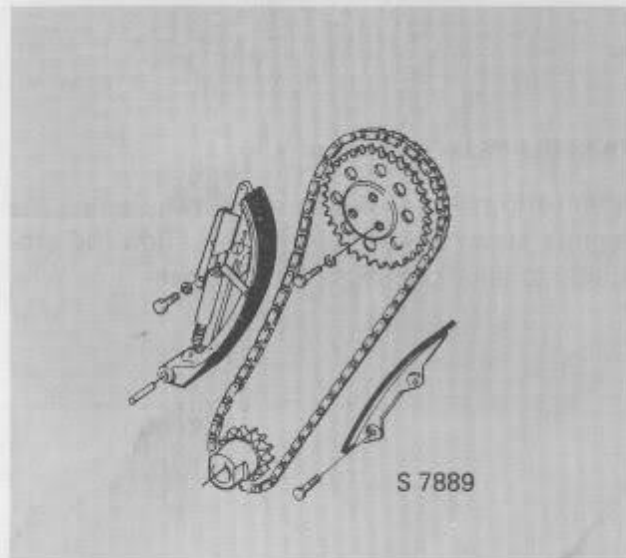
The camshaft is driven by a single chain with a mechanical chain tensioner and a straight chain guide.

N.B.

Never rotate the crankshaft or the camshaft once the timing chain has been detached.

A fully open valve can come into contact with a piston at top dead centre.

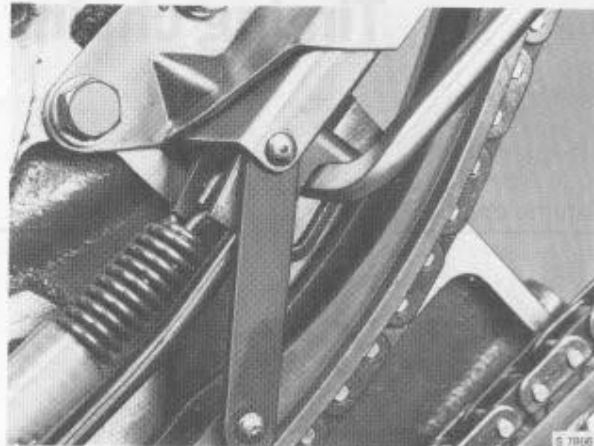
To remove or refit the timing chain, the camshaft and crankshafts must be lined up with their respective timing marks (No. 1 cylinder at top dead centre).



215-2 Timing chain, B201 and B202

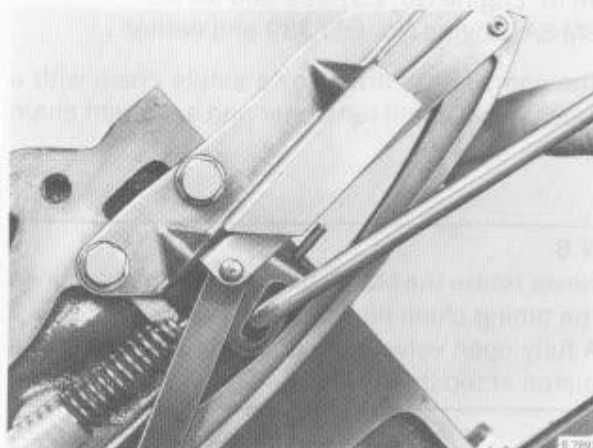
When removing or refitting the camshaft sprocket, use tool 83 93 357 to take the tension off the chain.

Insert the hook as shown and pull upwards to release the chain tensioner.



To fit the chain tensioner

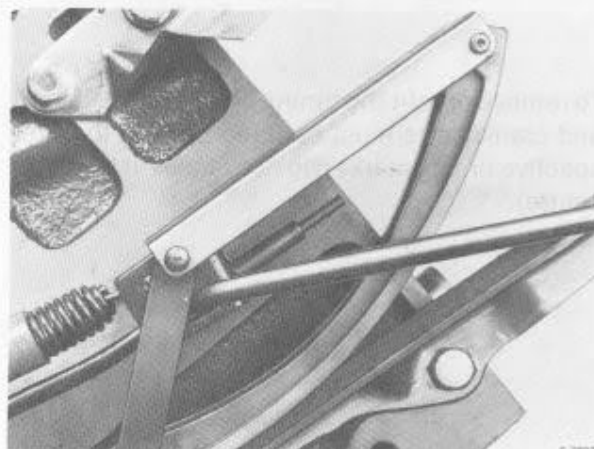
After fitting the tensioner, set it by inserting the tool as shown, and rotating it to allow the tensioner to slide back against the chain.



Fit the camshaft sprocket and move the chain on the sprocket teeth until the marks on the sprocket and bearing cap coincide.

N.B.

The 0° mark on the crankshaft must be in line with the timing mark.



Fit the sprocket bolts complete with plain washers.

Warning

If the washers are omitted, the bolts will foul the camshaft carrier.

Tightening torque for camshaft sprocket:
20 Nm (14.8 lbf ft)

M84 onwards

CM CA: Engine No. E22813 onwards

IM IA: Engine No. E57340 onwards

SM SA: Engine No. E57340 onwards

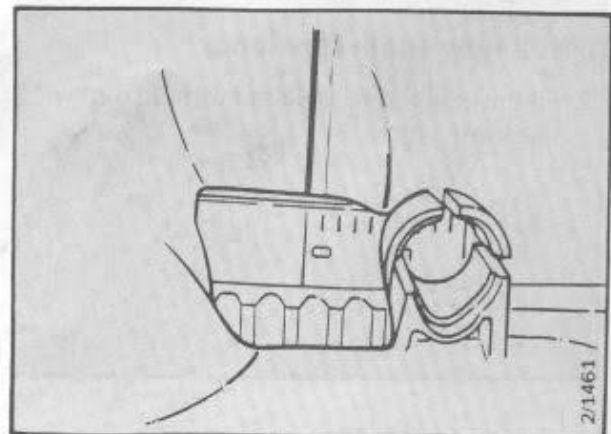
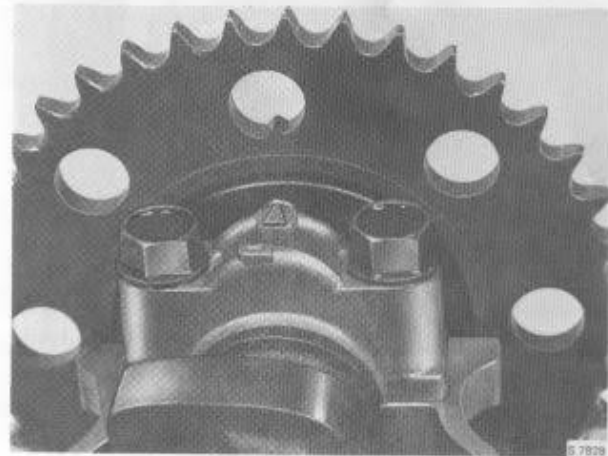
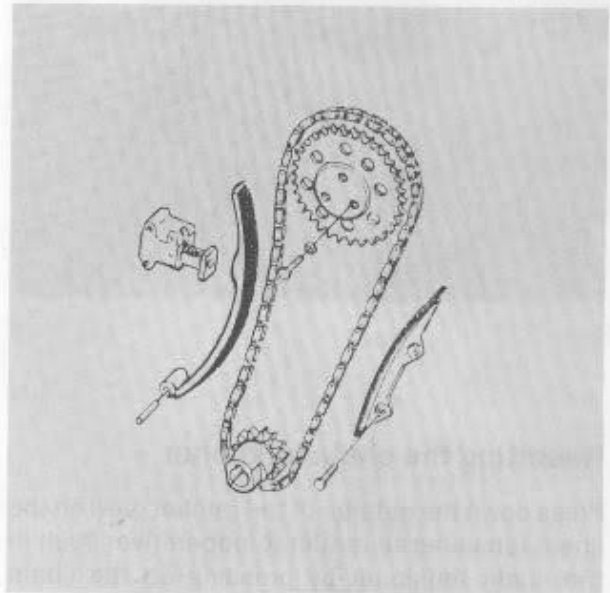
The camshaft is driven by a single chain with a mechanical chain tensioner, a pivoting guide and a fixed chain guide.

N.B.

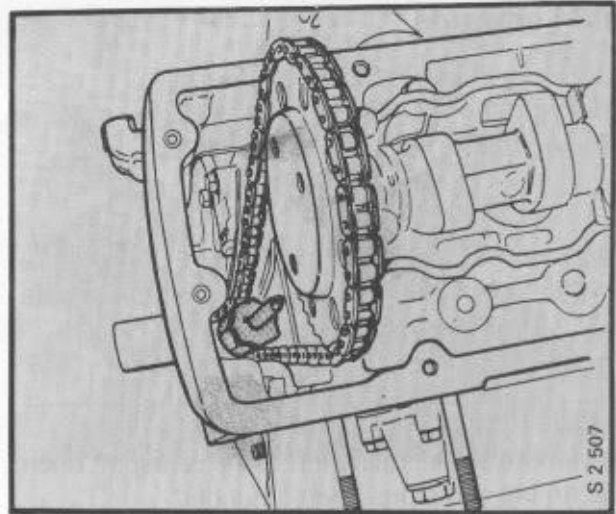
Never rotate the crankshaft or the camshaft once the timing chain has been detached.

A fully open valve can come into contact with a piston at top dead centre.

To remove or refit the timing chain, the camshaft and crankshafts must be lined up with their respective timing marks (No. 1 cylinder at top dead centre).

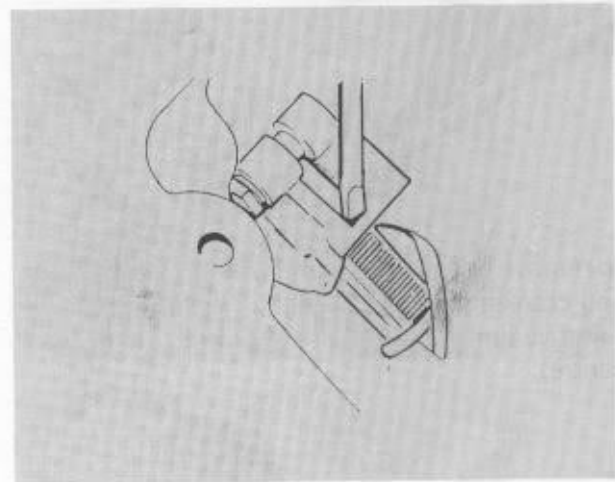


When removing or refitting the camshaft sprocket, lock the chain in position by inserting the handle of a suitable screwdriver between the two parts of the chain as shown.



Resetting the chain tensioner

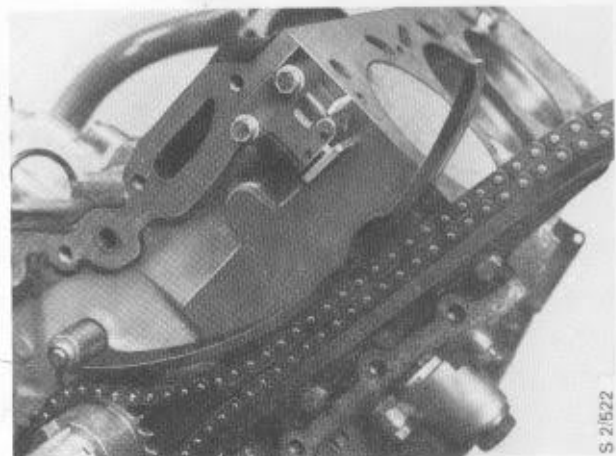
Press down the outside of the ratchet pawl on the chain tensioner to render it inoperative. Push in the chain tensioner by pressing on the chain guide.



Retain the chain guide in this position, refit the sprocket and chain and then release the chain guide, whereupon the tensioner will press against the chain.

To fit a new chain tensioner

- 1 Fit the new chain tensioner without removing the transit lock.



- 2 Fit the camshaft sprocket and move the chain on the sprocket teeth until the marks on the sprocket and bearing cap coincide.

N.B.

The 0° mark on the crankshaft must be in line with the timing mark.

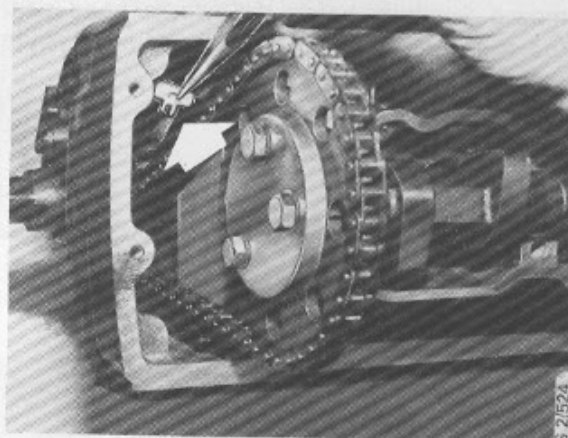
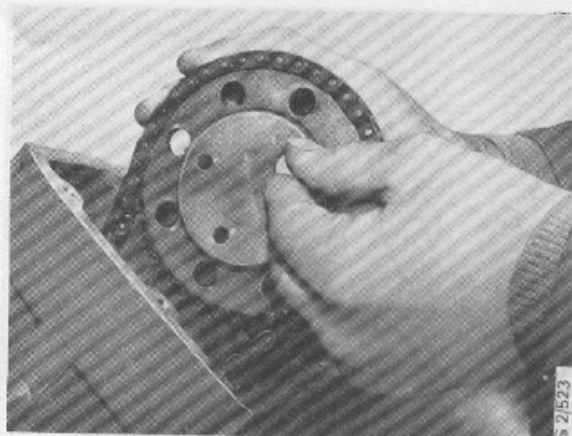
Fit the sprocket bolts complete with plain washers.

Warning

If the washers are omitted, the bolts will foul the camshaft carrier.

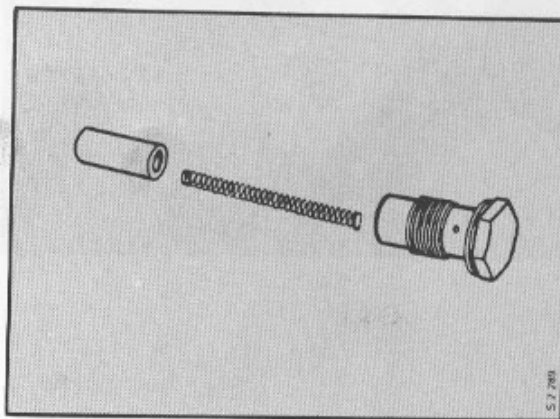
Tightening torque for camshaft sprocket:
20 Nm (14.8 lbf ft)

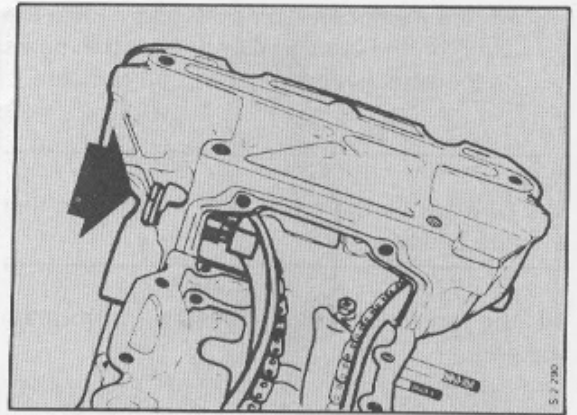
- 3 Remove the transit lock from the tensioner, thereby triggering the device.

**Timing chain, B202**

The chain tensioner, which is hydraulic and incorporates a spring and ratchet, is fitted inside the cylinder head and has an opposing action to the pivoting chain guide.

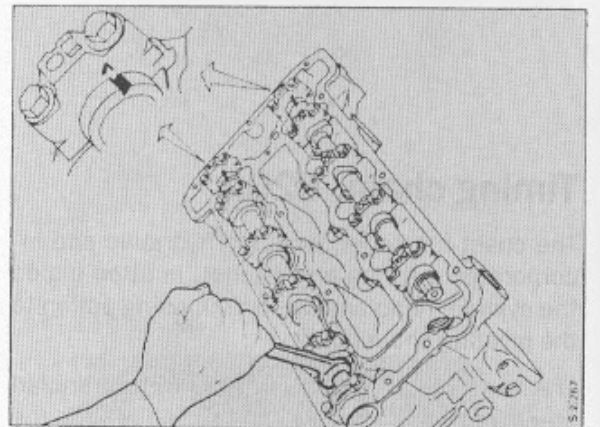
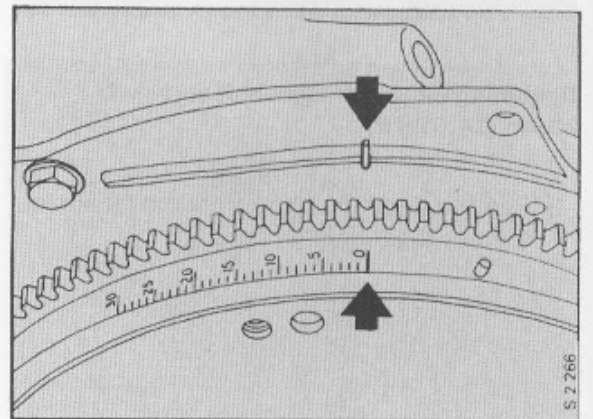
The fixed guide, which is made of rubber-clad steel and has a groove in the rubber for the chain, is secured by means of two bolts. The pivoting guide, which is made of rubber-clad light alloy, also has a groove for the chain in the rubber and has a pivot fixing at its lower end.





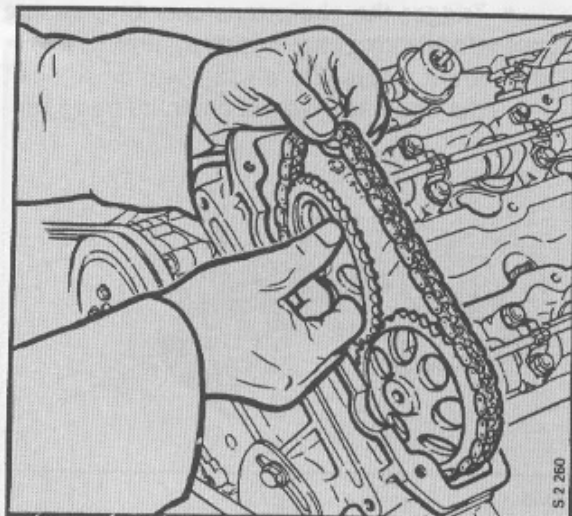
Removal and refitting of the timing chain

Before starting work to remove the timing chain, the 0° mark on the flywheel must be turned to line up with the timing mark on the flywheel cover or end plate. The basic settings of the crankshaft and valve gear must not be altered before the camshafts or the cylinder head have been removed. Similarly, before the cylinder head is fitted, the crankshaft and valve gear must be set to their respective timing marks.

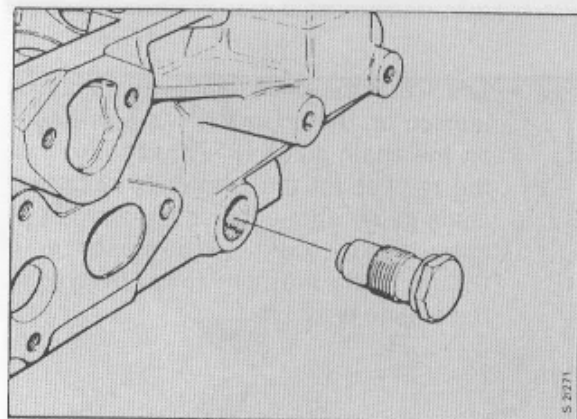


To refit

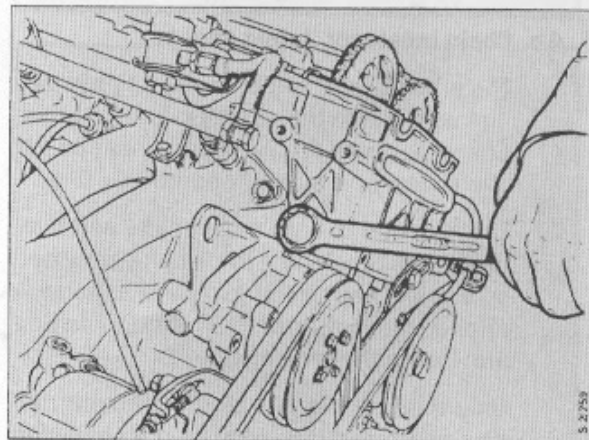
- 1 Place the chain on the crankshaft sprocket.
- 2 Fit the chain and sprocket on the exhaust-valve camshaft. Make sure the chain is taut between the crankshaft and the camshaft sprockets. Tighten the bolt.
- 3 Fit the chain and sprocket to the inlet-valve camshaft. Keep the chain taut between the sprockets while it is being fitted. Tighten the bolt. Refer to step 7 below for permitted tolerances in the basic timing setting.

**4 a Chain tensioner, early design**

- Tension the chain tensioner by fully depressing the piston and then rotating it to the locked position.

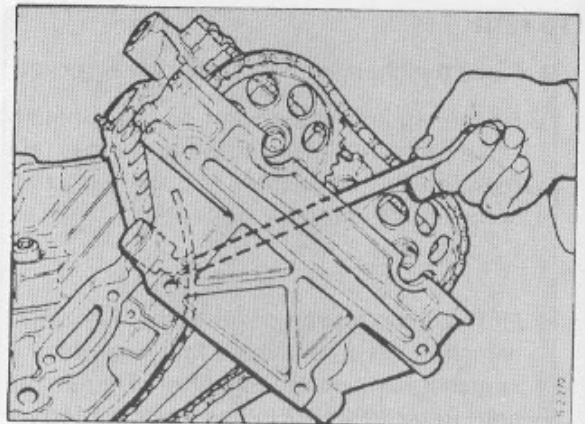


- Fit the chain tensioner with the piston under tension. Make sure that the copper gasket is in good condition and that the sealing surface is clean and free from burrs.



215-8 Timing chain, B201 and B202

- Trigger the chain tensioner by pressing the pivoting chain guide against it; thereafter, press the pivoting guide against the chain to give the chain its basic tension.



N.B.

Use a blunt instrument - not a screwdriver or similar.

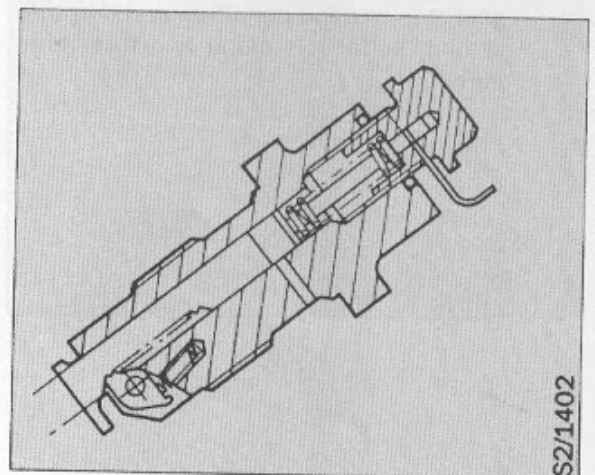
- Check that the chain tensioner maintains tension on the chain when the pressure on the chain guide is released and that the ratchet for the tensioner holds the chain guide tight against the chain. A limited amount of play will be present until the hydraulic pressure takes over once the engine is running.

4 b Chain tensioner, latest design

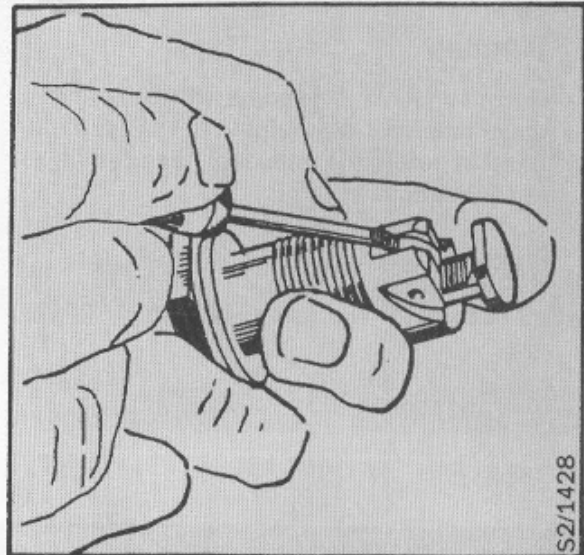
The latest chain tensioner has a tighter adjustment range than earlier versions, thus providing more-precise compensation for chain wear and quieter operation.

The function is both mechanical and hydraulic, the tensioning force being provided by a spring acting on the tensioning arm. A ratchet prevents return of the tensioning arm inside the tensioner unit.

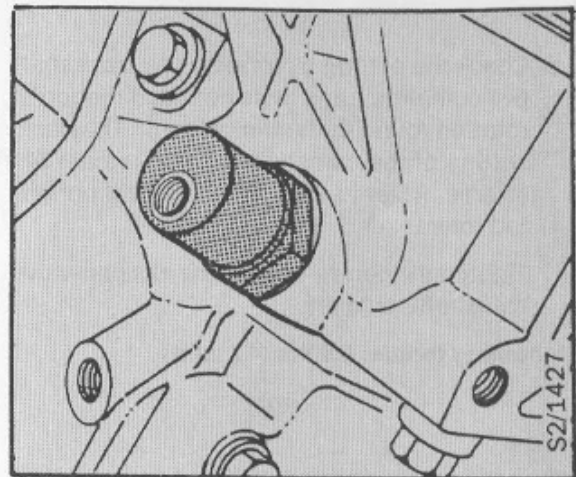
Only the latest chain tensioner is carried as a spare part, the earlier version having been discontinued.



- Preset the chain tensioner for fitting by pressing down on the ratchet and pushing in the tensioner.

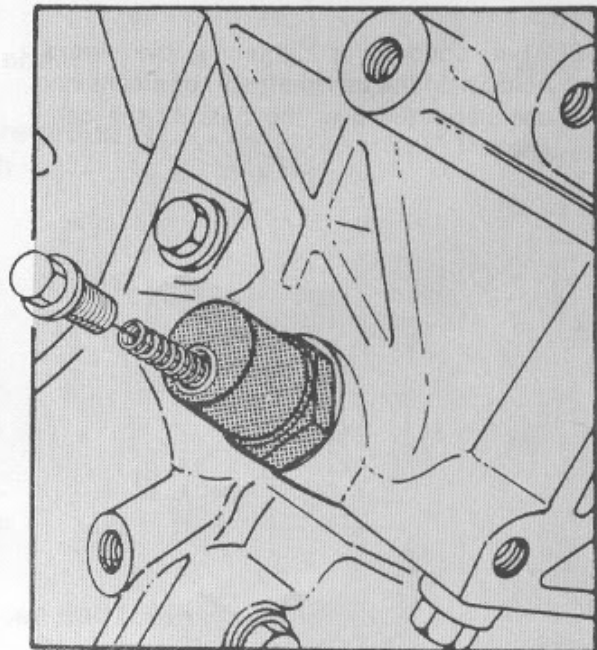


- Fit the chain tensioner complete with gasket and tighten to a torque of 65 Nm (52 lbf ft).



- Insert the spring and plastic guide pin into the tensioner body.
- Fit the plug, checking that the 'O' ring is properly seated.

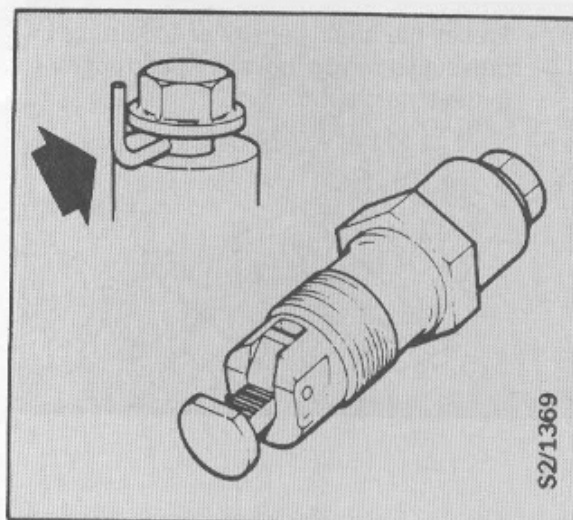
Tighten the plug to 22 Nm (16 lbf ft).



As the plug is screwed in, the spring will push the tensioning arm out, thereby tensioning the chain.

Warning

New chain tensioners come with the spring under tension. Never remove the safety pin (step 4) before the tensioner has been fitted to the engine.

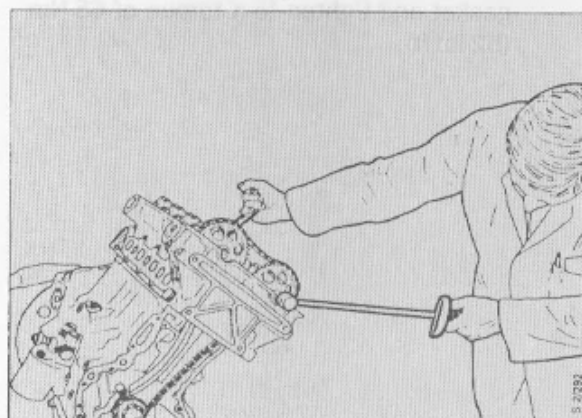


Withdraw the safety pin, whereupon the spring will push the tensioner arm out, thereby tensioning the chain.

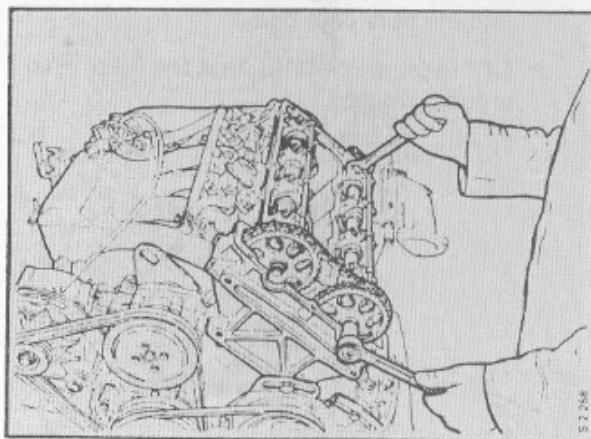
- 5 Check the setting by rotating the crankshaft two complete turns in its normal direction of rotation round to the timing mark. The basic setting of the camshafts should remain unaltered. Refer to step 7 for details of permitted tolerances.

Tighten the centre-bolt for the exhaust-valve camshaft sprocket.

Tightening torque: 63 Nm (47 lbf ft)

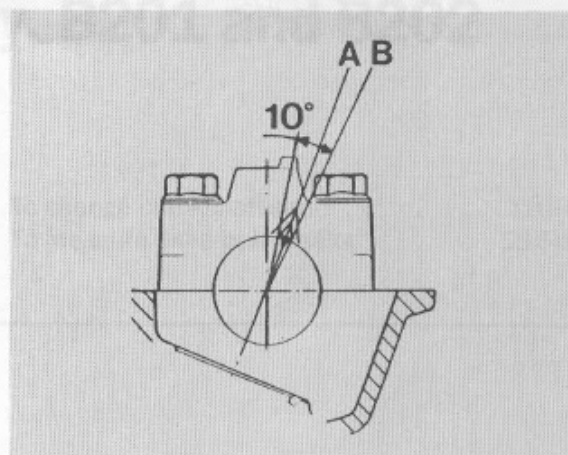


- 6 When undoing or tightening the centre-bolts, hold the camshaft still by means of a spanner fitted over the flats on the camshaft.

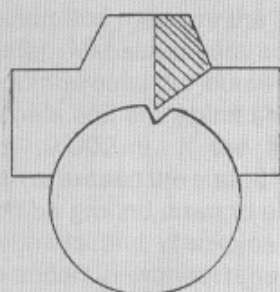


- 7 The adjusting accuracy will depend on the condition of the chain.

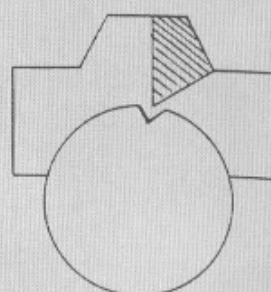
Moving the timing chain one tooth will rotate the camshaft through 10° , corresponding to approx. 3.0 mm (0.12 in), which is the width of the camshaft timing mark.



Camshaft setting

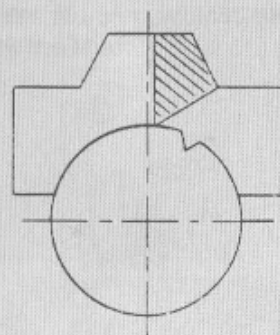


Exhaust

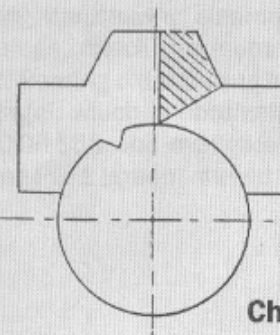
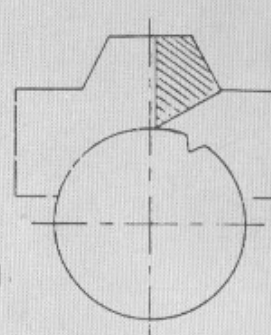


Inlet

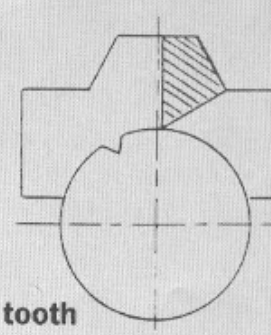
Correct



**Worn chain
or chain retarded
one tooth**



Chain advanced one tooth



S2/1099

Crankshaft assembly, B201 and B202

To measure the crankshaft	216-1	To change crankshaft seals	216-4
To measure bearing clearances	216-1	To measure drive-belt tension	216-9
To choose bearing shells for main and big-end bearings	216-3		

To measure the crankshaft

Clean the crankshaft and measure the journals, using a micrometer. Measurements should be made at several points round the journal. Out-of-round of the journals and crankpins should not exceed 0.05 mm (0.002 in). If the measurements are close to or exceed the stated limit, the crankshaft should be ground down to undersize as specified. Journals and crankpins can be ground down one undersize without rehardening. Grinding to further undersizes will necessitate 'Tenifer' rehardening. Check that the crankshaft is true to within 0.05 mm (0.002 in) using a dial indicator. Mount the crankshaft in two V-blocks, place the indicator plunger against the centre journal and rotate the shaft.

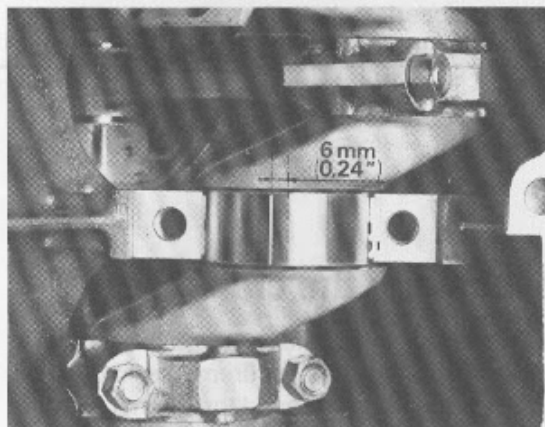
To measure bearing clearance

Before measuring the bearing clearance when fitting new bearings, check the journal out-of-round and taper. Bearing clearance is measured using a 'Plastigage', which is obtainable under part no. (45) 30 06 558 and available in three thicknesses. Type PG-1 (green) should be used.

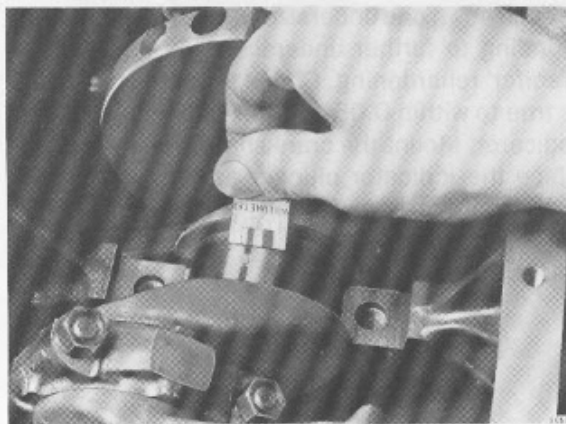
Main bearings

'Plastigage' can be used to measure both out-of-round and clearance.

- 1 Position the engine upside-down so that the weight of the crankshaft will not affect the measurements.
- 2 Ensure that the parts to be measured are free from oil and dirt. Put a strip of 'Plastigage' about 6 mm (0.2362 in) to one side of the longitudinal centre-line of the journal.
- 3 Refit the bearing cap and tighten to a torque of 108 Nm (80 lbf ft). The crankshaft must remain stationary while the measurement is taken.
- 4 Remove the bearing cap. The strip of 'Plastigage' should now adhere to the bearing shell or crankshaft journal.



- 5 Measure the width of the 'Plastigage' strip using the scale printed on the package and read off the clearance. One side of the package is calibrated in mm, the other side in thousandths of an inch. Measure the strip at its widest point but do not touch it with your fingers.

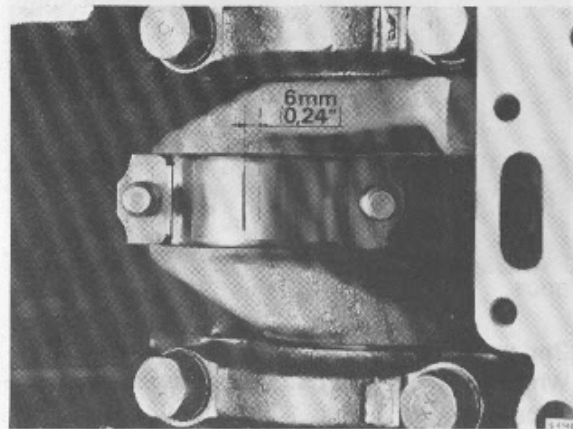


Big-end bearings

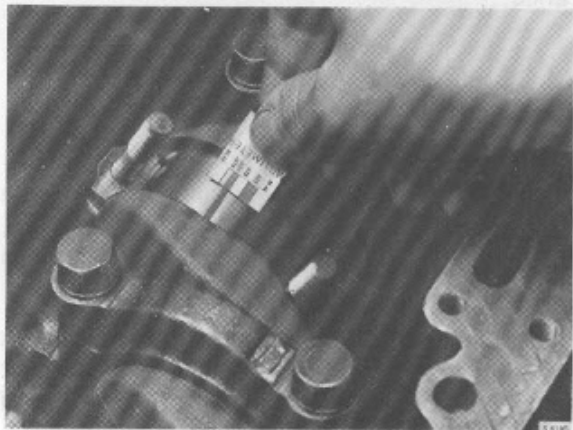
Plastigage strips cannot be used to measure the out-of-round of big-end bearings with the pistons fitted in the block. Use a micrometer instead.

When fitting new bearings, check the big-end bearing clearance as follows.

- 1 Rotate the crankpin to be measured to about 60° BTDC.
- 2 Ensure that the parts to be measured are dry and free from oil and dirt. Place a strip of 6 mm (0.2362 in) Plastigage to one side of the centre-line of the crankpin.



- 3 Refit the bearing cap and tighten to a torque of 54 Nm (40 lbf ft). The crankshaft must remain stationary while the measurement is taken.



- 4 Remove the bearing cap. The strip of Plastigage should now adhere to the bearing shell or crankpin.
- 5 Measure the width of the Plastigage strip using the scale printed on the package and read off the clearance. One side of the package is calibrated in mm, the other side in thousandths of an inch. Measure the strip at its widest point but do not touch it with your fingers.

Main bearing clearance:
0.020 - 0.062 mm (0.0008 - 0.0024 in)

Big-end bearing clearance
0.026 - 0.062 mm (0.0010 - 0.0024 in)

To choose bearing shells for main and big-end bearings

Bearing shells are available in two classes for standard size, 1st undersize and 2nd undersize. The two different thicknesses are can be combined to obtain the correct clearance. Bearing shells for 3rd and 4th undersizes are only available in one thickness.

216-4 Crankshaft assembly, B201 and B202

The different thicknesses of bearing shells are colour-coded as follows:

Standard size:

Red - thin bearing half, gives **increased** clearance

Blue - thicker bearing half, gives **reduced** clearance.

1st undersize:

Yellow - thin bearing half, gives **increased** clearance.

Green - thicker bearing half, gives **reduced** clearance.

2nd undersize:

White - thin bearing half, gives **increased** clearance.

Brown - thicker bearing half, gives **reduced** clearance.

Example

Try to obtain the correct clearance by fitting two thin bearing shells. If the clearance is excessive, reduce it by fitting one thin and one thick, or two thick shells.

If the clearance is excessive even after two thick bearing shells have been fitted, the crankshaft must be ground down to the next undersize and the appropriate undersized bearing shells fitted. (See the 'Technical data' section).

N.B.

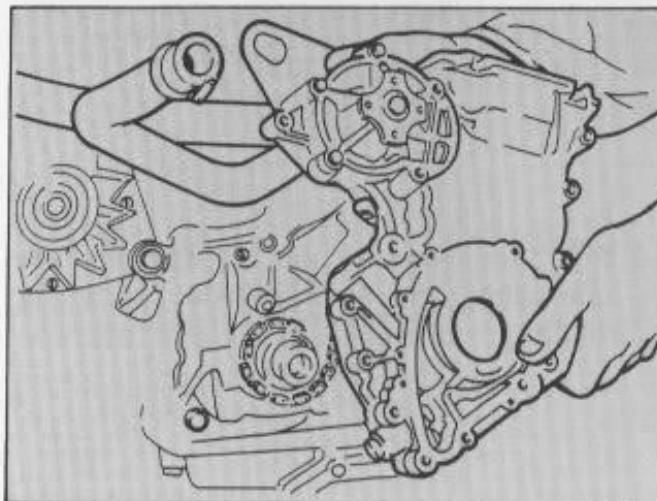
The journals can be ground down one undersize (0.25 mm or 0.0098 in) without requiring rehardening. Grinding to further undersize will necessitate Tenifer rehardening.

To replace the crankshaft seal at the flywheel end

The seal can be replaced with the engine in situ or removed from the car, but the clutch and flywheel must always be removed first.

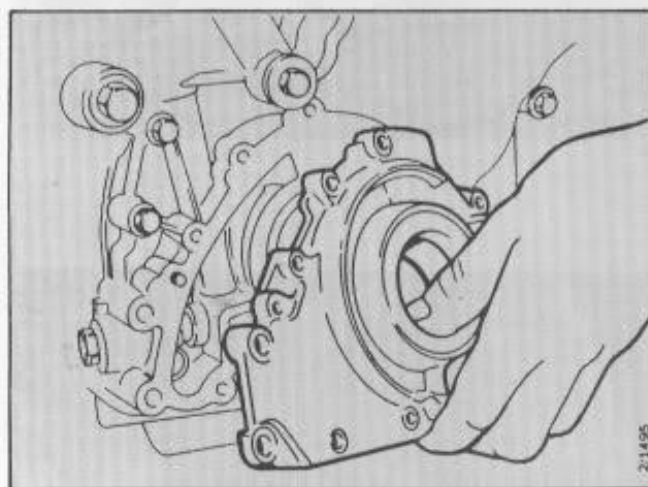
12 Fit new gaskets to the timing cover, using dabs of grease to hold the gaskets in place.

13 Fit the timing cover.



14 Fit the timing cover bolts and the alternator steady bar and reconnect the coolant hose to the bottom of the water pump.

15 Fit a new 'O' ring for the oil pump and offer up the pump, locating it on the guide pins.



If there are no guide pins, centre the pump using tool 83 93 589.

Remove the old stuffing box, put the tool in position and fit a new stuffing box.

For further details, see page 221-2.

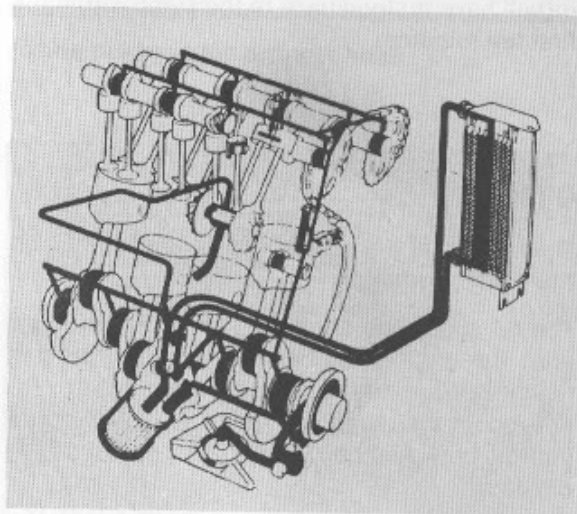
Lubrication system, B201 and B202

General

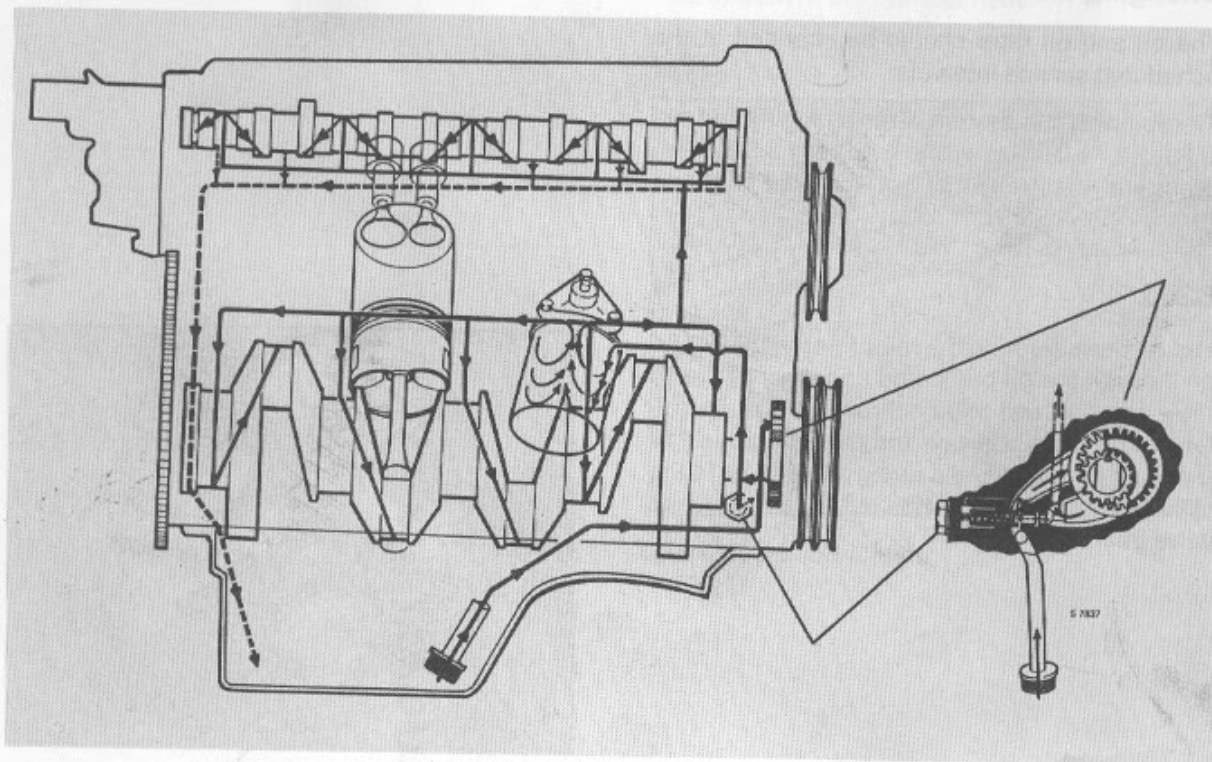
The engine has a forced-flow lubrication system. Oil pressure is generated by a gear-type pump consisting of a gear wheel and an eccentric ring gear. The pump is driven by the crankshaft and is interposed between the timing cover and crankshaft pulley. A reduction valve in the timing cover limits the oil pressure by directing excess oil to the inlet side of the pump.

The oil pan is integral with the gearbox casing but totally separated from the gearbox lubrication system. The oil filter is of the full-flow type, i.e. all the oil circulated round the lubrication points passes through the filter.

On the dipstick are marks for the minimum and maximum levels of oil in the sump. The marks represent oil quantities of 2.7 litres (2.9 liq qt) 3.7 litres (3.9 liq qt) respectively. The total capacity of oil, including that in the filter, is: B201, 3.8 litres (4 liq qt); B202, 4.0 litres (4.2 liq qt).



Lubricating system, B202



Lubricating system, B201

Quantity of oil circulating

When the engine is running, 1.2 litres of oil is used to fill the oilways in the engine. This will result in the oil in the sump dropping to a level midway between the marks on the dipstick.

After the engine has been switched off, the oil in the engine oilways starts to drain back to the sump. The time taken for the oil to drain back into the sump depends on the temperature of the engine. If the engine has reached its normal operating temperature, it will take about an hour for all the oil to drain back, although most of the oil will have drained back to the sump within the first ten minutes.

Oil level

The sensor for the oil warning light is located on the oil filter adaptor.

The oil should be checked two or five minutes after the engine has been switched off having reached its normal operating temperature. Do not top up the oil unless the level is lower than midway between the MAX and MIN marks on the dipstick.

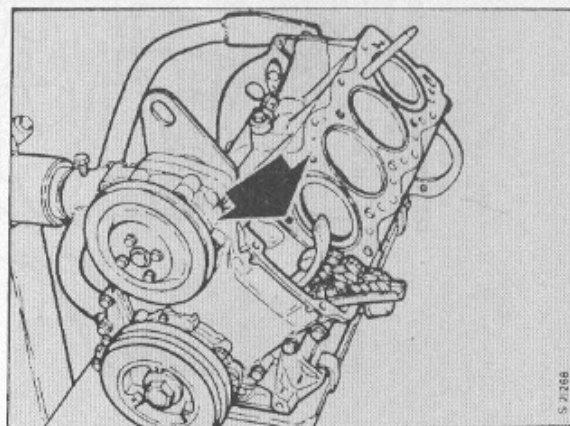
Changing the oil

The oil and oil filter should be changed at the scheduled service intervals.

To replenish the system after changing the oil, 3.8 litres (4.0 liq qt) will be required for B201 engines and 4.0 litres (4.2 liq qt) for B202 engines.

B201

The oil flows through the inlet filter in the sump, on through the oil pump and an oilway to the oil filter adaptor, and thence through the main gallery in the block. Oilways run from the gallery to the main bearings and a rising oilway runs to the cylinder head for lubrication of the camshaft and valve gear.

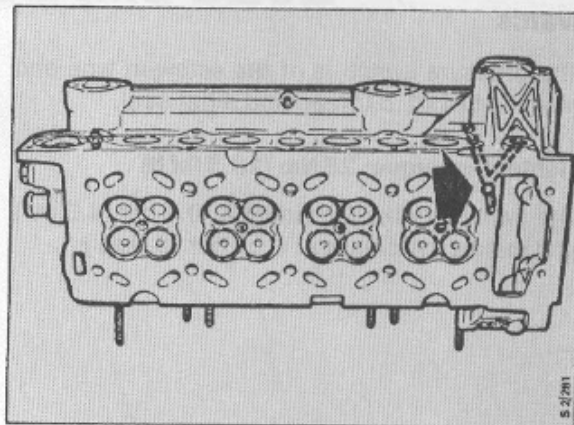


Rising oilway in the block (arrowed)

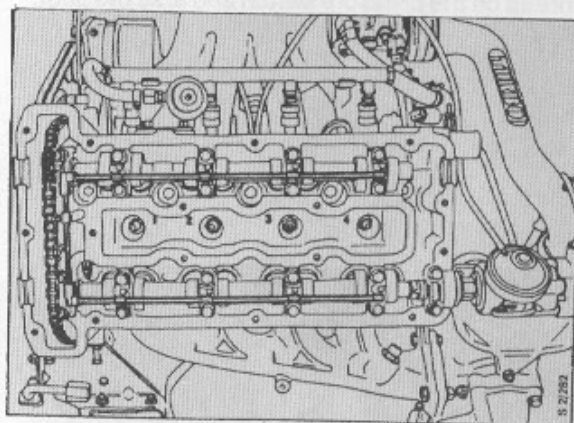
B202 engine

In the cylinder head, the oil flows through pipes to the camshaft bearings and the hydraulic cam followers. The hydraulic chain tensioner is connected to the rising oilway by a drilled passage in the cylinder head. Also connected to the main oil gallery is an oil line for lubrication of the turbo unit. On Turbo engines, the oil cooler is connected by means of a special adaptor for the oil filter, which also incorporates the oil thermostat and connectors for the oil cooler.

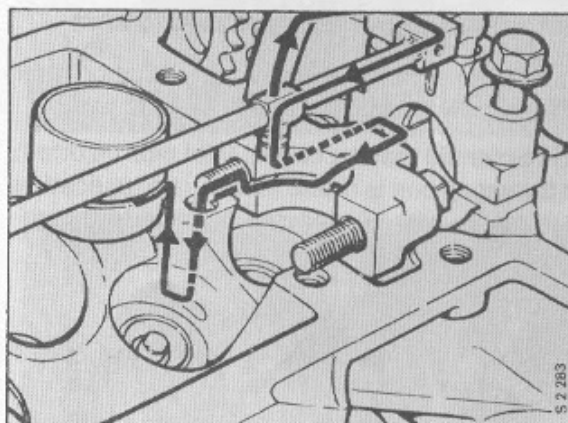
Oil is filled through the dipstick pipe.



Rising oilway in the cylinder head



Pipe system in the cylinder head



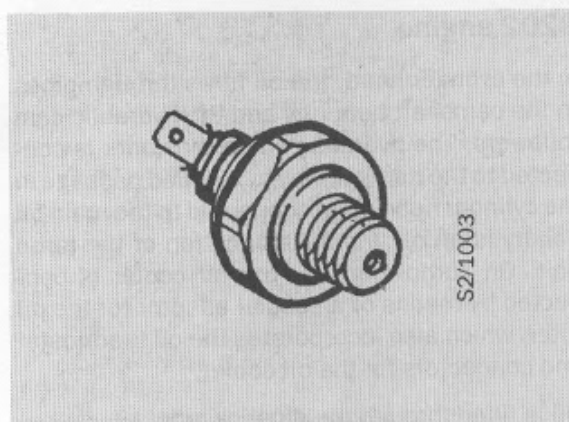
Cam follower lubrication

Pressure switch and adaptor, M86 onwards

The pressure switch is of the screw-in type and has an M14 x 1.5 thread and a flat seal.

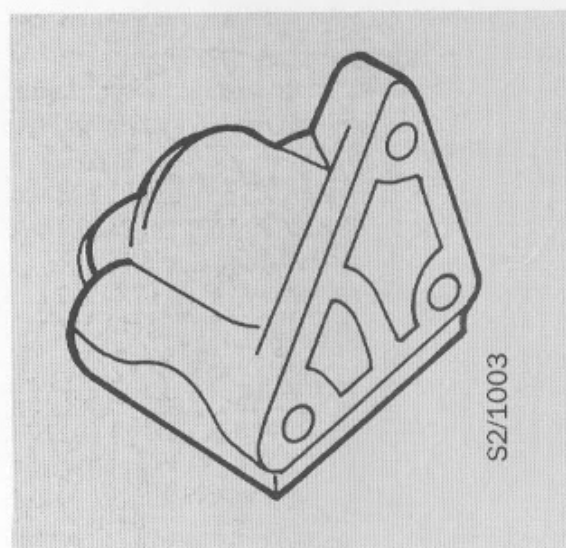
Tightening torque: 25 Nm (18.5 lbf ft)

The switch breaks the circuit at 0.3 bar (4.3 psi) and makes the circuit at 0.55 bar (8.0 psi).



Pressure switch

The adaptor for the engine oil filter matches the thread on the pressure switch and also the seal.

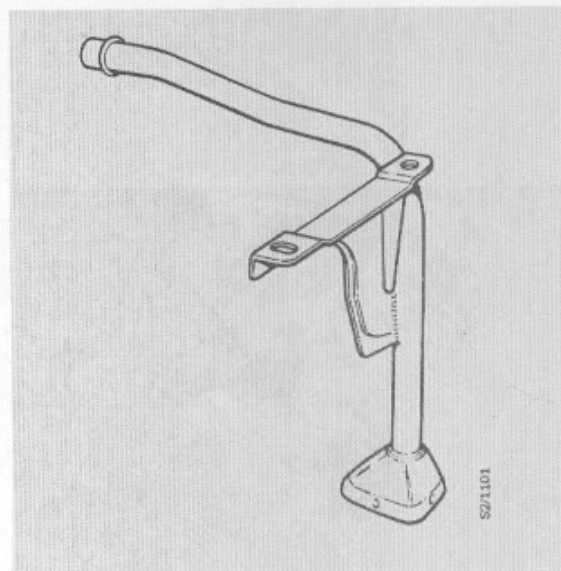


Adaptor

Oil pump filter inlet pipes of different lengths, manual and automatic cars

The length of the inlet pipe to the oil pump filter differs between manual and automatic cars.

It is essential that the correct inlet pipe be fitted; if the wrong one is fitted, inadequate lubrication can result, with consequent damage to the engine.



Oil pump, B201 and B202

The oil pump is a gear type with one gear wheel and an eccentric ring gear. The pump is mounted on the timing cover and is driven by a hub mounted on the crankshaft.

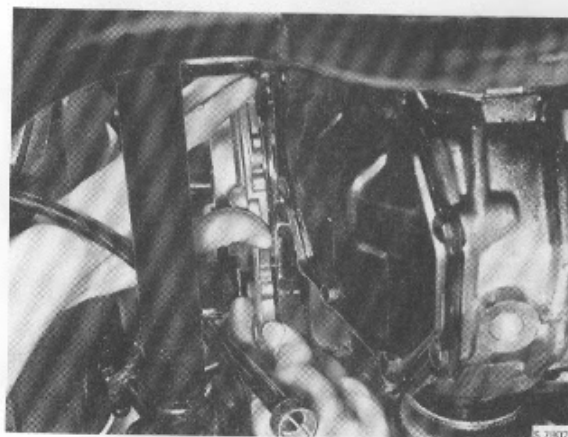
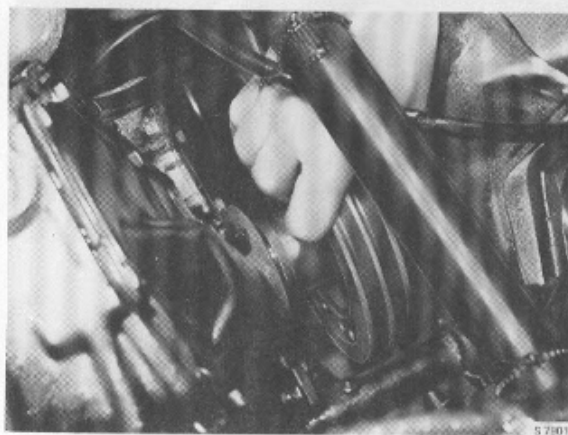
The oil pump reduction valve is situated in the timing cover and returns excess oil to the inlet side of the pump.

To remove

The oil pump can be removed with the engine in the car.

- 1 Clean the area round the oil pump.
- 2 Remove the crankshaft pulley centre-bolt and the pulley from the crankshaft. Immobilize the crankshaft by attaching locking segment 8392987 to the flywheel ring gear.

- 3 Remove the oil pump retaining bolts and extract the pump.



To check

Use a straightedge and feeler gauge to check the end float between the pump body and the gear-wheel.

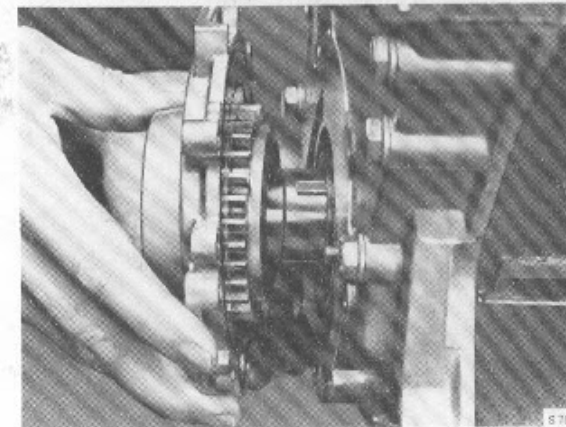
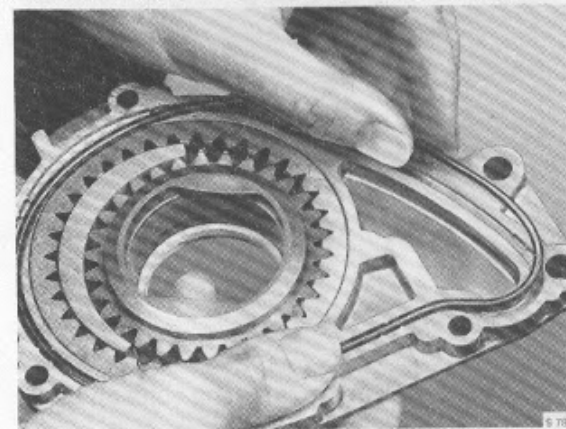
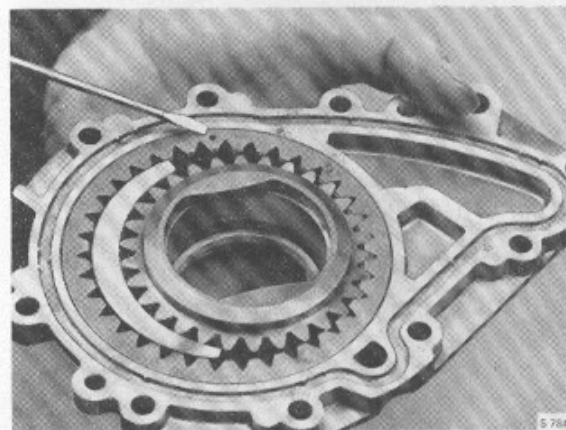
Permissible end float: 0.03 - 0.08 mm
(0.0012 - 0.0031 in)

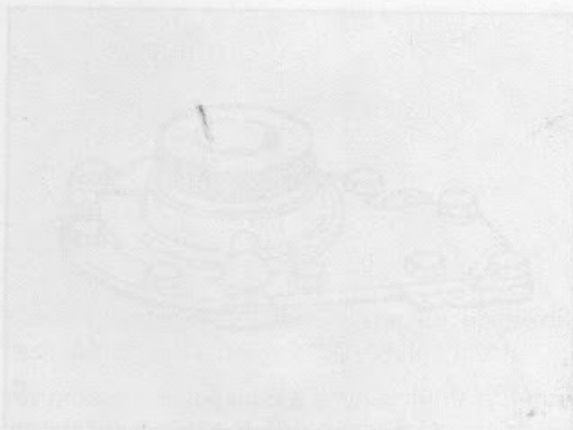
To refit

- 1 Oil the gearwheels.
- 2 Refit the ring gear with the mark on its face uppermost.

- 3 Fit a new seal in the groove in the pump body and check that the locating dowel is fitted.

- 4 Refit the pump. Extract the pump gear slightly and engage the dog on the gear in the slot in the hub.





Marked with the design number in the 121X main
121X main 121X

11.8.

Only the latest design filter should be used.
Remains to be seen

- 5 Remove the oil filter adaptor casting and fill the oilway to the oil pump pressure side with engine oil.

Caution

The oil pump must be primed with oil prior to fitting.

- 6 Refit the oil filter adaptor.

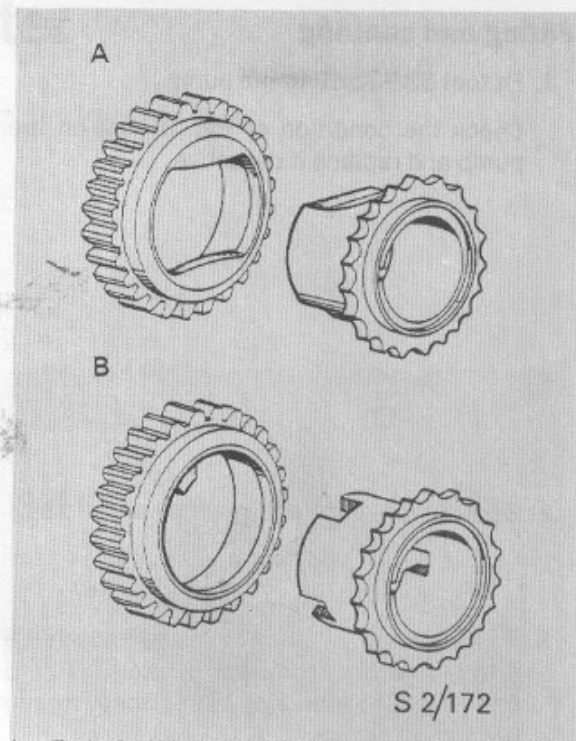
Change the filter
Remove the filter
Remove the adaptor
121 121 1200-121 1200-121 1200-121
22/3-221

Centring of the oil pump

Should noise emanate from an otherwise serviceable oil pump, or if a pump not equipped with locating pins is to be fitted, tool 83 93 589 should be used to fit the pump. This obviates the need for locating pins.

To remove

- 1 Remove the pulley from the crankshaft.
- 2 Remove the pump.
- 3 Remove existing locating pins.
- 4 Remove the shaft seal in the pump.



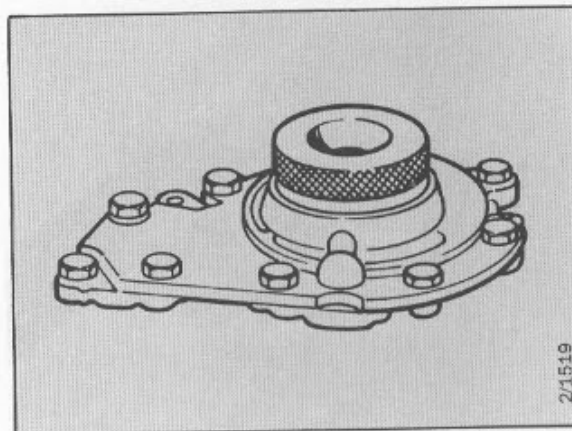
A = Early design
B = Latest design



Fitting and centring

- 1 Fit tool 83 93 589 to the pump.

Check the condition of the 'O' ring on the pump and replace if defective.



- 2 Fit the pump complete with the special tool.

- 3 Fit the pulley retaining bolt and tighten the special tool to a torque of 27 Nm (20 lbf ft) using a 400-mm (15.75-in) long torque wrench.

- 4 Secure the pump (8 + 2 bolts).

- 5 Remove tool 83 93 589, using strap wrench 83 93 332 or a large pair of water-pump pliers.

- 6 Fit a new shaft seal on the pump.

- 7 Fit the pulley.

Tightening torque: 190 Nm (140 lbf ft)