Workshop Manual

944 turbo

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This Workshop Manual describes all of the important operations whose proper completion requires special instructions. This manual is essential for shop foremen and mechanics, as the information contained is essential for the maintenance of vehicles in safe operating condition. The basic rules of safety in vehicle repair naturally also apply throughout.

Only maintenance procedures differing from those for the vehicle type 944 are described in the Workshop Manual 944 turbo. All other information can be found in the Workshop Manuals 944 and 924.

The information in this manual is organized in repair groups according to work position numbering. The two-digit numbers of the repair groups correspond to the first digits of the work position numbers.

A repair group table and an index of key words assist in locating information.
Exploded views are numbered in order of disassembly, and where necessary are supplemented by instructions on assembly or installation and the use of special tools.

Descriptions of design and function can be found in the service training course reference material.

The contents of this Workshop Manual will from time to time be supplemented with Technical and Quality Information Bulletins. These information Bulletins are compiled in the Technical Handbook.

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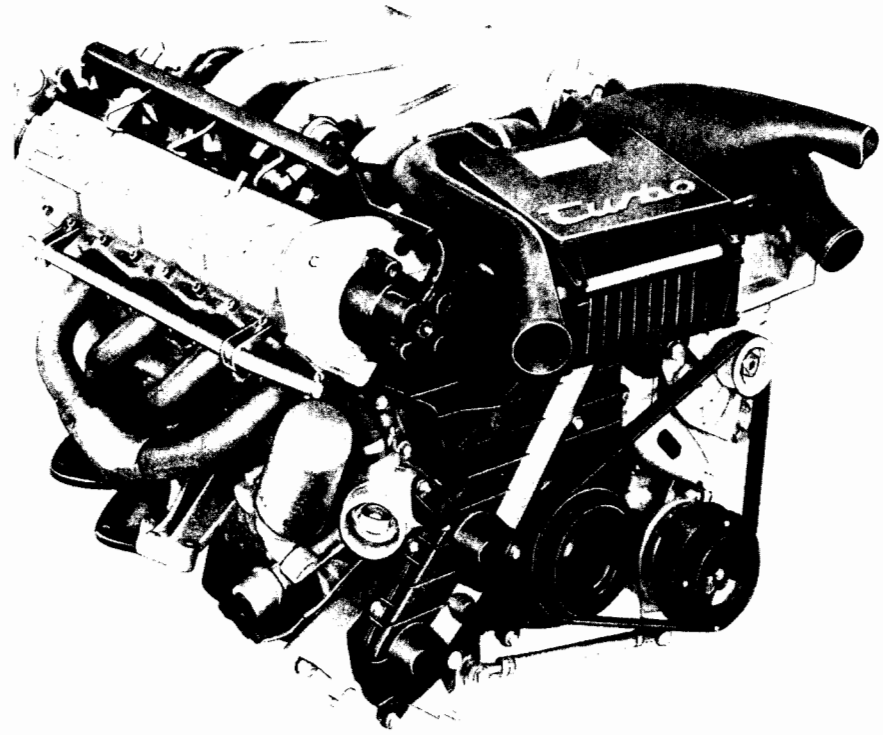

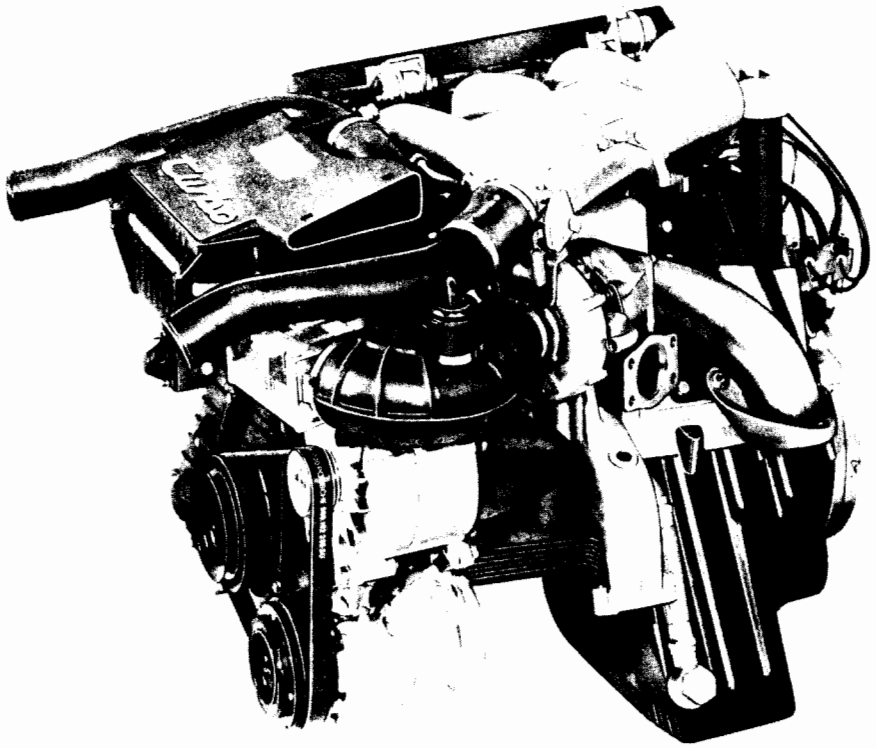

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TECHNICAL DATA

N o t e: Values for USA in brackets

P o w e r P l a n t

Company engine code		M 44/51
No. of cylinders		4
Bore	mm/in.	100/3.94
Stroke	mm/in.	78.9/3.11
Actual displacement	$cm^3/in.^3$	2479/151
Compression ratio		8.0 : 1
Max. power to 80/1269/EC	kW/HP	162/220
Net power, SAE J 1349	kW/HP	162/217
At engine speed	rpm	5800
Max. torque to 80/1269/EC	Nm/kpm	330/33.6
Net power, SAE J 1349	Nm/ft.lbs.	330/243.4
At engine speed	rpm	3500
Max. liter output	kW l/HP l	65.3/88.7
Net power, SAE J 1349	kW l/HP l	65.3/87.5
Fuel octane grade	RON/MON	96/86(96/86 lead-free)
Max. engine speed	rpm	6500
Engine weight (dry)	kg/lbs	182/401

E n g i n e D e s i g n

Type	Water-cooled, axial, four-cylinder, four-stroke, in-line internal combustion engine with toothed-belt-driven overhead camshaft and two balance shafts
Crankcase	Light alloy, two-piece
Crankshaft	Forged, with five bearings
Crankshaft bearings	Slide bearings

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Connecting rods	Sinter-forged
Connected rod bearings	Slide bearings
Piston pin bearings	Press-fit brass bushings
Pistons	Forged light alloy
Balance shafts	Forged
Balance shaft bearing	Slide bearings with bearing shells
Cylinders	Light alloy
Cylinder head	Light alloy
Valve guides	Press-fit special brass
Valve arrangement	1 intake, 1 exhaust, overhead, in-line
Valve timing	By overhead camshaft and hydraulic cam followers
Camshaft	Shell hardcast
Camshaft bearings	Camshaft runs in camshaft housing without bearing shells
Camshaft drive	Toothed belt with tensioning roller
Balance shaft drive	Toothed belt with tensioning roller
Valve clearance	Automatic hydraulic adjustment
Timing at 1 mm lift and zero valve clearance	Intake opens 1° after TDC Intake closes 49° after BDC Exhaust opens 43° before BDC Exhaust closes 3° before TDC
Boost	1 ETC, charging air cooling, electronic pressure control, wastegate
E n g i n e C o o l i n g	Closed water cooling system, two electric fans with thermoswitch, freeze protection to -25°C

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Engine Lubrication		
System		Pressure circulation with sickle-type pump
Oil cooling		Oil cooler in air flow, thermostatically controlled
Oil filter		Screwed on
Oil pressure at 5000 rpm		Approx. 4 bar positive pressure at operating temperature
Oil pressure display		Warning lamp at above 5 bar
Oil consumption,ltr./1000 km		Up to 1.5
Exhaust System		Standard: Double-pipe up to primary muffler, primary and final mufflers (M298 and USA: as standard, cat. conv. instead of primary muffler, cat. conv. in bypass line)
Emission Control		(M298 and USA: 3-way cat. conv., controlled air-fuel mixture)
Heating		Warm water heater with heat exchange and blower
Fuel System		
Fuel preparation		DME (Digital Motor Electronics)
Fuel supply		1 electric delivery pump
Octane requirement	RON/MON	96/86, 95/85 unleaded (96/86 unleaded)
Electrical System		
Interference suppression		ECE-R 10 and 72/245/EWG or VDE 0879
Battery voltage	V	12
Battery capacity	Ah	50 (63)
Battery capacity (M-eq.)	Ah	63
Alternator output	A/W	115/1610
Ignition		via DME
Firing sequence		1 - 3 - 4 - 2

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Ignition timing control and knock control		Electronically controlled map
B o d y D e s i g n		2-door integral steel body, with front and rear spoilers, as coupe with optional removal hardtop roof, with integral foglights in polyurethane front air dam
D i m e n s i o n s (at DIN curb weight)		
Length	mm/in.	4230/166.535 (4290/168.90)
Width	mm/in.	1735/68.31
Height	mm/in.	1275/50.20
Wheelbase (design position)	mm/in.	2400/94.49
Front track	mm/in.	- 7 J x 16 rim-1477/58.2
Rear track	mm/in.	- 8 J x 16 rim-1451/57.1
Ground clearance (at max. tot. weight)	mm/in.	120/4.72
Bed clearance (at max. tot. weight)	mm/in.	53/2.09
Overhang angle, front rear		12.5° 15°
W e i g h t (per DIN 70020)		
Curb weight	kg/lbs	1280/2822 (1315/2899)
Curb weight axle load front	kg/lbs	640/1411 (660/1455)
rear	kg/lbs	640/1411 (655/1444)
Max. total weight	kg/lbs	1600/3527
Max. front axle load	kg/lbs	730/1609
Max. rear axle load	kg/lbs	920/2028
Max. roof load, incl.roof baggage carrier	kg/lbs	35/77 or 75/165 with original Porsche roof transport system
Max. trailer load, without brakes*	kg/lbs	500/1103

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Max. trailer load with brakes*	kg/lbs	1200/2646
Max. car+trailer weight	kg/lbs	2800/6173
Max. drawbar load	kg/lbs	50/110 84 for Italy up to 100 km/h

*Gradients up to 16%

F i l l C a p a c i t i e s

Engine oil (measurement with dipstick per owner's manual is definitive)	Brand name heavy-duty oil per API classification SE or SF; see Owner's Manual
Engine oil volume	Approx. 6.5 ltr. with filter
Engine coolant	Approx 7.8 ltr.
Transmission with differential	Approx. 2.0 ltr. hypoid gear lub. SAE 80 per MIL-L 2105, API classification GL4
Fuel tank	Approx. 80 ltr., incl. approx. 8 ltr. reserve
Brake fluid reservoir	Approx. 0.2 ltr.
Washing fluid reservoir and headlight cleaning system	Approx. 6.0 ltr.

P e r f o r m a n c e

Top speed	km/h/mph	245/152
Acceleration from 0-100 km/h*	sec.	6.3
(0-60 mph)*	sec.	(6.1)
(1/4 mile)*	sec.	(14.4)
Kilometer from standing start*	sec.	26.0

H i l l C l i m b i n g

		Manual transmission
In % (slip limit)	1st gear	61.5%
	2nd gear	49.0%
	3rd gear	29.5%
	4th gear	19.5%
	5th gear	13.5%

*DIN curb weight + 1/2 of payload

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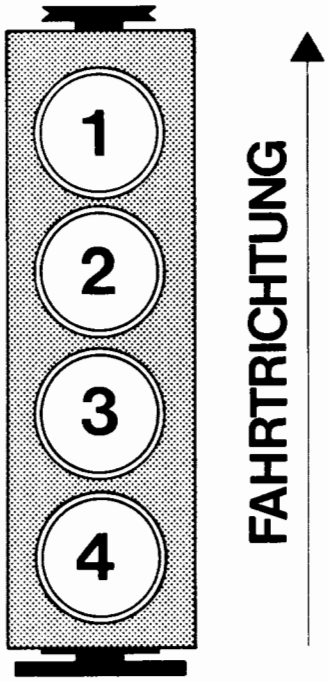
DESIGNATION OF CYLINDERS



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944 turbo - special model "S" (M 758)

In model year 1988, there will be a limited number of exclusively equipped, tuned versions of the 944 turbo available, with a modified sports chassis suitable for the high driving performance.

87/955

The most significant modifications or distinguishing features (exact description in information brochure WKD 495010)

1. Engine: 250 HP/184 kW, catalyst version for FRG, others in accordance with respective national regulations.

2. Clutch: Clutch plate with two-stage torsional spring damper, friction lining bonded as well as riveted to the support plate.

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3. Transmission: Transmission ratio as standard but some parts adapted to the higher performance. Only outwardly recognizable by the additional identification code AOR.

4. Chassis:

- Milled forged wheels (larger cutouts)
  front 7 J x 16 ET 65 mm with 225/50 VR 16
  rear 9 J x 16 ET 60 mm with 245/45 VR 16

- Brake system: front-axle brakes similar to 928 S4 with asbestos-free brake pads.

- Wheel suspension: at front and rear axle bearings with harder rubber compounds (shore hardness)

- Springs/shock absorbers: Harder spring rates (also with height adjustment at the front) Koni twin tube pressurized shock absorbers (adjustable rebound).

5. Paintwork: Special color silver-rose metallic

6. Interior: multicolor burgundy

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7. Equipment (incomplete listing). Listed equipment valid for all countries.

Special model "S" turbo equipment	M-No. in the turbo series
Sports chassis	M 030
ABS	M 593
Limited-slip differential 40 % locking ratio (compared with the series model special option M 220 has reinforced plates and pressure ring, differential bolts molybdenum-coated and ground)	(M 220)
Comfort seat left	M 437
Comfort seat right	M 438

8. Technical data:

	Engine type M 44.52 Turbo special model "S"	Engine type M 44.51 turbo (series)
Performance	250 HP/184 kW at 6000 rpm	220 HP/162 kW at 5800 rpm
Torque	350 Nm at 4000 rpm	330 Nm at 3500 rpm
Compression ratio	8.0:1	8.0:1
Fuel	95 RON Unleaded Leaded*	95 RON Unleaded Leaded*
Curb weight	1 350 kg	1 350 kg
Acceleration:		
0 - 100 km/h (0 - 62 mph)	5.7 s	6.3 s
0 - 60 mph	5.5 s	6.1 s
V_{max}	260 km/h 162 mph	245 km/h 152 mph

* For vehicles without catalytic converter only

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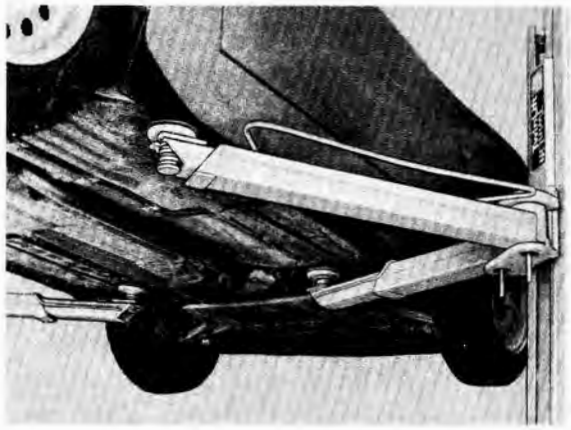
LIFTING THE VEHICLE

1. With Lifting Platform

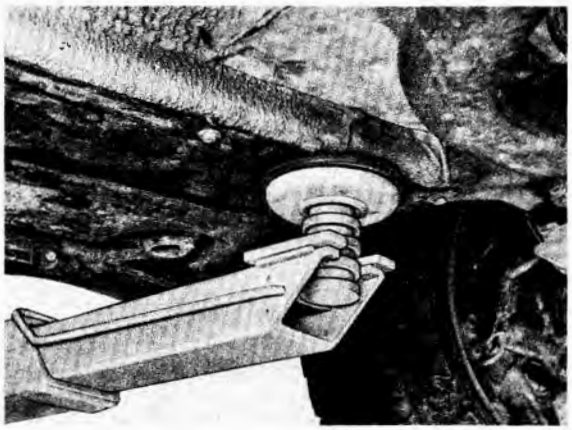
Lift vehicle only at illustrated jacking points.

When driving vehicle onto lifting platform, make sure of sufficient space between platform and vehicle.



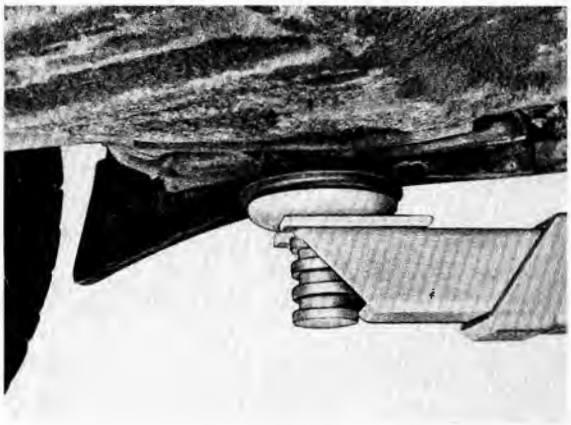
Front

On inside side member



Rear

On side reinforcement



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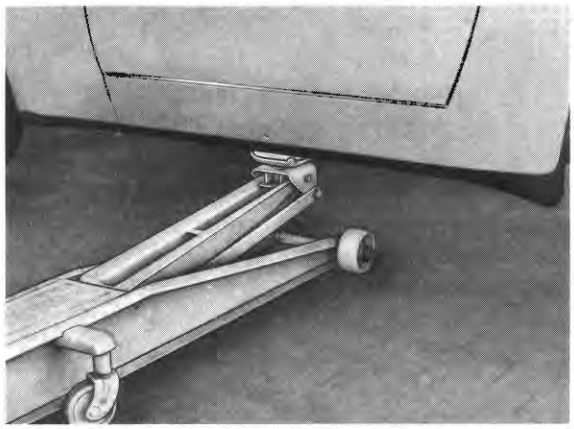
2. With Shop Trolley Jack

Apply jack only underneath jacking points on sides of vehicle. Never jack on engine oil pan or transmission, as this can cause serious damage.



Important

Avoid damage by inserting block of wood between vehicle and jack.

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TOLERANCES AMD WEAR LIMITS

		On Installation (new)	Wear Limit
Cooling System			
Coolant thermostat	Opening temperature	81 - 85°C	
Radiator cap Over pressure valve	Opens at overpressure	1.5 + 0.15 bar - 0.10	
Low pressure valve	Opens at negative pressure	0.1 bar	
Oil System			
Oil consumption	ltr./1000 km		up to 1.5
Oil pressure at 80°C oil temperature and 5000 rpm	Positive pressure	approx. 4 bar	
Dipstick			
Upper mark	Contents	6.5 ltr.	
Lower mark	Contents	5,3 ltr.	
Valve Timing			
Camshaft bore	Inside dia.	60.5 + 0.03 - 0	
Camshaft	Diameter	60.5 - 0.04 - 0.055	
Camshaft	Axial play	0.10 - 0.18	
Cam follower bore in camshaft housing	Inside dia.	38 + 0.027 + 0.007	
Cam followers	Diameter	38 - 0.018 - 0.034	
Camshaft	Runout	0.02	

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TOLERANCES AND WEAR LIMITS

		On Installation (new)	Wear Limit
Cylinder Head and Valves			
Bearing surface	Distortion		Max. 0.08
Valve seat:			
Intake	Width	1.7	
Exhaust	Width	2.5	
Intake	Seat angle	45°	
Exhaust	Seat angle	45°	
Outer correction angle		30°	
Inner correction angle		60°	
Valve guides:			
Intake and Exhaust	Inside dia.	9 + 0.015	
Valve stem:			
Intake	Diameter	8.97 - 0.012	
Exhaust	Diameter	8.95 - 0.012	
Valve guide / Valve stem	Clearance		
Intake			0.8
Exhaust			0.8
Compression		10 bar positive pressure and above	6.5 bar
Pistons and Connecting Rods			
KS - Pistons			
Cylinder/Piston	Clearance	0.008 - 0.032	Approx. 0.080 (limit for wear and deformation)
Piston rings	Side clearance	Groove 1 = 0.04 - 0.072 Groove 2 = 0.03 - 0.062 Groove 3 = 0.02 - 0.055	
Piston rings	End gap	Groove 1 = 0.20 - 0.40 Groove 2 = 0.20 - 0.40 Groove 3 = 0.30 - 0.60	0.80 0.80 1.20

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		On Installation (new)	Wear Limit
Connecting rod bushing	Diameter	24 + 0.018 + 0.028	
Piston pin	Diameter	24 - 0.004	
Connecting rod bushing/ piston pin	Radial play	0.018 - 0.032	

Crankshaft and Engine Block

Crankshaft	Runout	0.04 - 0.06	Max. 0.08
Connecting rod bearing journal	Diameter	51.971 - 51.990	
Connecting rod bearing / crankshaft	Radial play	0.034 - 0.092	
	End play	0.100 - 0.400	
Crankshaft bearing journal	Diameter	69.971- 69.990	
Crankshaft bearing/crankshaft	Radial play	0.020 - 0.098	
Crankshaft bearing/ crankshaft	End play	0.110 - 0.312	0.40
Cylinder bore	out-up-round	0.010	0.020
Bore for balance shaft bearing shells in crankcase and balance shaft cover	Diameter	35.000-35.019	
Bore for bushing in bearing housing	Diameter	34.000 - 34.019	
Balance shaft	Diameter	30.975 - 30.991	

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TIGHTENING TORQUE FOR ENGINE

Location	Tightening Instructions	Torque Nm (ftlb)	Thread
Crankcase upper and lower sections (studs)	3 steps: 1st step 2nd step 3rd step	20 (14) 40 (29) 75 (54)	M 12 x 1.5
	2 steps: 1st step 2nd step	20 (14) 50 (36) 8 (6) 20 (14)	M 10 M 6 M 8
Rotation element to balance shaft		10 (7) sealed with Loctite 270	M 6
Balance shaft housing cover to crankcase upper section Hex bolt	Bolt lightly oiled 2 steps: 1st step 2nd step	10 15 (11) 20 (14)	M 6 M 8
Balance shaft bearing bridges (nuts) on crankcase upper section	2 steps: 1st step 2nd step	15 (11) 30 + 3 (22 + 2)	M 8
Left and right sides of bearing housing to crankcase upper section		20 (14)	M 8
Connecting rod Verbus rip nut		75 + 5 (54 + 3.6)	M 10x1.25
Water drain plug in crankcase upper section		20 (14)	M 8
Fastening oil pan to crankcase	3 steps: 1st step 2nd step 3rd step	hand-tighten 4 (3) 9.5 (7)	M 6
Oil pan lighter to oil pan		5.6 (4) sealed with Loctite 270	M 5
Oil drain plug		50 (36)	M 20 x 1.5

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Location	Tightening Instructions	Torque Nm (ftlb)	Thread
Left and right engine supports to crankcase		48 (35)	M 10
Flywheel to crankshaft		90 (65)	M 10x1.25
Holder for sensors to crankcase		20 (14)	M 8
Sprocket to crankshaft		210 (145)	M 16x1.5
Sensor to holder		8 (6)	M 6
Pulley to sprocket		8 (6)	M 6
Cylinder head to crankcase upper section	Tightening cylinder head gasket: 1st step 2nd step 3rd step Threads of studs must be lightly oiled	 20 (14) 50 (36) 90 (65)	
Intake pipe to cylinder head		20 (14)	M 8
Hollow-core bolt for negative pressure connection		10 (7)	M 8x1
Neck for coolant pipe		20 (14)	M 8

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Location	Tightening Instructions	Torque Nm (ftlb)	Thread
Heated feed connection to cylinder head		20 (14)	M 8
Camshaft housing to cylinder head		20 (14)	M 8
Aluminium plug bolts in camshaft housing		40 (29)	M18x1.5
Camshaft bearing to camshaft housing		8 (6)	M 6
Knock sensor	Use original bolt without washer	9 (6.6)	M 8
Camshaft sprocket to camshaft polygon socket-head bolt		65 - 70 (47-51)	M 10
Console to camshaft bearing		8 (6)	M 6
Connector to drive dog		5 (3.6)	M 5
Cover and transport guard to camshaft housing		8 (6)	M 6
Distributor arm to connector		4 (3)	M 4

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Location	Tightening Instructions	Torque Nm (ftlb)	Thread
Sprocket to balance shaft		45 (33)	M 10
Tensioning roller to bearing housing		45 (33)	M 10
Guiding roller to bearing housing, right		45 (33) (sealed with Loctite 270)	M 10
Water pump to crankcase		8 (6) (sealed with Loctite 270)	M 6
Guiding roller to water pump housing		45 (33)	M 10
Oil pump to crankcase		8 (6) 45 (33)	M 6 M 10
Tensioning roller to oil pump housing		45 (33)	M 10
Drive belt cover		8 (6)	M 6
Spark plugs		25 - 30 (18-22)	M14x1.25
Alternator console to crankcase		45 (33)	M 10
Cap nut on catalytic converter		30 (22)	M 14x1.5
Temperature sensor		15 (11)	M 12x1.5
Oil pressure sensor		35 (25)	M 18x1.5
Diaphragm damper and pressure regulator to fuel collection pipe		30 (22)	M 16x1.5
Cap nut on fuel collection pipe		22 (16)	M 12x1.5

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Location	Tightening Instructions	Torque Nm (ftlb)	Thread
Housing liner in oil pump housing	Joint surface sealed with Loctite 574	8 (6)	M 6
Cooler housing/ thermostat housing to crankcase housing		20 (14)	M 8
Threaded plug on oil/water cooler housing		35 (25)	M18x1.5
Coolant bleeder bolt		12 + 3 (9 + 2)	M 8 x 1
Pressure relief valve,		45 (33)	M 20x1.5
oil filter		20 (14)	
Oil trap to crank-case		20 (14)	M 8
Hollow-core bolt/ oil line to balance shaft cover		25 + 3 (18 + 2)	M 14
Hollow-core bolt/ oil return line to oil pan		75 + 5 (55 + 3.6)	M 26x1.5
Hollow-core bolt/ coolant line to exhaust turbocharger		35 + 5 (25 + 3.6)	M 16x1.5
Connection stud to exhaust turbocharger		35 + 5 (25 + 3.6)	M 16x1.5
Coupling nut/coolant lead to exhaust turbocharger		35 + 5 (25 + 3.6)	M 22x1.5
All other bolts and nuts:			
M 6		8 + 2 (6 + 1.4)	
M 8		20 + 2 (14 + 1.4)	
M 10		40 + 5 (29 + 3.6)	

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Modified tightening torques for engine

Location	Thread	Tightening torque Nm (ftlb)	
Crankshaft/ crankcase			
Bolts of crankcase top and bottom sections (studs)	M 12 x 1,5	30 (22)	Stage 1
		60° torque angle	Stage 2
	M 10	20 (15)	Stage 1
		50 (37)	Stage 2
	M 8	20 (15)	
	M 6	10 (7)	
Oil pan to crankcase	M 6	hand-tight	Stage 1
		4 (3)	Stage 2
		10 (7)	Stage 3
Oil pan insert to oil pan	M 5	6 (4), use Loctite 270 to secure	
Knock sensor as of MY 88	M 8	20 (15), genuine bolt without washer	
Cylinder head			
Cylinder head to crankcase top section		20 (15)	Stage 1
		90° torque angle	Stage 2
Engine type M 44.51/52	M 12	90° torque angle	Stage 3
Fuel system			
Cap nut at fuel collection pipe	M 12 x 1,5	12 (9)	

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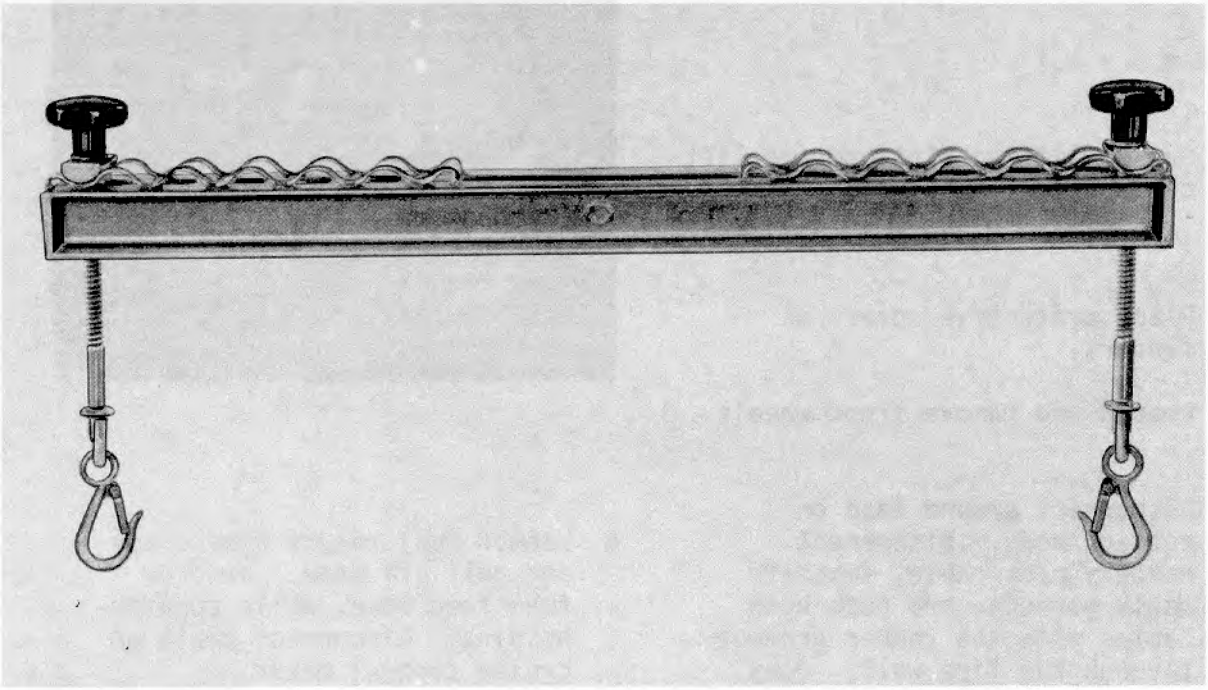
REMOVING AND INSTALLING ENGINE

TOOLS



No.	Description	Special Tool	Remarks
	Engine suspension fixture	3033	Used together with a shop hoist, e.g. Bilstein K750 H.

N o t e:

If necessary, connect engine suspension fixture and shop hoist with standard spring-loaded hooks (load capacity: 650 kg).

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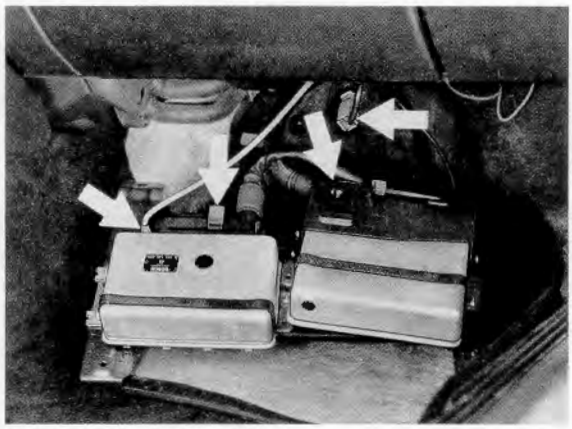
REMOVING AND INSTALLING ENGINE (MANUAL TRANSMISSION)

Engine is removed from below.
Clutch housing remains on engine.



R e m o v a l

1. Set up lifting platform and lift car on jacking points.

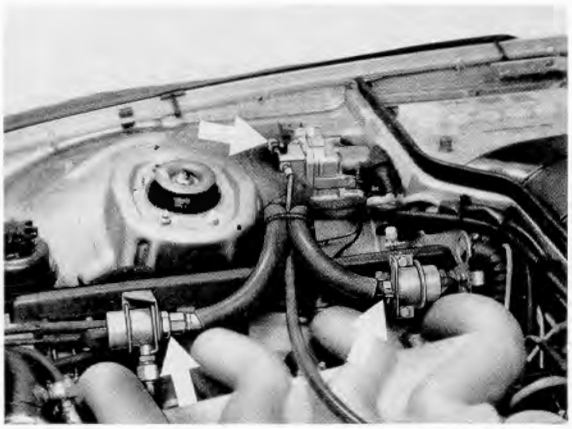
2. Place protective covers on fenders.

3. Loosen and remove front wheels.

4. Disconnect ground lead on battery/body. Disconnect battery plus cable, separate cable harness, and push both cables with the rubber grommet through the fire wall. Open wire straps.

5. Unscrew and remove cover in footwell of passenger side. Unscrew carrier for DME and knock control unit and remove both multiple-pin plugs. Disconnect vacuum hose on knock control unit. Disconnect four-pin plug.

6. Loosen fuel return hose clamp and pull off hose. Unscrew fuel feed hose, while counterholding. Disconnect cable on cruise control motor.



7. Unscrew and remove air cleaner upper section.

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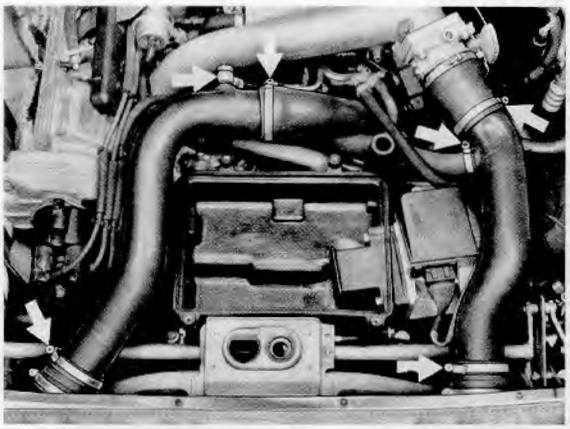
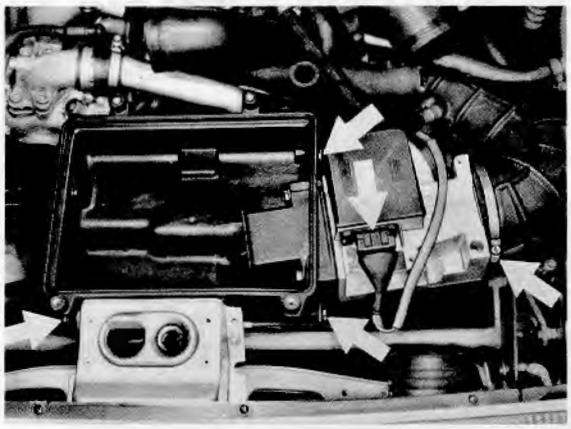
8. Remove both charging-air guide pipes.

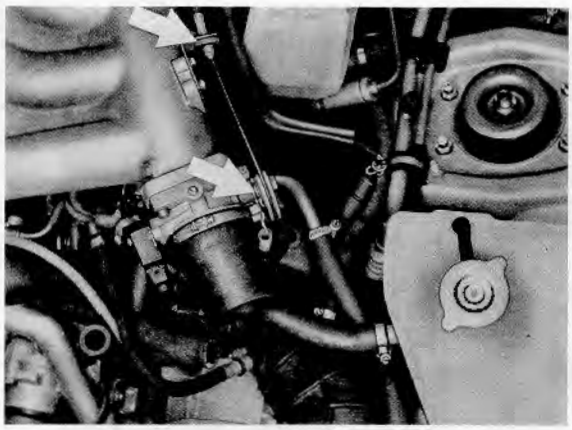


9. Remove air cleaner lower section together with air flow sensor.

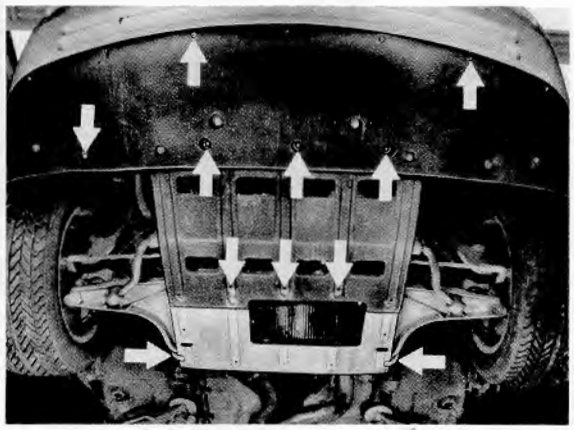


10. Unscrew and remove distributor cover. Remove oil filter and ATF supply reservoir.

11. Disconnect throttle operating cable. Disconnect oxygen sensor plug connection and loosen wire straps. Unscrew coolant expansion tank cap.



12. Remove front and lower trim panel and engine splashguard.



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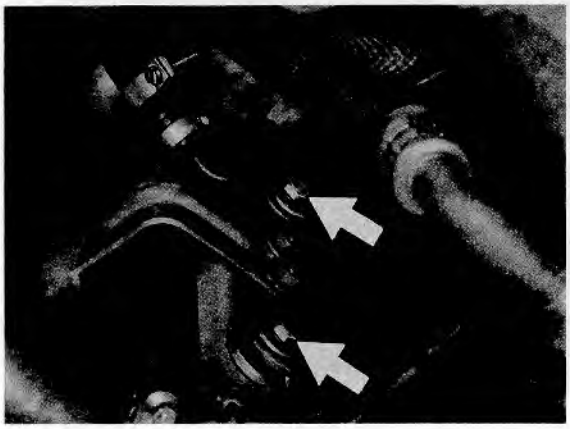
13. Unscrew coolant drain plug and catch escaping coolant. Disconnect alternator venting hose.

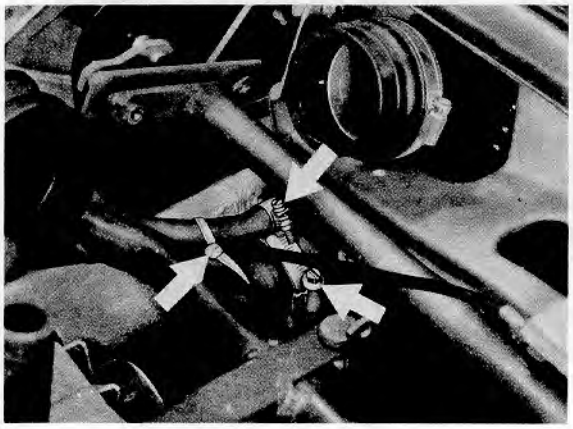
14. Loosen and remove coolant hose on radiator at bottom right and on engine. Catch escaping coolant. Disconnect oil cooler from body, allowing it to hang on the hoses.



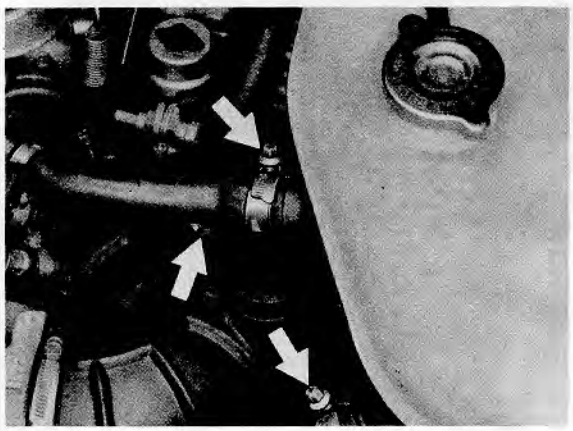
15. Pull off electric wires on fan motors. Unscrew fan motor brackets on radiator and remove from below.

16. Loosen coolant hoses on coolant pipe (cross member) and remove cross member.

17. Unscrew and remove coolant hose and vent hose on radiator at top left. Remove electric connection from temperature switch on radiator.



18. Loosen and remove coolant hose from expansion tank to turbocharger. Disconnect tank discharging valve suction hose on intake air cowl. Remove coolant pump with its bracket from body.



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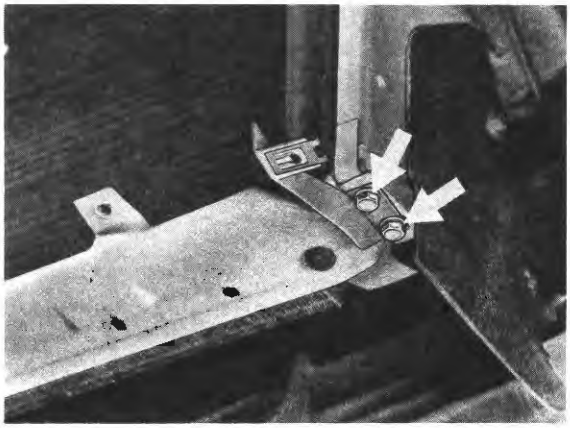
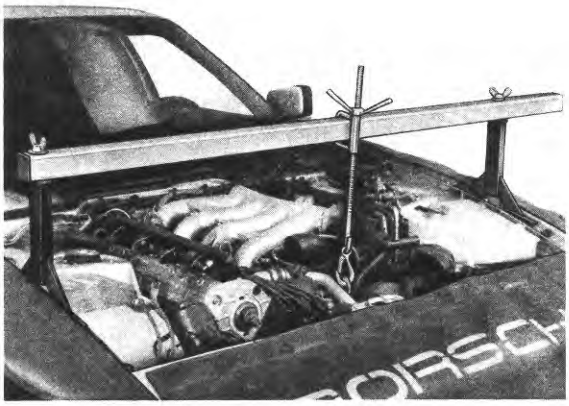
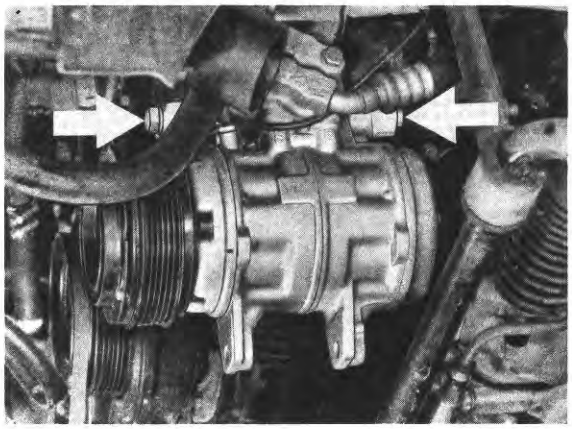
19. Detach radiator holder and remove radiator from above. Unscrew radiator mount and remove from body.



20. Suspend engine from front transporting bracket with Special Tool 10-222 A, and hold in installed position.

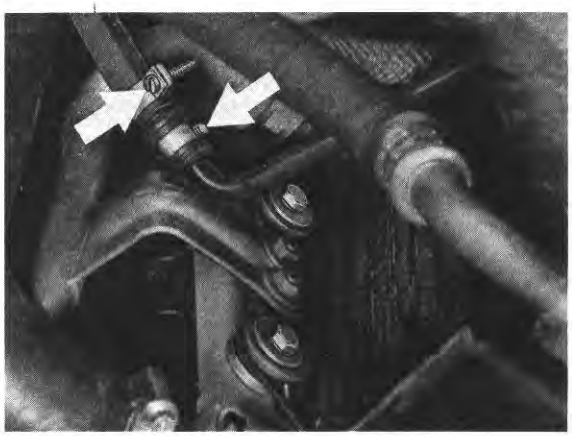


21. Loosen poly-rib drive belt tensioner on a/c compressor and remove belt. Unscrew compressor on console and allow it to hang down to the side (refrigerant hoses remain connected).



22. Unscrew and remove stabilizer with holders on body and control arms. Disconnect left and right tie rods.

23. Loosen hose clamps between ATF cooler and steering, and disconnect hose.



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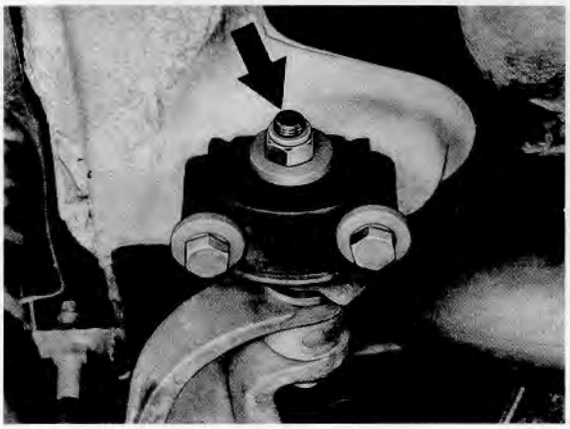
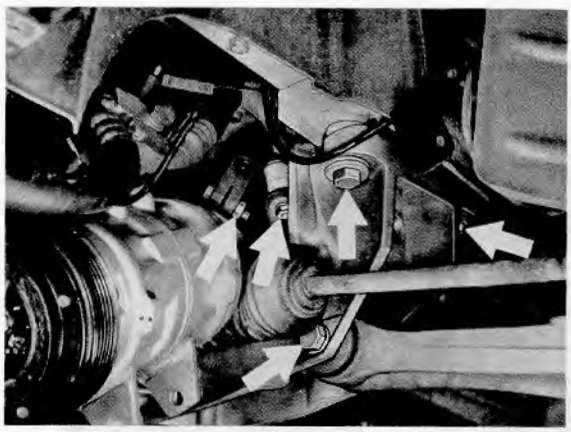
24. Unscrew power pump from console and let it hang down on steering.

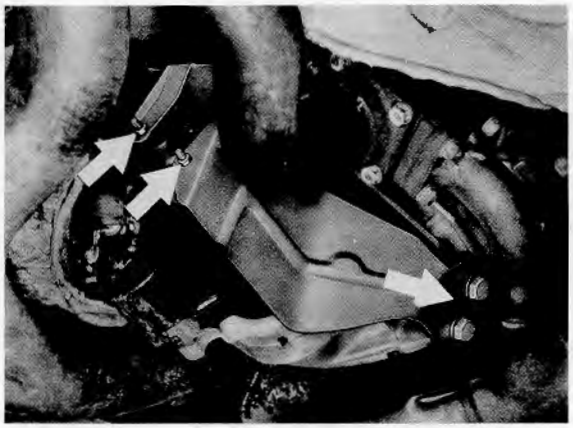
25. Unscrew left and right control arms on front axle cross member and rear mount, and pull out from front. (Console bolts must not be loosened).



26. Unscrew universal joint from steering gear and upper hydraulic engine mounts from engine supports. Remove front axle cross member with steering gear and power pump from below.



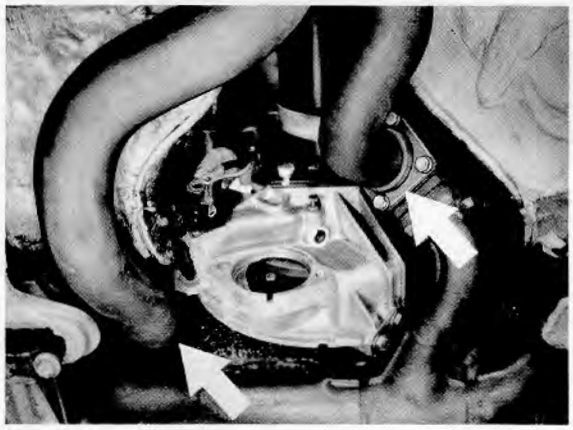
27. Unscrew deflection plate on starter and clutch housing and remove toward rear.



28. Disconnect electrical connections on starter and unscrew starter. Loosen hose clamps on clutch housing.

29. Unscrew clutch slave cylinder on clutch housing (line remains connected).

30. Remove exhaust assembly together with catalytic converter. Unscrew bolts on flange between turbocharger and exhaust pipe, as well as flange on bypass valve.



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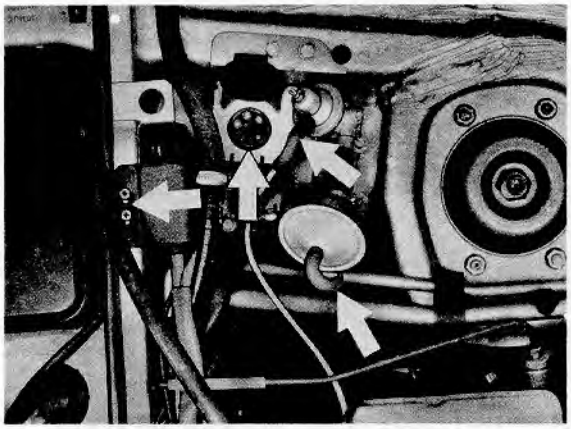
31. Unscrew flange after catalytic and suspension, and remove assembly.

32. Unscrew hose clamp, exhaust flange, and bypass valve holder. Remove bypass valve. Unscrew bracket on transaxle at bottom and push back.

33. Unscrew upper transaxle / clutch housing mounting bolts.

34. Disconnect coolant hoses for heater above exhaust manifold and on cylinder head.

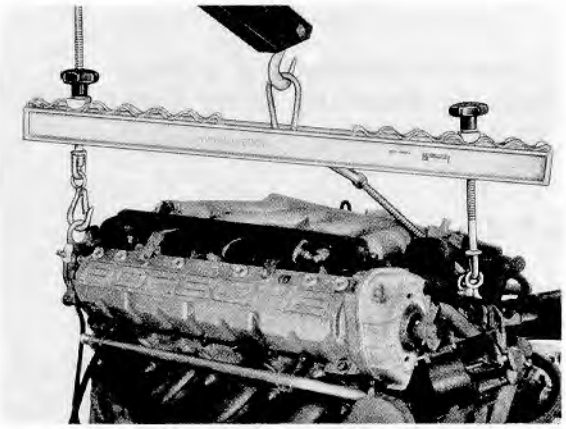
35. Loosen wire strap on firewall. Disconnect two-pin and multiple-pin plugs. Pull off vacuum hose on tank discharging valve and brake booster. Remove diagnosis plug from holder downward.



36. Connect Special Tool 3033 in transporting bracket of engine as described below.

Pulley:	Pos. 3
Flywheel:	Pos. 11

In Position 3 the threaded rod is "below" the suspension unit. In Position 11 the threaded rod is "above" the suspension fixture.



37. Slightly tighten suspension fixture on engine using a shop hoist, e.g. K 750 H, and remove Special Tool 10 - 222A.

38. Remove lower transaxle/clutch housing mounting bolts.

39. Pull engine forward, press rubber sleeve out of separating wall towards engine compartment, and remove wire harness carefully.

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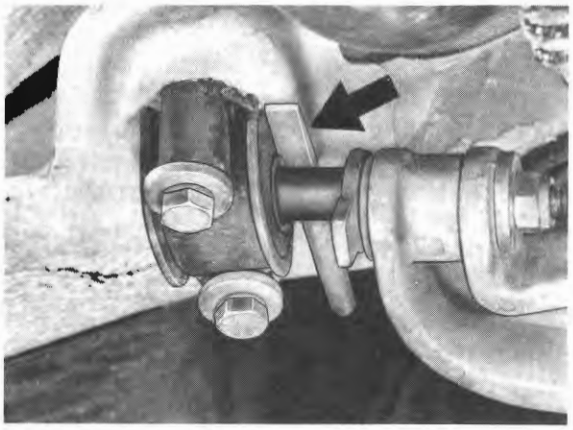
40. Separate engine from central tube or central shaft, and lower engine.



I n s t a l l a t i o n

The following should be observed:

1. Carefully guide wire harness for DME and knock control unit, multiple-pin plug, and vacuum hose into footwell on passenger side.

2. Screw in transaxle / clutch housing mounting bolts first, but do not tighten.

N o t e

Tighten mounting bolts to final torque only after installation of hydraulic engine mounts on front axle cross member.
Tightening torque of mounting bolts: 42 Nm (30 ftlb).

3. Install control arms. For easier installation, press down slightly on sleeves in rubber/middle mounts.

4. Make sure radiator fits properly in rubber mounts.

5. Tighten bolts and nuts to specified tightening torque.

6. Fill and bleed cooling system.

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7. Fill supply reservoir with ATF and bleed steering system.

8. Run engine to operating temperature. Check engine oil and coolant level, correcting if necessary.

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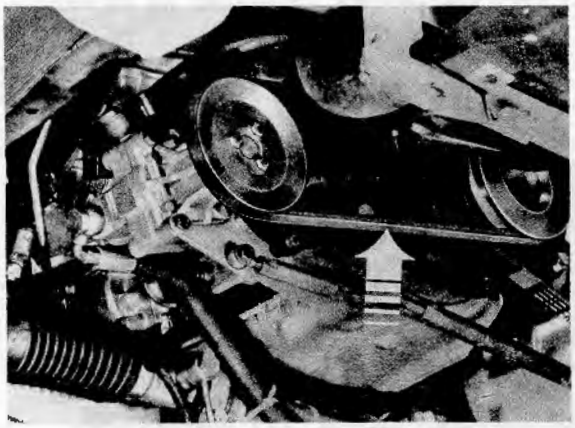
CHECKING AND ADJUSTING POWER STEERING PUMP DRIVE BELT TIGHTNESS

C h e c k i n g

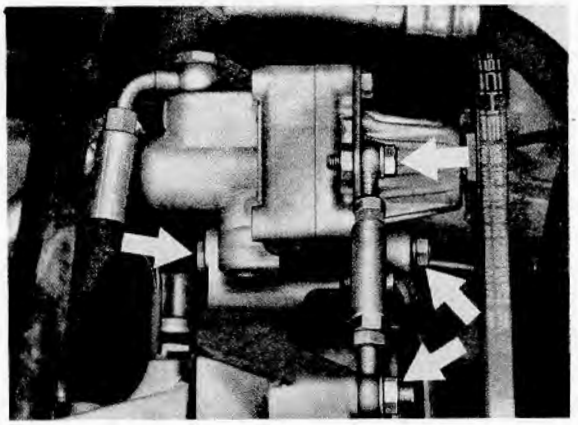
Check tightness by applying thumb pressure on belt midway between two pulleys. Deflection: approx. 5 mm.



A d j u s t i n g

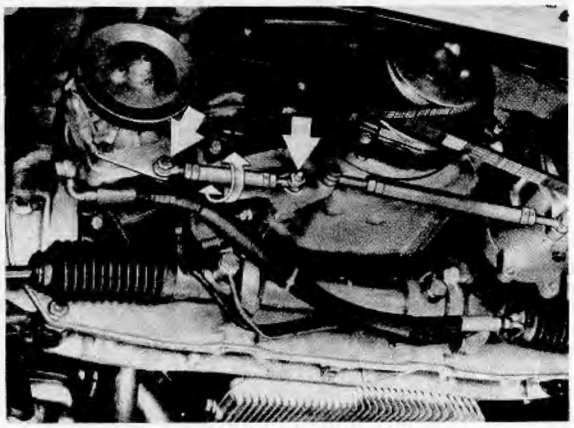
1. Remove engine splashguard.

2. Loosen upper mounting bolt or nut slightly.



3. Loosen connecting rod bolts slightly.

Loosen connecting rod nuts and turn connecting rod until correct belt tightness is obtained.



4. After finishing adjustments, re-tighten mounting bolts and/or nuts.

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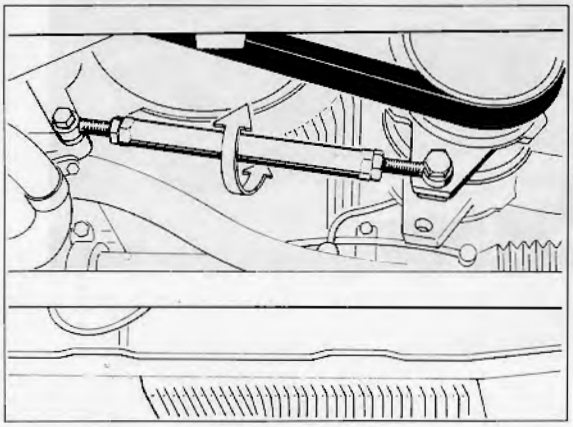
CHECKING AND ADJUSTING TIGHTNESS OF POLY-RIB DRIVE BELT FOR ALTERNATOR AND A/C COMPRESSOR

Checking and adjusting

1. Remove engine splashguard.

2. Loosen connecting rod hex bolts slightly. Loosen connecting rod nuts and turn back connecting rod one turn (reduces tightness).

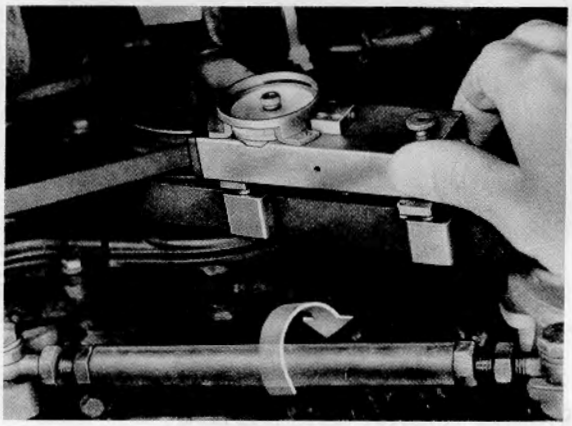


3. Prepare Special Tool 9201 for checking operation. Pull out lockpin in special tool and push out test pin opposite lockpin completely. Line up drag needle with gage needle.

4. Slide special tool onto belt. Press in gaging pin (arrow) slowly until lockpin is felt to engage, and read value indicated on dial gage. Adjusting value: 9.5 scale units. From this position, turn the connectingr rod one more complete turn (increase tension).

Note

Slides must be in perfect contact with drive belt. The special tool must not be turned or moved on drive belt during checking.



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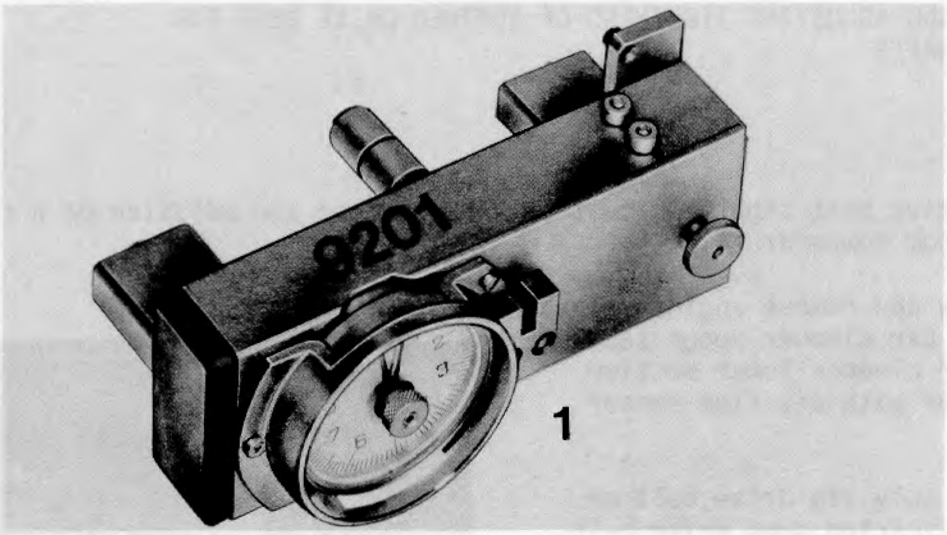
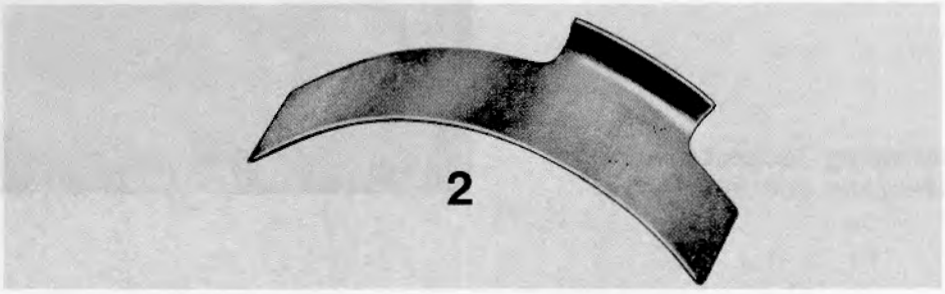
TOOLS





No.	Description	Special Tool	Remarks
1	Drive belt tightness tester	9201	
2	Adjusting gage	9207	
3	Adjusting wrench	9244	

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CHECKING AND ADJUSTING TIGHTNESS OF TOOTHED DRIVE BELT FOR BALANCE SHAFTS

N o t e

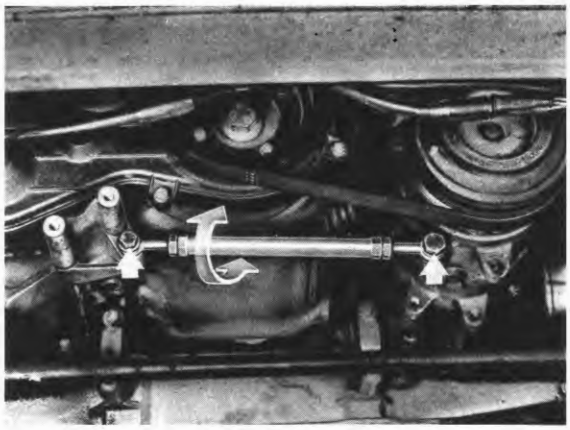
Toothed drive belt tightness must only be checked and adjusted on a cold engine (room temperature).

1. Unscrew and remove engine splash-guard, air cleaner upper section, and air cleaner lower section together with air flow sensor.

2. Remove poly-rib drive belt or power steering pump drive belt.

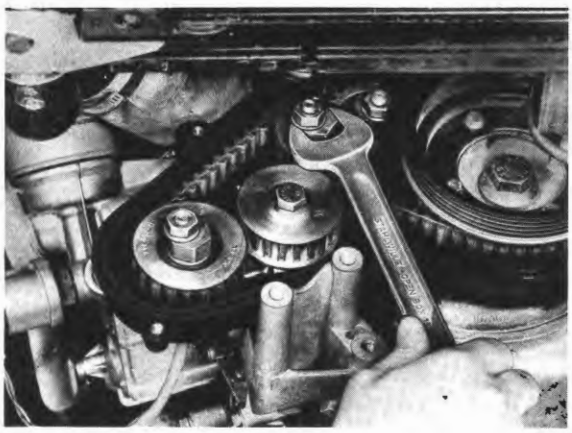
N o t e

Before unscrewing locknuts, always loosen connecting rod hex bolts slightly.



3. Disconnect vent hose at top and remove toothed drive belt cover.

4. Loosen guide roller enough so that guide roller no longer tensions toothed drive belt.



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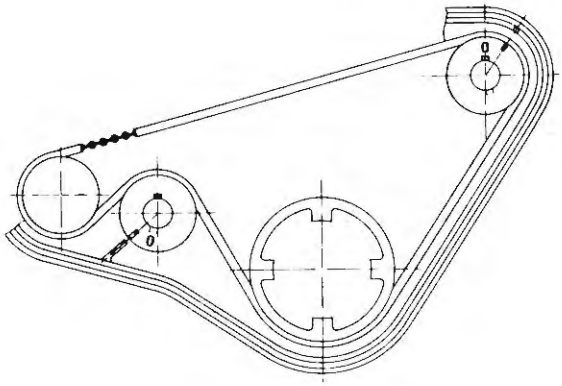
5a. Turn crankshaft clockwise until TDC mark on camshaft sprocket is aligned with mark cast in console for distributor cap.

b. TDC mark on flywheel and cast boss on clutch housing must also be aligned.

6. Check basic position of balance shaft sprockets. Marks on sprockets must be aligned with marks of rear toothed drive belt cover.



7. Prepare Special Tool 9201 for testing operation. Pull out lockpin on special tool and push out test pin opposite lockpin completely. Line up drag needle with gage needle.

8. Slide special tool onto belt. Push in gage pin (arrow) slowly until lockpin is felt to engage, and read value indicated on dial gage.

N o t e

In order to rule out incorrect displays, make sure to line up drag needle with gage needle after engagement of lockpin (turn counter-clockwise).

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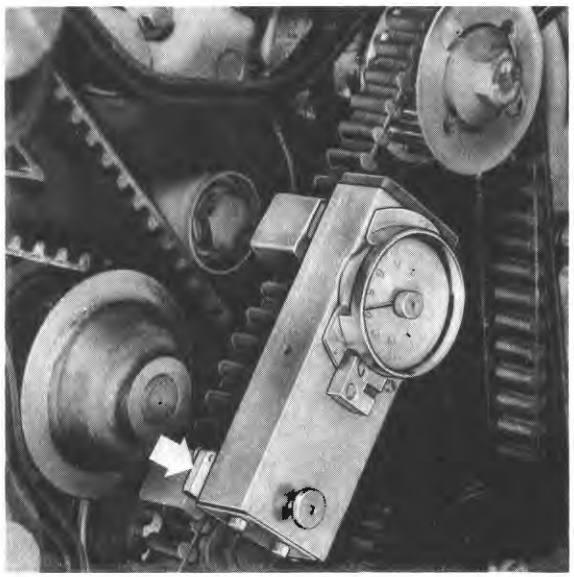
A d j u s t i n g V a l u e:

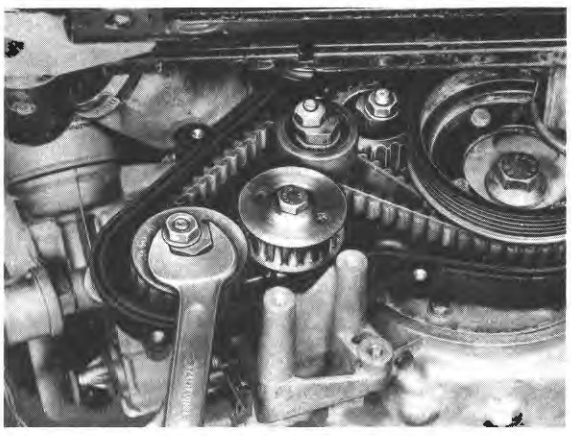
(new and used belts)
2.7 ± 0.3 scale units

Correct toothed drive belt tightness if necessary.

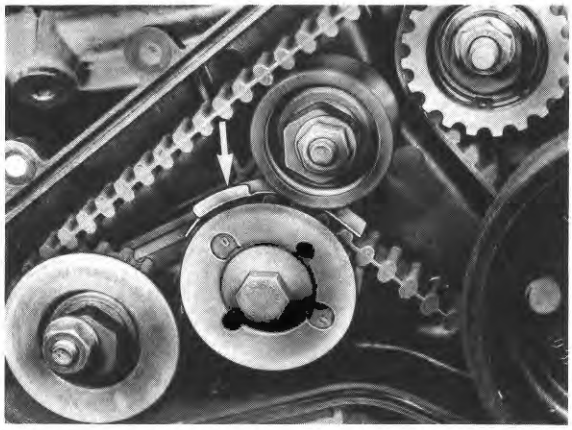


A d j u s t i n g

9. When tightening, turn tensioning roller clockwise. Turn tensioning roller counter-clockwise to loosen belt. Tighten nut to torque of 45 Nm (33 ftlb), making sure to counterhold.



10. Adjust guide roller after adjusting tightness of toothed belt. Set distance between guide roller and toothed belt in area of lower balance shaft to 0.5 mm using Special Tool 9207 or a 0.5 mm feeler gage blade, pre-tensioning upper belt strap with 0 to 1 mm at same time. Secure guide roller in this position. If the adjusting distance is insufficient, turn guide roller 180° and repeat adjusting procedure. Tighten hex nut to torque of 45 Nm (33 ftlb), making sure to counterhold.



11. Install and adjust poly-rib belt or power pump drive belt.

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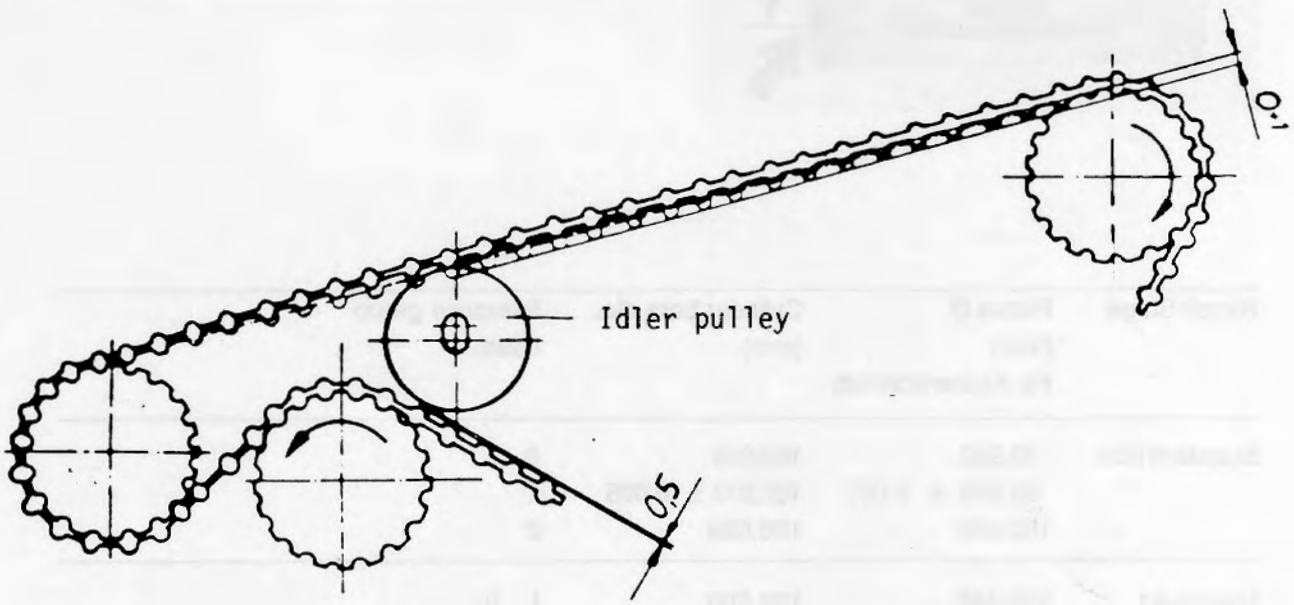
N o t e

Slides must have full contact on the drive belt.

The special tool must not be turned or moved on belt while checking.



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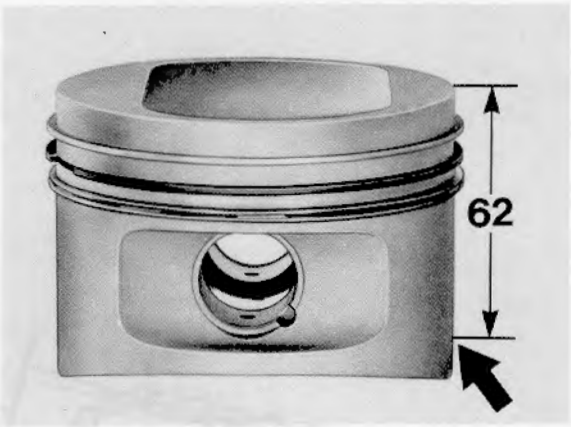
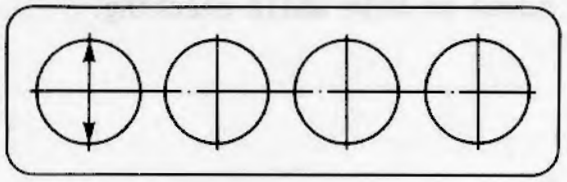
Checking pistons and cylinder bores





Repair Stage	Piston Ø (mm) Fa. Kolbenschmidt	Cylinder bore dia. (mm)	tolerance group code
Standard size	99,980	100,000	0
	99,990 ± 0,007	100,010 ± 0,005	1
	100,000	100,020	2
Oversize 1	100,480	100,500	I 0
	100,490 ± 0,007	100,510 ± 0,005	I 1
	100,500	100,520	I 2

Checking pistons

Measure approx. 62 mm from piston crown, 90° offset from piston pin axis.

Checking cylinder bores

Measure approx. 65 mm from upper edge of cylinder bore, transverse to engine block. Mount lower crankcase section and tighten bolts to specified torque for measuring.

Note

It recommended that the stocks of the relevant tolerance group are checked before machining the cylinders. If necessary, hone to the piston size available.
In some cases, certain tolerance groups may be in short supply.

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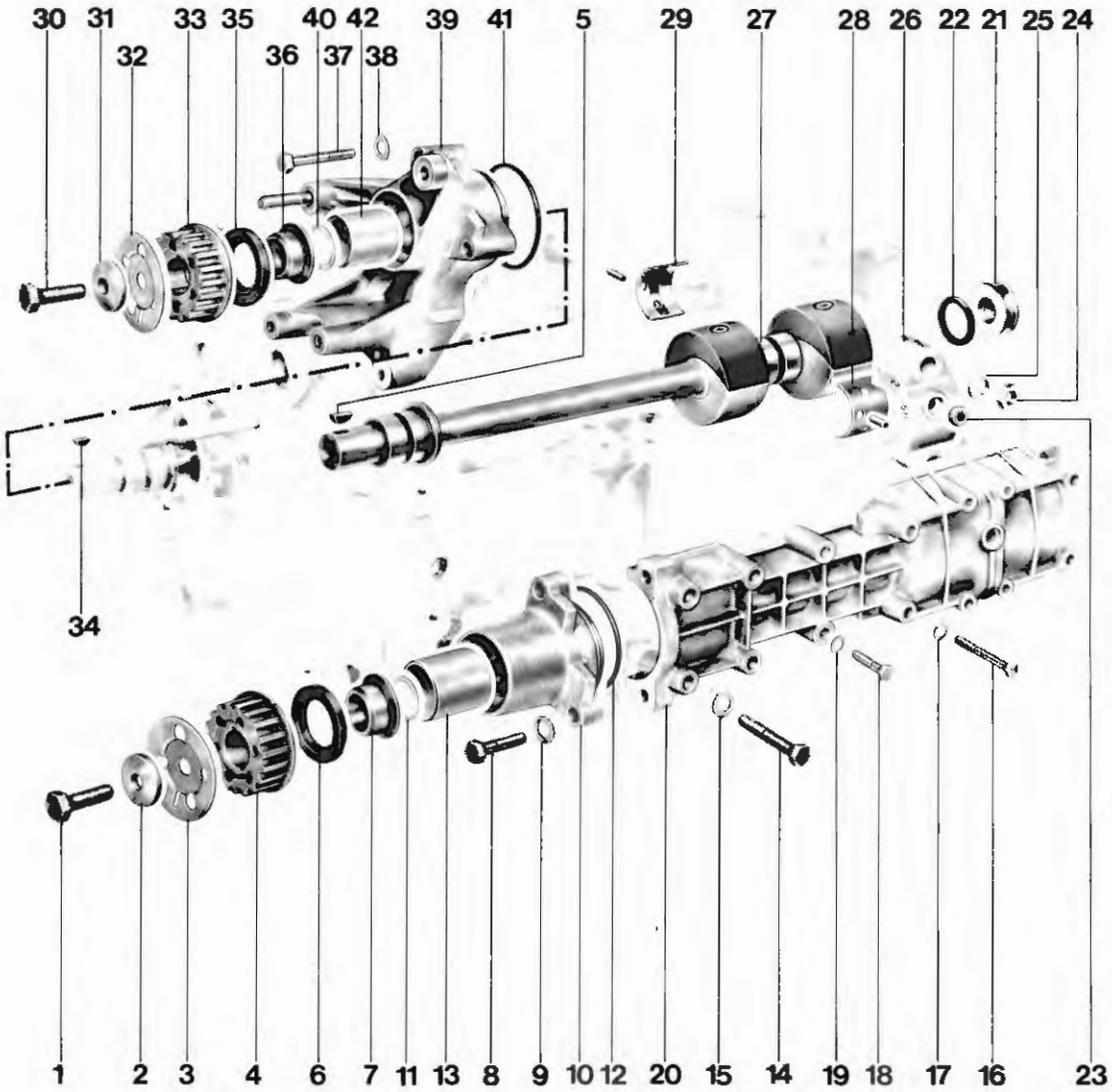
DISASSEMBLING AND ASSEMBLING PISTONS AND CONNECTING RODS



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No.	Description	Qty.	Note When: Removing	Installing
1	Hex bolt, M 10 x 35	1		Coat threads with Loctite 574, torque: 45 Nm (33 ftlb), counterhold with Special Tool 9200.
2	Washer	1		Position correctly.
3	Collar for upper balance shaft	1		Position correctly, locating tab inserts into unmarked groove of drive gear. Mark "O" is visible in large opening in collar.
4	Drive gear for balance shaft	1		Check ease of movement on seat of balance shaft, machining if necessary. Lightly coat seat with Optimoly HT.
5	Woodruff key	1		
6	Upper balance shaft seal ring 30 x 47	1		Replace, oil-lubricate sealing lip, mark (arrow) faces in direction of turn of balance shaft.
7	Spacer	1		
8	Hex bolt M 8 x 35	3		

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No.	Description	Qty.	Note When: Removing	Installing
9	Washer A 8.4	3		
10	Upper bearing housing	1		
11	Polyester seal	1		Replace, making sure of correct fit.
12	O-Ring	1		Replace, lightly coat with oil, make sure it is not twisted.
13	Sleeve	1		
14	Hex bolt M8x55	4		
15	Washer A 8.4	4		
16	Hex bolt M6x50	8		
17	Washer A 6.4	4		
18	Hex bolt M6x42	2		
19	Washer A 6.4	2		
20	Upper balance shaft housing	1		Apply Loctite 574 to sealing surface with velour roller. Note tightening instructions.
21	End ring	1		
22	Round seal	1		Replace

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No.	Description	Qty.	Note When: Removing	Installing
23	Seal ring	1		Replace, insert in bearing bridge take-up bore with grease.
24	Hex nut M 8	2		Tightening torque 30 + 3 Nm (22 + 2 ftlb)
25	Washer	2		
26	Bearing bridge for balance shaft	1		
27	Upper balance shaft	1		
28	Bearing shell	1		Check for correct fit.
29	Bearing shell	1		Check for correct fit.
30	Hex bolt M10x35	1		Lightly coat threads with Loctite 574, torque: 45 Nm (33 ftlb), counterhold using holding wrench 9200.
31	Washer	1		Position correctly.
32	Collar for lower balance shaft	1		Position correctly, with locating tab protruding into groove "0" of drive gear; mark "0" is visible in square opening of collar.
33	Drive gear for balance shaft	1		Check ease of movement on seat of balance shaft, machining if necessary. Apply thin coat of Optimoly HT to seat.

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No.	Description	Qty.	Note When: Removing	Installing
34	Woodruff key	1		
35	Balance shaft seal ring 30 x 48	1		Replace, oil-lubricate sealing lip. Observe marking (arrow). Rotational direction counter-clockwise.
36	Spacer sleeve			
37	Hex bolt M 8 x 60	3		
38	Washer	3		
39	Lower bearing housing	1		
40	Polyester seal	1		Replace, making sure of correct seating.
41	O-Ring	1		Replace, lightly lubricate with oil, make sure ring is not in a twisted position.
42	Sleeve	1		

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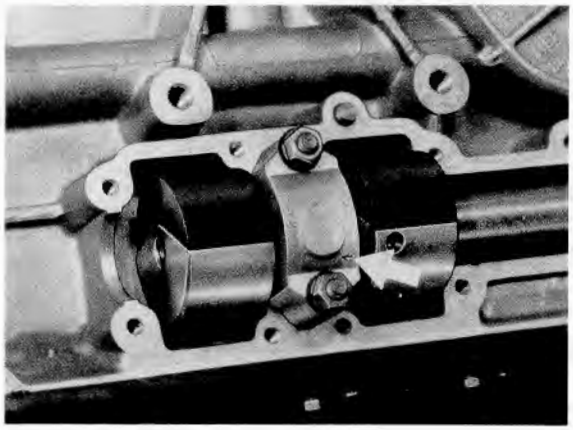
INSTALLATION INSTRUCTIONS

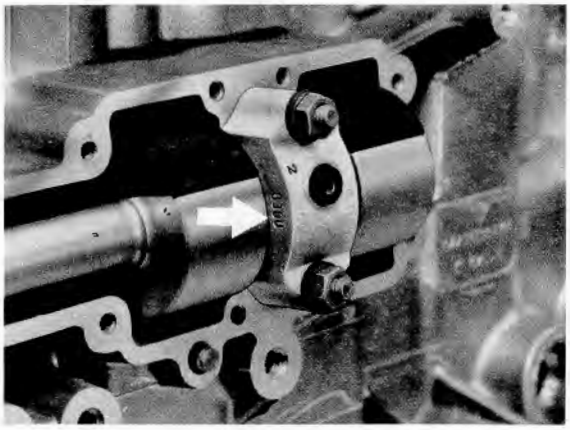
Crankcase upper and lower sections as well as bearing bridges of balance shafts are machined together and must always be installed together. Check identification codes.

In addition, the bearing bridges are stamped with 1 and 2.



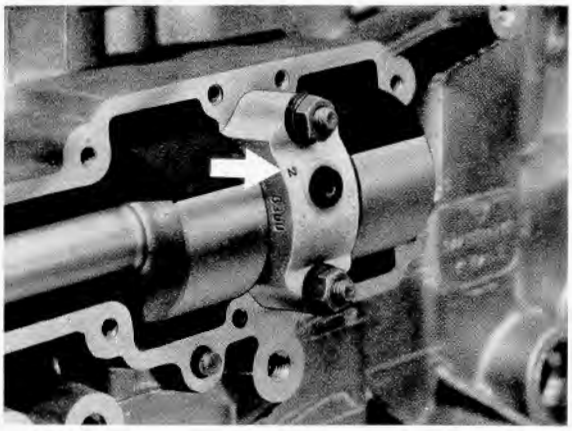
Installing Bearing Bridges of Balance Shafts

In installed position it must be possible to read the identification codes of both bearing bridges from the front (as seen looking forward in vehicle).



Picture shows left balance shaft.

1 = Right side



2 = Left side

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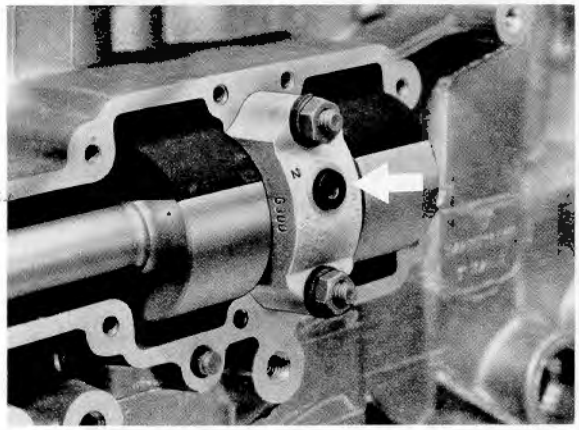
Note

The bearing bridge for the left balance shaft has on oil feed bore for the exhaust turbo-charger. Before installing the balance shaft, it is vital to ascertain that the seal ring is in position in the take-up bore of the bearing bridge (use grease).



Assembly note

Whenever performing repairs on the engine, make sure the seal is replaced.

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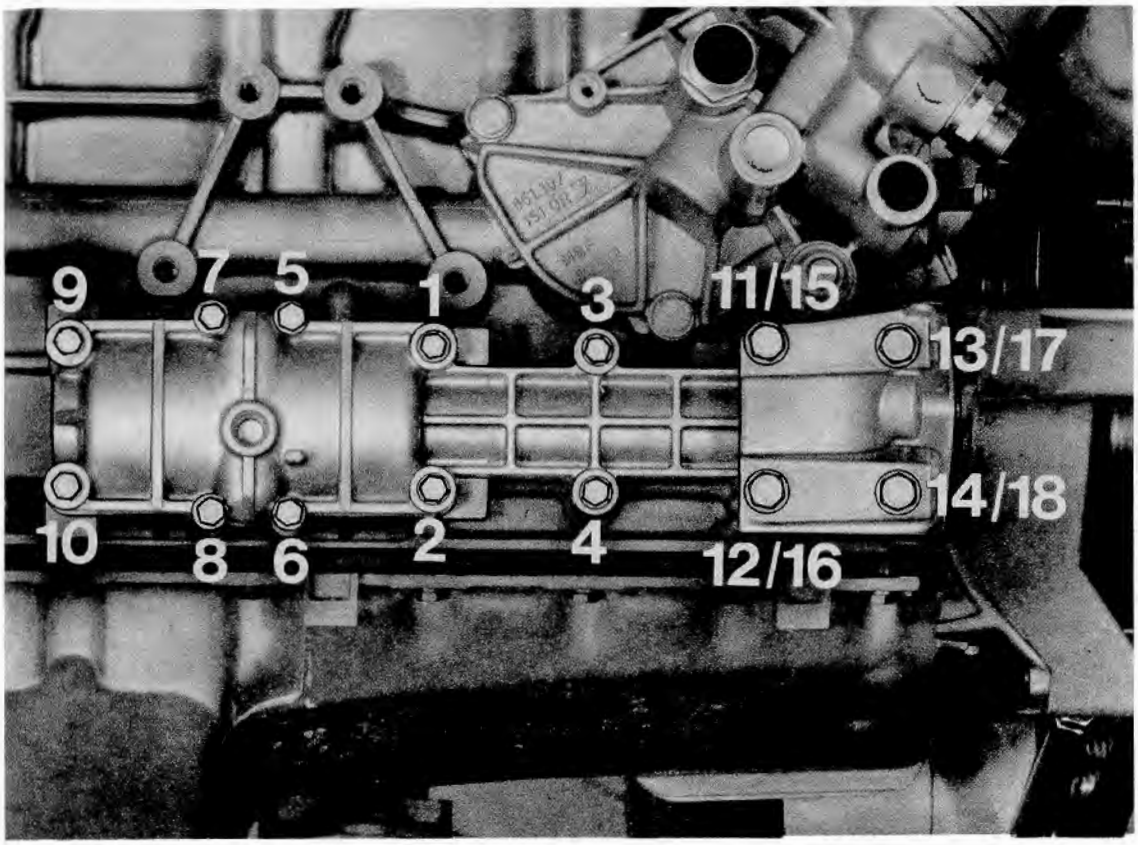
ASSEMBLY INSTRUCTIONS

TIGHTENING PROCEDURES AND TORQUES FOR CRANKCASE UPPER SECTION ON BALANCE SHAFT HOUSING



N o t e

The crankcase upper section and balance shaft housing must be aligned with one another as described below.

1. Hand-tighten all hexagonal-head bolts.

2. Mount bearing housing with a lightly oiled O-ring, but without tightening mounting bolts.

3. Tightening torque for M 6 bolts = 10 Nm (7 ftlb).
   Tightening torque for M8 bolts in 2 steps:

   1st step = 15 Nm (11 ftlb)
   2nd step = 20 Nm (14 ftlb)

See illustration for order of tightening.

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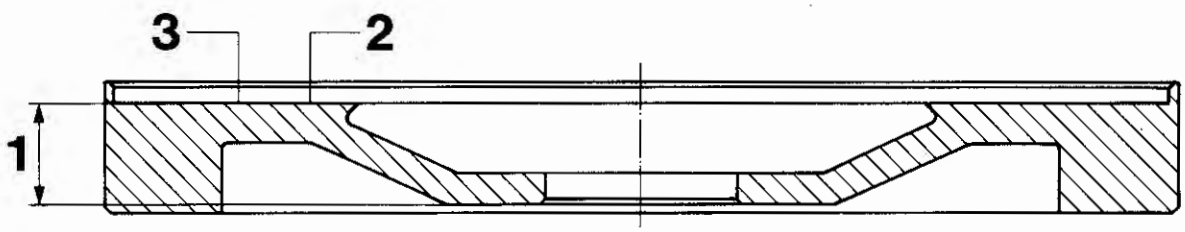
Refacing the flywheel

If severe score or burning marks are evident on the flywheel, the clutch disc mating surface in the flywheel may be refaced on a lathe.

Remove as little material as possible.
Wear limit for flywheel thickness: 25.2 mm.



727/13

1 Wear limit 25,2 mm

2 Remove as little material as possible

3 Max. runout 0.05 mm

Note for refacing the mating surface:
Surface roughness + unevenness = 0.008 mm

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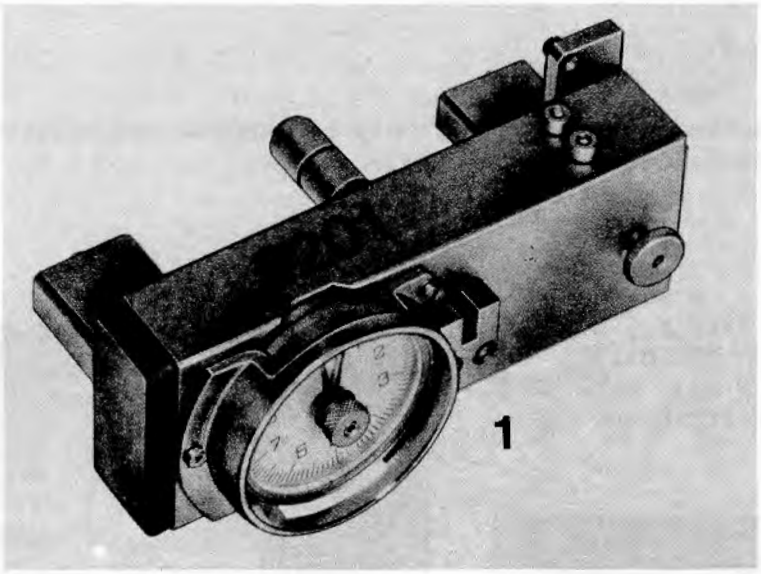
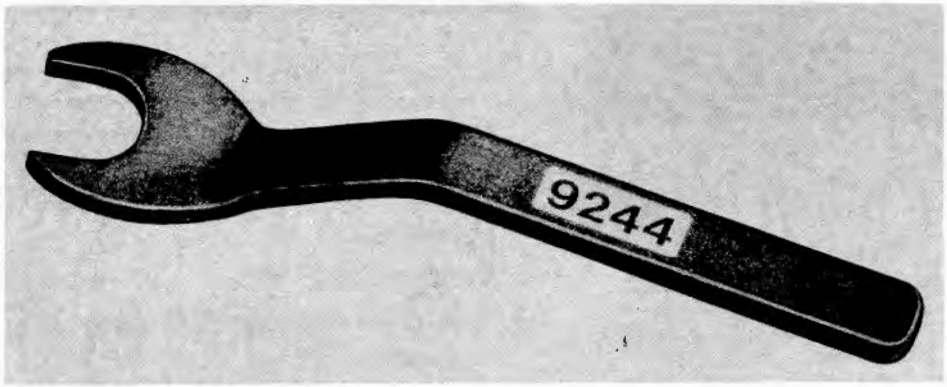
TOOLS





No.	Description	Special Tool	Remarks
1	Belt tightness tester	9201	
2	Adjusting wrench	9244	

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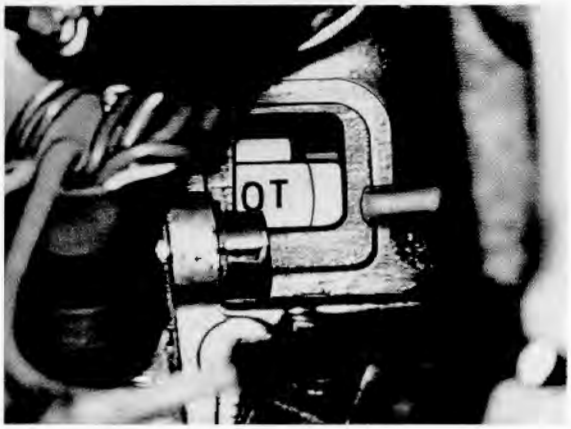
CHECKING AND ADJUSTING TIGHTNESS OF CAMSHAFT DRIVE BELT

N o t e

Tightness of the toothed drive belt may only be checked and adjusted on a cold engine (room temperature).

C h e c k i n g

1. Turn crankshaft slowly clockwise until TDC mark on camshaft sprocket lines up with mark cast in console for distributor cap.



3. Turn engine counter-clockwise on crankshaft approx. 10 crankshaft degrees, which equals approx. 1.5 teeth toward mark on camshaft sprocket.

4. Prepare Special Tool 9201 for checking operation. Pull out lockpin on Special Tool and push test pin opposite lockpin completely out. Line up drag needle with gage needle.

N o t e

While turning, check toothed drive belt for wear and damage.

2. The TDC mark on flywheel and the cast boss on the clutch housing must likewise be aligned.

5. Slide special tool onto belt. Slowly push in gaging pin (arrow) until lockpin is felt to engage, and read value indicated on dial gage.

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N o t e

To avoid incorrect readings, always line up drag needle and gaging needle only after engagement of the lockpin (turn counter-clockwise).

A d j u s t i n g V a l u e s:

New belt: 4.0 + 0.3 scale units
Used belt: 2.7 ∓ 0.3 scale units

Correct toothed drive belt tightness if necessary.

N o t e

Slides must have full contact with drive belt. Do not turn or move special tool on belt during testing.

A d j u s t i n g:

6. To tighten, turn tensioning roller counter-clockwise.
To loosen, turn tensioning roller clockwise. Move tensioning roller accordingly with Special Tool 9244 (adjusting wrench).

7. Tighten mounting nut to torque of 45 Nm (33 ftlb), making sure to counterhold.

8. Crank engine two turns clockwise and align TDC mark on camshaft sprocket with mark cast in console for distributor cap. Crank engine counter-clockwise from this position about 10 crankshaft degrees.

9. Recheck, and if necessary correct tightness of toothed drive belt.

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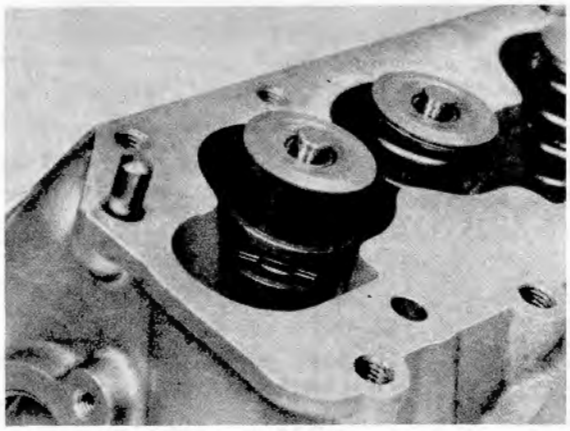
CHECKING AND ADJUSTING INSTALLED LENGTH OF VALVE SPRINGS

1. Install Special Tool 9138/1 with the shims, spring retainer, and two collets belonging to the valve in question.

2. Read distance on Special Tool 9138/1 and if necessary correct by installing or removing shims. Shims are available in thicknesses of 0.5 and 1.0 mm.

Intake valve	41.0 + 0.5 mm
Exhaust valve	40.0 + 0.5 mm



N o t e

The outer valve spring has a length when at rest of approx. 58 mm (approx. 52 mm suction motor). Identifying mark: 2 light purple/ green lines on the spring wire.

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INSTALLING SHAFT SEAL ON
CAMSHAFT BEARING COVER

N o t e

The shaft seal (32 x 47 x 7) and spacing sleeve for the camshaft are no longer identical with the seal and spacer for the upper balance shaft (they were previously).

Marking (arrow) points in direction of turning of camshaft.

Lubricate sealing lip with oil and install together with spacer, and drive end with Special Tool 9202 (pressure pad).

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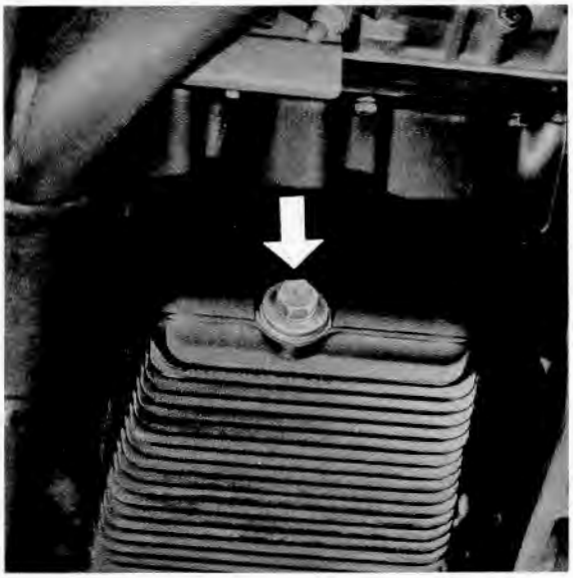
REPLACING ENGINE OIL AND FILTER

Requirement:

Engine at operating temperature.

1. Unscrew and remove oil filler cap.

2. Remove engine splashguard. Remove drain plug from oil pan and drain engine oil.



3. Unscrew oil filter with Special Tool 9204 (oil filter wrench). Catch remaining oil.

4. Clean drain plug, making sure to replace seal. Tightening torque: 50 Nm (36 ftlb).

5. Give gasket on oil filter a light coat of oil. Screw filter on by hand until gasket makes contact, and then tighten by one additional turn. Finally recheck tightness of filter with oil filter wrench. Recommended tightening torque: 20 Nm (14 ftlb).

6. Add engine oil, run engine to operating temperature, and check for leaks.

7. Check oil level on stopped engine.

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COOLANT MIXING TABLE

(A v e r a g e V a l u e s)

Freeze Protection	Anti-Freeze	Water	Anti-Freeze	Water
- 25° C (-13°F)	40 %	60 %	3.1 ltr	4.7 ltr
- 30° C (-22°F)	45 %	55 %	3.5 ltr	4.3 ltr
- 35° C (-31°F)	50 %	50 %	3.9 ltr	3.9 ltr

CHECKING COOLING AND HEATING SYSTEM FOR LEAKS

1. Inspect visually for leaks.

2. Check cooling and heating hoses for correct routing, porosity, swelling, tears, and rubbing damage. Replace damaged hoses.

3. Tighten hose clamps.

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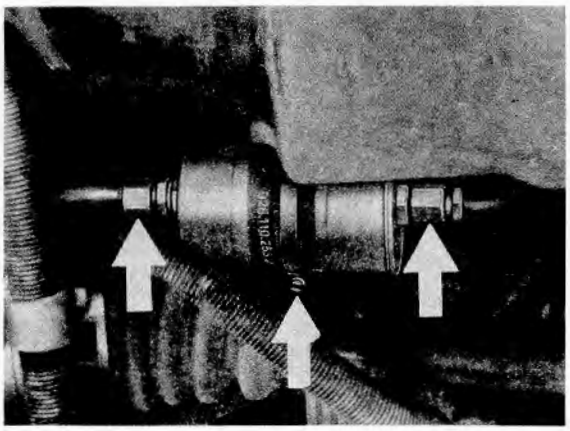
REPLACING FUEL FILTER

1. Detach fuel lines, making sure to counterhold. Catch escaping fuel.

2. Loosen clamp and remove fuel filter.

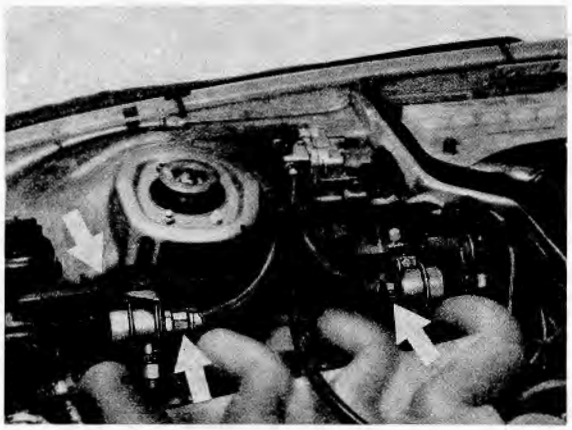


3. Install new filter, checking direction of flow = direction of arrow.

CHECKING FUEL AND INJECTION LINES FOR LEAKS AND TIGHTNESS

1. Inspect visually for leaks.

2. Tighten coupling nuts and hose clamps.



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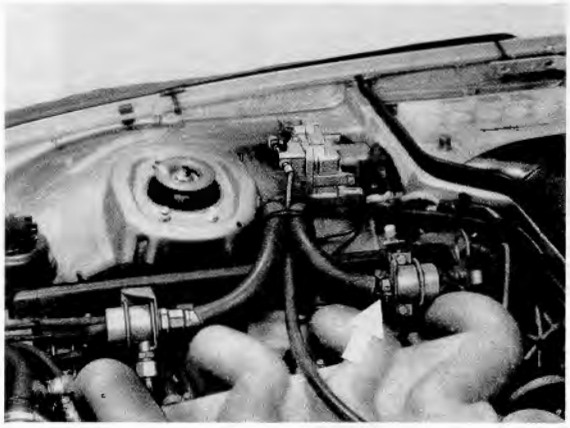
CHECKING FUEL PUMP DELIVERY RATE

Requirements:

Fuel filter and electric power supply okay.

1. Unscrew fuel return hose on pressure regulator and hold end of hose in a measuring glass (volume: approx. 1500 cm^3).



2. Pull off DME relay on central electric board and bridge terminals 30 and 87 b with a piece of wire.

Let fuel run into measuring glass 30 seconds. Delivery rate should be at least 850 cm^3/30 seconds. Replace fuel pump if necessary.

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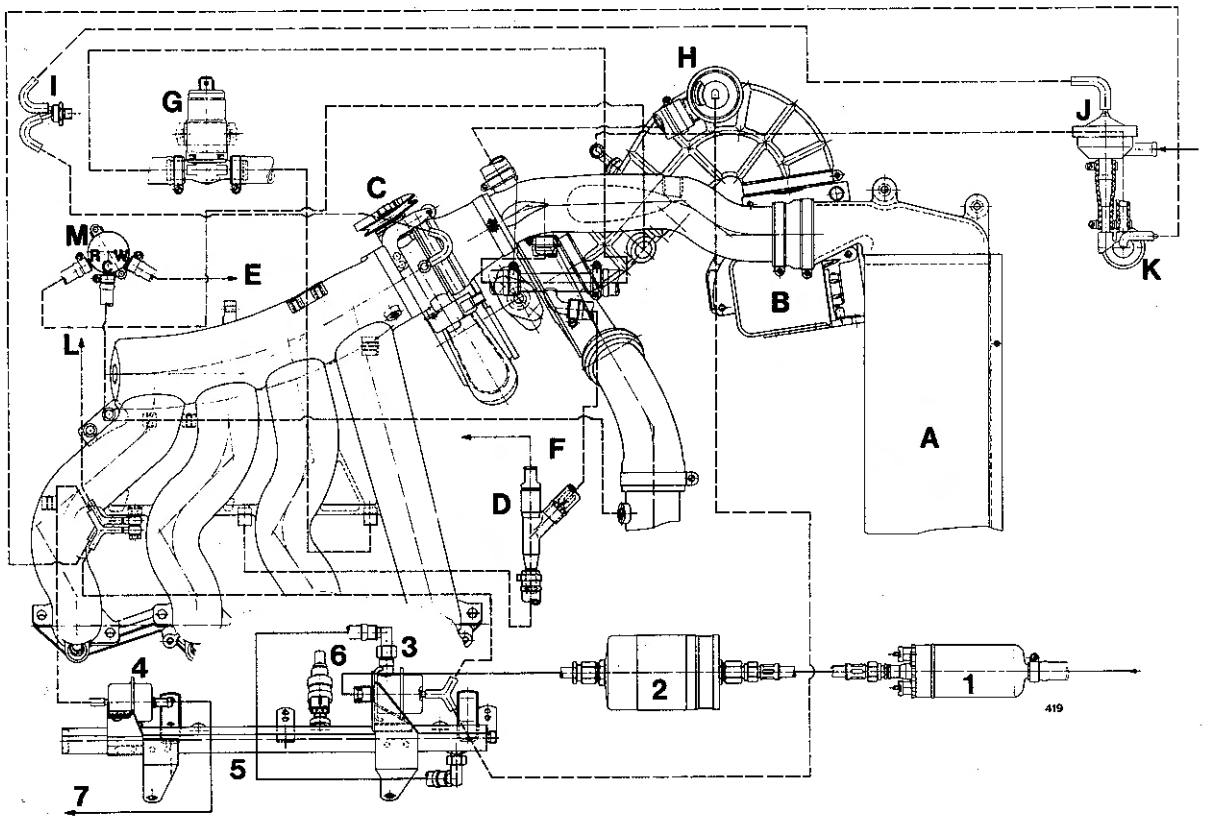
FUEL SYSTEM LINE ROUTING



1 - Fuel pump	A - Charging air cooler	H - Air circulation valve
2 - Fuel filter	B - Air flow sensor	I - Temperature valve (open above 58°C/ 136.4°F)
3 - Pressure damper	C - Throttle housing	
4 - Pressure regulator	D - Intake pipe	J - Shutoff valve
5 - Injection line	E - To charging pressure control valve	K - Control valve
6 - Fuel injector	F - To brake booster	L - To control unit (charging pressure control)
7 - Fuel return	G - Idle actuator	M - Timing valve for charging pressure

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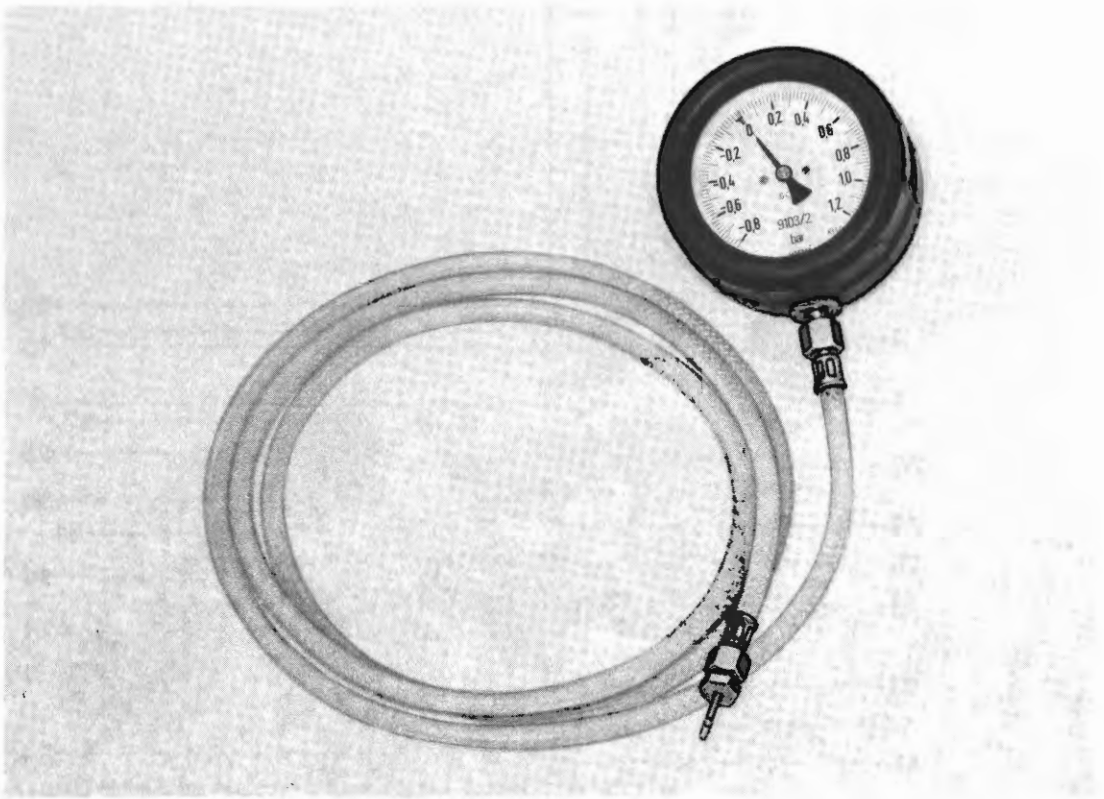
TOOL

Measuring charging pressure



No.	Description	Special Tool	Remarks
1	Pressure gage with adapter	9103/2	Use pressure hose from Special Tool 9103

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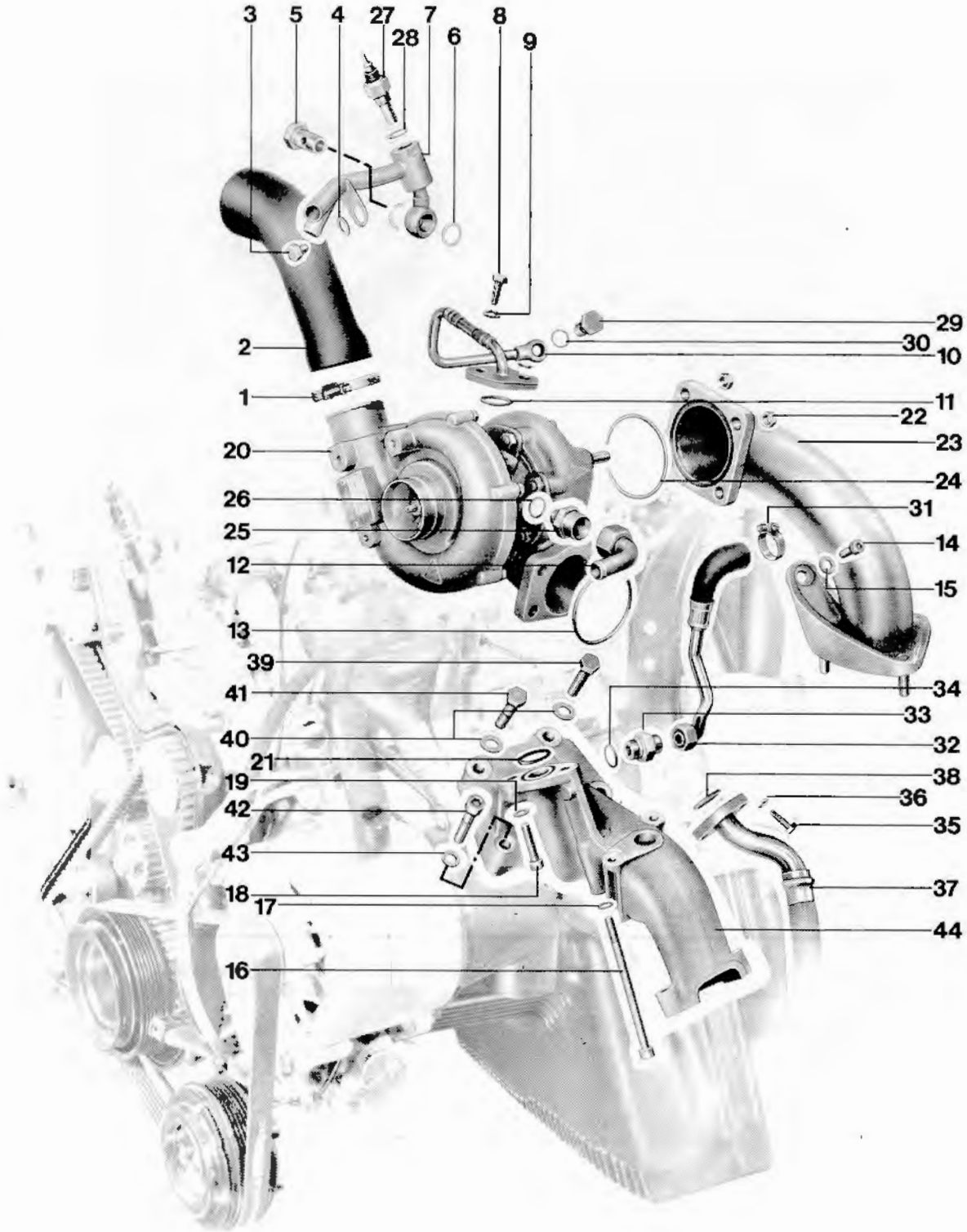
TURBOCHARGER SYSTEM DISASSEMBLY AND ASSEMBLY



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No.	Description	Qty.	Note When: Removing	Installing
1	Hose clamp	1		
2	Hose	1		
3	Hex bolt M8 x 10	1		
4	Washer	1		
5	Hollow-core bolt	1		
6	Seal ring	2		Replace
7	Water hose	1		
8	Hex bolt M8 x 20	2		
9	Washer	2		
10	Oil line	1		
11	O - Ring	1		Always replace. Make sure of correct seating in groove.
12	Cooling water pipe	1		
13	Seal ring	1		Always replace
14	Pan head bolt M8 x 25	1		
15	Washer	1		
16	Pan head bolt M8 x 125	1		
17	Washer	1		
18	Pan head bolt M8 x 35	1		

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No.	Description	Qty.	Note When: Removing	Installing
19	Washer	1		
20	Turbocharger	1		
21	O-Ring	1		Always replace. Make sure of correct seating in groove.
22	Locknut	4		Check and if necessary replace.
23	Exhaust pipe	1		
24	Filler seal ring	1		Always replace
25	Threaded connection	1		
26	Seal ring	1		Replace
27	Temperature switch	1		
28	Seal ring	1		Replace
29	Hollow-core bolt	1		
30	Seal ring	2		Replace
31	Hose clamp	1		
32	Ventilation line	1		
33	Threaded connection	1		
34	Seal ring	1		Replace
35	Hex bolt M6 x 20	2		
36	Washer	2		
37	Oil return line	1		

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No.	Description	Qty.	Note when: Removing	Installing
38	O-Ring	1		Always replace. Make sure of correct seating in groove.
39	Hex bolt M10 x 45	1		
40	Washer	3		
41	Hex bolt M10 x 55	2		
42	Pan head bolt M 10 x 55	1		
43	Washer	1		
44	Engine support	1		

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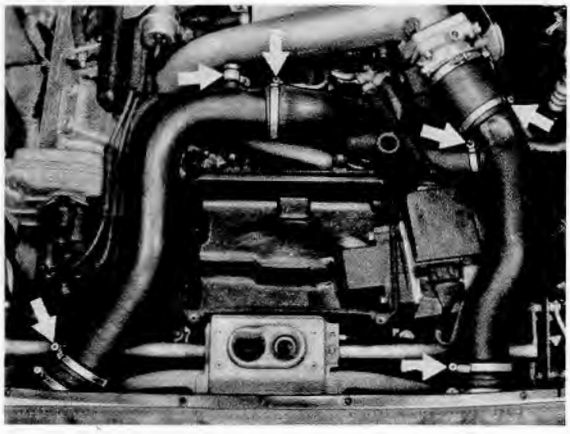
REMOVING AND INSTALLING TURBOCHARGER

1. Disconnect ground lead on battery.

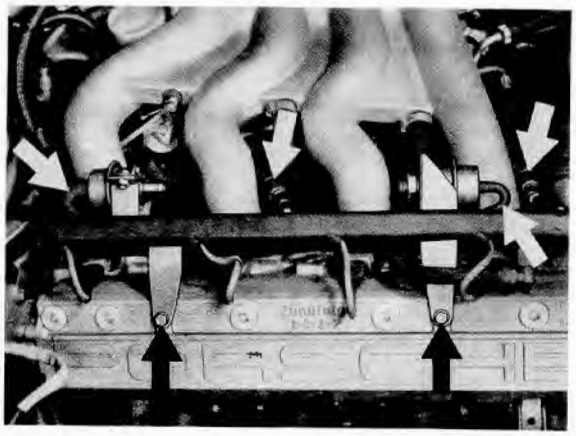
2. Unscrew air cleaner upper section and remove together with air intake and filter cartridge.

3. Remove both charging air guide pipes.



4. Disconnect fuel feed and return lines, and set aside. Detach vacuum hoses from pressure regulator and pressure damper. Disconnect cable on cruise control motor.

5. Pull off spark plug connectors. Unscrew distributor cap. Detach fuel collection pipe with fuel injectors and ignition leads on intake air distributor and camshaft housing.



6. Carefully remove fuel collection pipe with fuel injectors and ignition leads from intake air distributor, and set aside.

7. Disconnect throttle operating cable. Loosen and remove vacuum hoses from intake air distributor.

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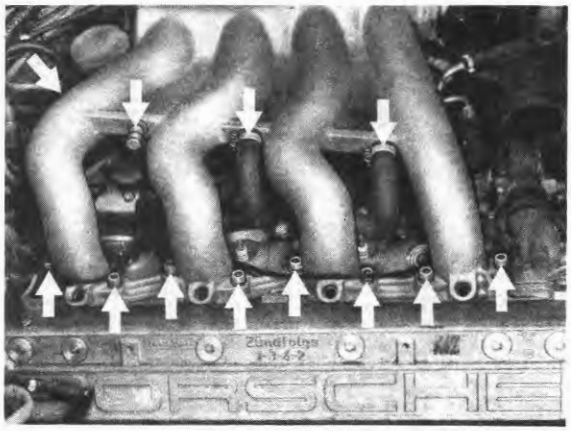
8. Remove intake air distributor with throttle housing, and cover intake ports leading to intake valves.

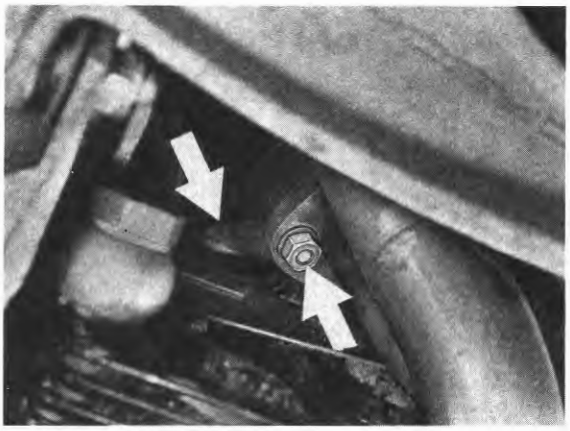


9. Remove engine splashguard.

10. Drain and catch coolant. Pull off alternator ventilation hose. Remove coolant pump with bracket from body.

11. Loosen and remove oil dipstick with guide tube and main brake cylinder heat dissipator.

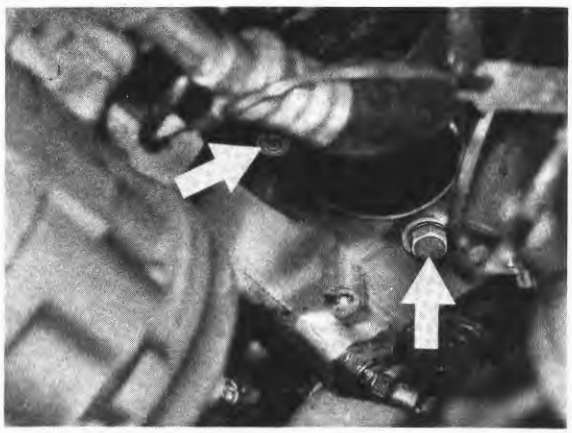
12. Unscrew flange between turbocharger and exhaust assembly with the M 8 bolt on engine block.



13. Unscrew exhaust flange on turbine housing, coolant lines, and oil pressure line on turbocharger.

14. Loosen and pull off intake air cowl between air flow sensor and turbocharger (compressor housing) as well as pressure hose to charging air cooler.

15. Remove shield for universal joint on engine support. Loosen turbocharger attachment on motor support from below.



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I n s t a l l i n g

1. Always use new seals (filling seal rings).

2. Make sure round seal ring fits correctly on left engine support.

3. Insert seals for exhaust flanges and secure them from falling out (e.g. with grease).

4. Check and if necessary replace locknuts for exhaust flanges.

5. Tighten the M 8 bolt of the exhaust flange on engine block only after installation of all bolts for exhaust flanges and turbocharger.

6. All bolts in the turbocharger / exhaust flange area should be coated with Optimoly HT.

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MEASURING END PLAY ON EXHAUST TURBOCHARGER

1. Mount dial gage with bracket. Special Tool VW 387 can be used as a dial gage bracket.

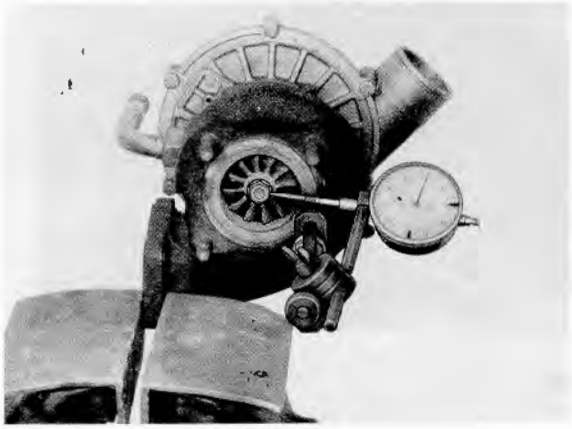
2. Bring dial gage measuring stud into contact with turbine wheel shaft end. Press rotor shaft against dial gage and note gage reading. Push rotor shaft in the opposite direction and note reading. The difference between the readings obtained is the end play.

Max. play 0.16 mm.

MEASURING EXHAUST TURBOCHARGER RADIAL PLAY

Radial play is measured only on the turbine side.

Set dial gage measuring stud against hub face. Press turbine wheel to one side and record reading. Press turbine wheel in opposite direction and again record reading. The difference between the readings obtained is the radial play.



Max. play 0.42 mm.

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Measuring charging pressure

General

Special tool 9103/2 (pressure gage) shows charging pressure in bar above atmospheric pressure.

By contrast, the charging pressure indicator in the vehicle tachometer shows charging pressure in bar absolute pressure.

	bar, absolute value	bar , excess pressure
Air pressure at sea level	1	0
Boost pressure 944 turbo M 44.51/52	1,75 ± 10%	0,75 ± 10%

Maximum boost pressure of 1.75 bar (absolute value) is reached at approx. 3,000 rpm. At higher engine speeds (engine type M 44.51) the boost pressure drops again and reaches a boost pressure of 1.52 ± 0.03 bar (absolute value) at 5,800 rpm. With engine type M 44.52, the boost pressure remains constant at 5,800 rpm (1.75 bar absolute value) and drops only after this value has been passed.

Note

Measure charging pressure only under dry roadway conditions.

1. Connect pressure hose with adapter piece to pressure damper vacuum connection.

2. Locate pressure gage on passenger side of passenger compartment, with hose running from engine compartment.

Note

Make certain that the hose is not pinched at hood-body crossing.

3. Accelerate to approx. 3000 rpm in 2nd gear, and using simultaneous braking against the motor maintain rpm. Have a second person read off charging pressure.
   Charging presure 1.6 - 1.7 bar (absolute).

Note

Carry out measuring as quickly as possible (approx. 3-5 sec.), to avoid overheating brakes.

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REMOVING AND INSTALLING TURBOCHARGER COOLANT PUMP

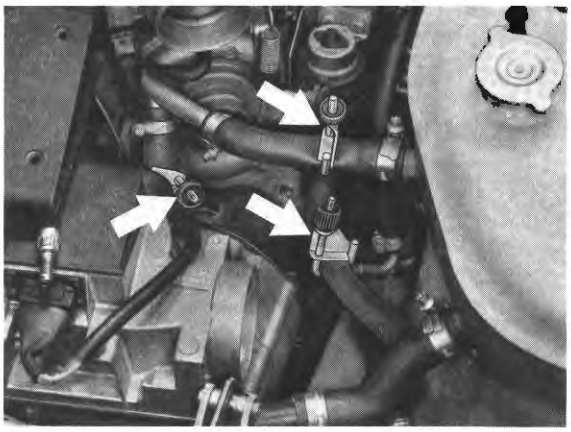
R e m o v a l

1. Remove intake snorkel from air filter upper section.

2. Remove vacuum connection on by-pass air valve. Loosen and remove hose clamps on charging air guide pipe, throttle housing, and bypass air valve.

3. Loosen hose clamps on air intake cowl, remove hose connections from cowl and remove cowl.

4. Pinch off coolant hoses to turbo-charger and pump with hose clips.



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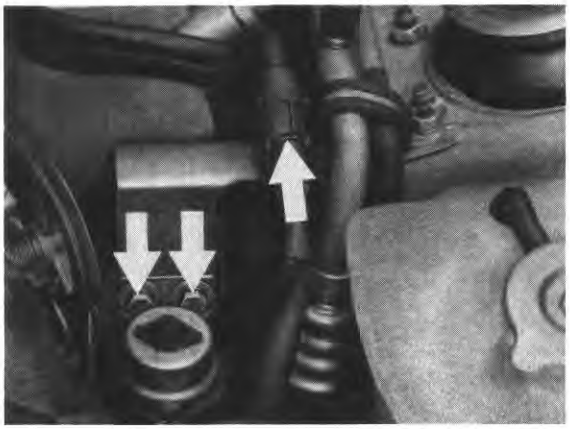
5. Disconnect electric plug connection and loosen pump along with bracket.



6. Loosen hose clamp on turbocharger coolant water pipe and pull the hose forward along with the pump.

7. Loosen lower hose clamp on pump, pull off hose, and remove pump.

Installation

1. Make sure of correct seating of hoses and hose clamps.

2. Fill and bleed cooling system.

Note

Checking Function of Turbocharger Coolant Pump

1. Turn on ignition and start engine.

2. Turn off motor. The pump must be switched on for 25 seconds after turning off engine. At this time coolant can be observed flowing back into the expansion tank.

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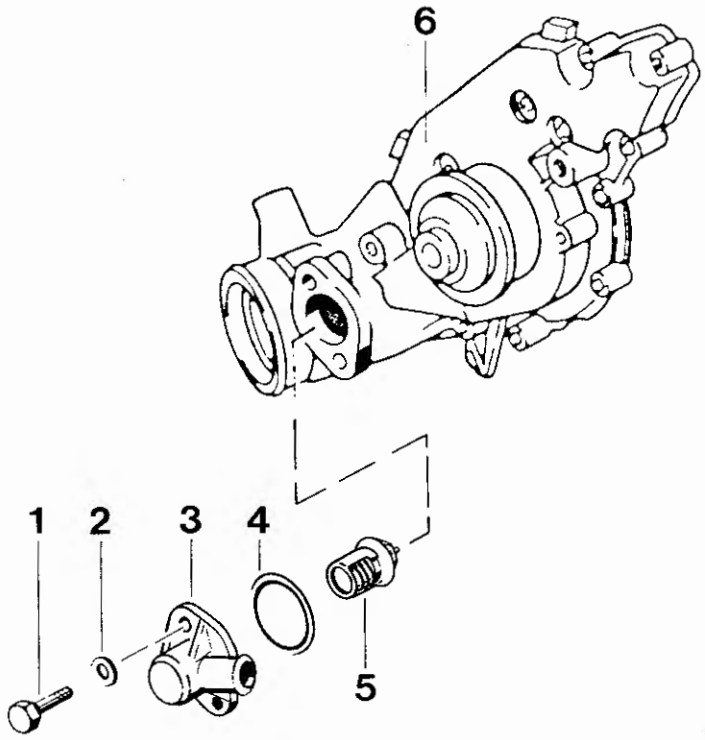
Turbo charger cooling system components, removing and installing



No.	Description	Qty.	Note: Removing	Installation
1	Hexagon head screw M6 x 20	2		
2	Washer A 6.4	2		
3	Housing	1		
4	O-ring seal 28 x 2.5	1		Replace
5	Thermostat for turbo charger cooling system	1		Observe the mounting position, long cylindrical part into the plastic housing
6	Water pump	1		

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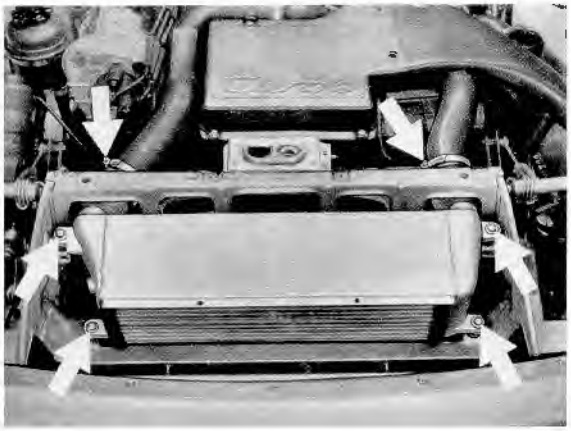
REMOVAL AND INSTALLATION OF CHARGING AIR COOLER

Removal

1. Remove front end panel. See Workshop Manual, 944, page 50-5.

2. Loosen air duct on cooler and body and lift out.

3. Loosen hose clamps for charging air duct and unscrew hex bolts on cooler.



4. Remove cooler with rubber connection towards the front.

Installation

Make sure of correct seating of rubber connection between cooler and charging air duct, as well as of hose clamps.

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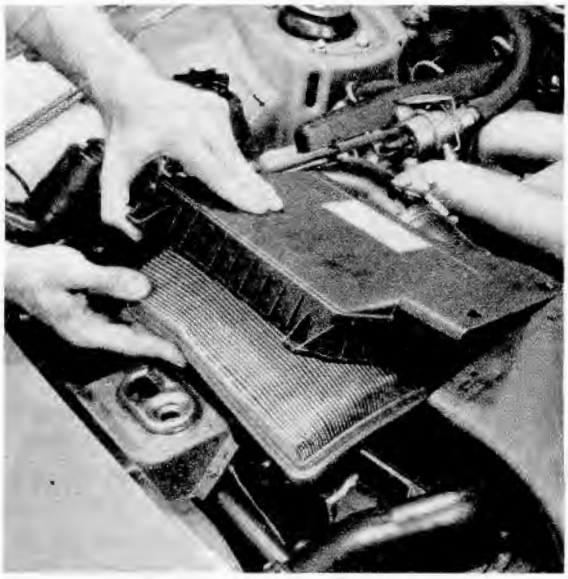
REPLACING AIR FILTER CARTRIDGE

1. Unscrew air intake on air cleaner upper section.

2. Loosen clamps and unscrew bolts with screwdriver. Remove air cleaner upper section.



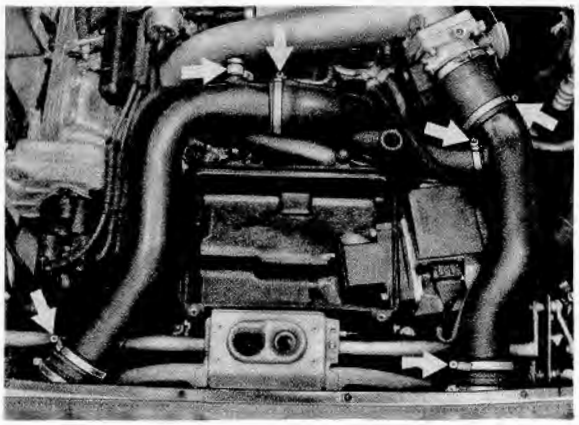
3. Remove air filter cartridge and clean inside of air cleaner lower section with a cloth that will not leave lint.

4. Install air filter cartridge. Mount housing cover and tighten mounting bolts. Engage clamps. Make sure dust cover fits correctly between air cleaner intake and wheelwell side panel.

CHECKING INTAKE AIR GUIDE AND CRANKCASE END HOSES FOR LEAKS AND TIGHT FIT

1. Check all hoses of intake system for correct fit.

2. Tighten hose clamps.



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TESTING AND ADJUSTING VALUES

Test step	Testing and Adjusting Value	Remarks
Electric fuel pump delivery rate	At least 850 cc/30s	
Fuel pressure (engine stopped), fuel pump bridged	2.3 ..... 2.7 bar	
Test value at idle spped	Approx. 2 bar	
Leak test, minimum pressure after 20 min.	1 bar	
Idle adjustment		
Idle speed in rpm	840 ± 40	
CO level in %	1.0 - 1.5 *0.6 ± 0.2	* Measured upstream of catalytic converter with oxygen sensor plug disconnected
HC values in ppm	≤300 *≤300	

*USA and catalytic converter models

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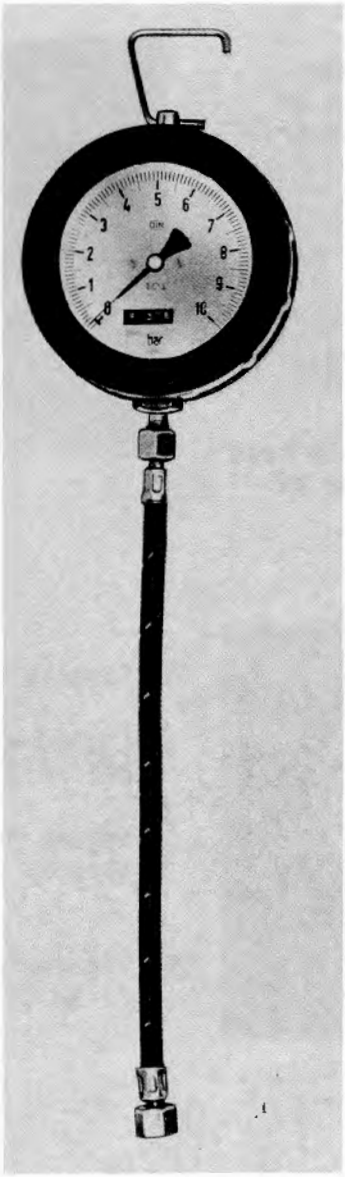
CHECKING FUEL PRESSURE

TOOLS



No.	Description	Special Tool	Remarks
	Pressure meter with hose from pressure tester	P 378	or VW 1318

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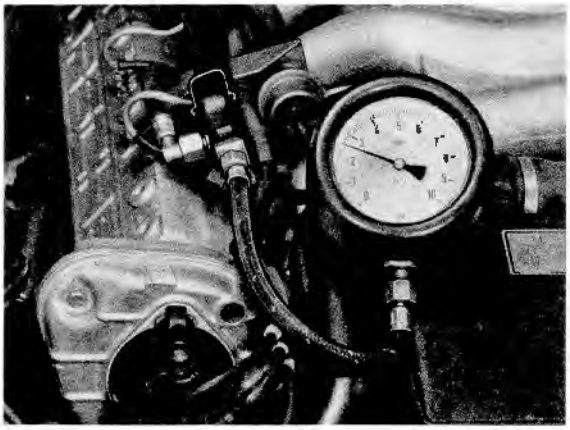
CHECKING FUEL PRESSURE

1. Disengage and fold up cover. Unscrew and remove cap nut on test connection of fuel distribution line.

N o t e

Make sure sealing ball does not fall out when removing cap nut.

2. Connect pressure meter with hose from Special Tool P 378 or VW 1318 on test connection.



4. Test Values:

   Engine stopped 2.3 to 2.7 bar (DME relay bridged)

   Engine running at idle speed approx. 2 bar

5. Tightening torque for cap nut: 22 Nm (16 ftlb).

3. Pull of DME relay on central electric board and bridge terminals 30 and 87 b with a piece of wire. Fuel pump should now run.

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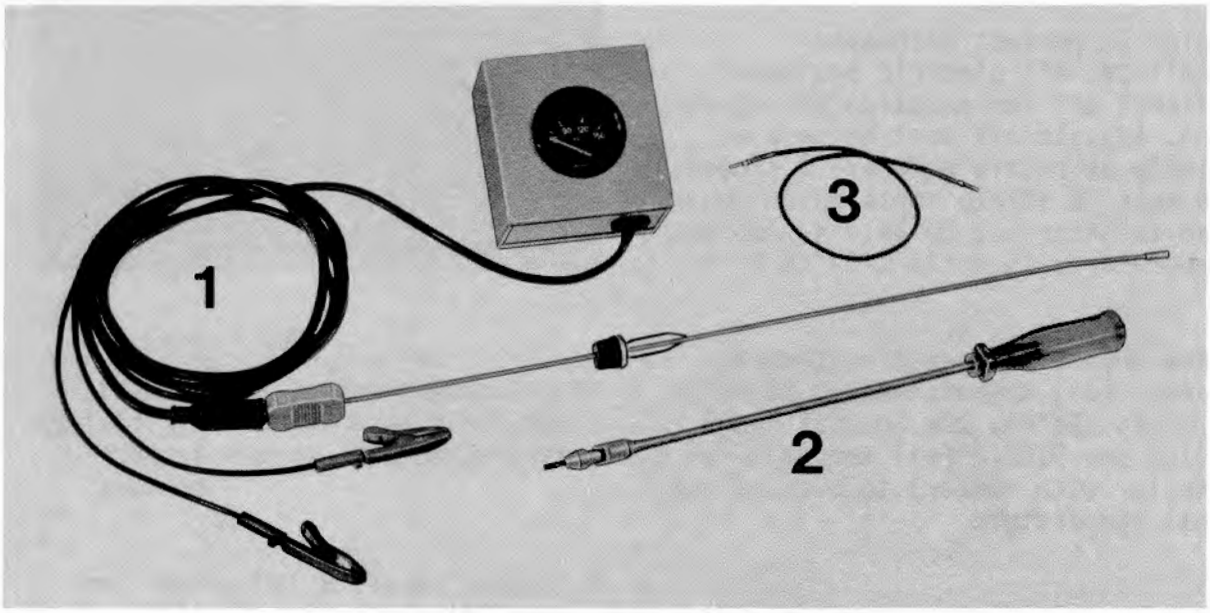
IDLE ADJUSTMENTS

T o o l s



No.	Description	Special Tool	Remarks
1	Oil temperature tester with sensor	9122 + 9122/2	
2	Articulated screw-driver	9230	
3	Lead		Made locally, or use test relay 9246.

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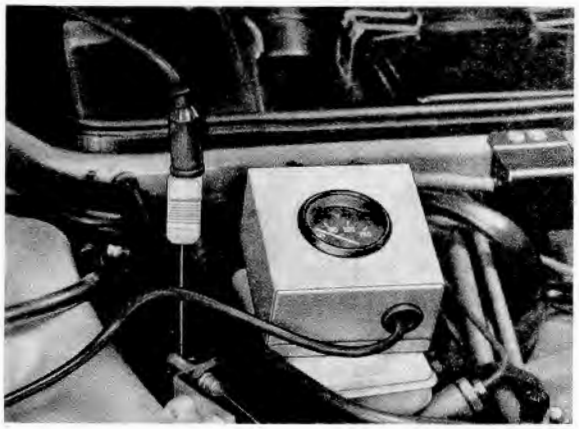
IDLE ADJUSTMENTS

Note:

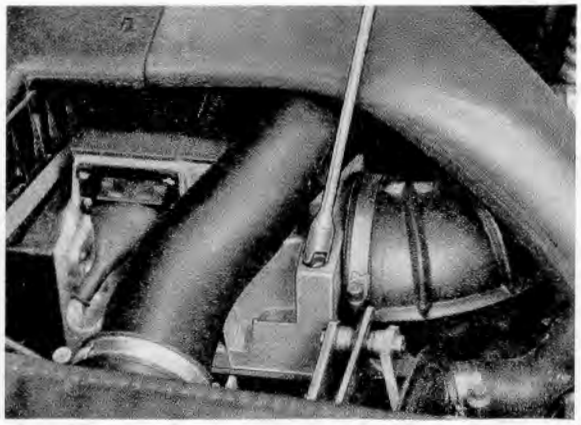
Requirements for adjustments:

Engine in perfect mechanical condition. All electric equipment switched off for duration of adjustment. Adjustments must be made as quickly as possible to avoid excessive heat in intake ports which would lead to incorrect CO levels. Ambient temperature: 15 to 35°C/59 to 95°F.

1. Run engine to operating temperature (oil temperature 70 to 90°C/158 to 194°F). Use Special Tools 9122 and 9122/2 (oil temperature tester with sensor) to measure the oil temperature.



2. Check CO level. If CO level is not within specified range, correct setting on air flow sensor, using Special Tool 9230 (articulated screwdriver).

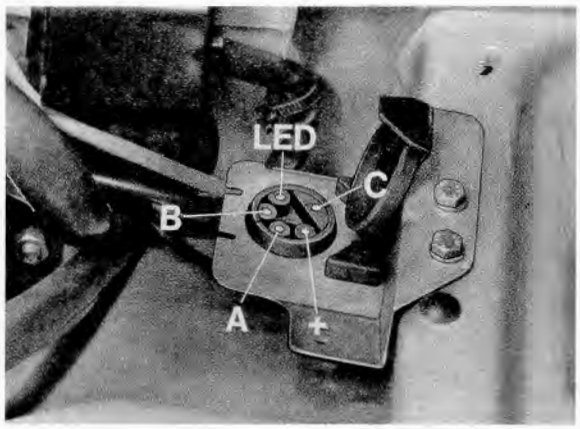


CO adjustment range: 1.0 to 1.5%.
Clockwise turn = richer mixture
Counter-clockwise turn = leaner mixture

3. Connect separate tachometer per manufacturer's instructions. Idle adjustment value: 840 ± 40 rpm.

4. Check and, if necessary, adjust engine idle speed. This requires stopping the operation of the idle speed charging control.

a. Jumper round female plugs B and C on diagnosis socket with a wire lead. This stops operation of the idle charging control.



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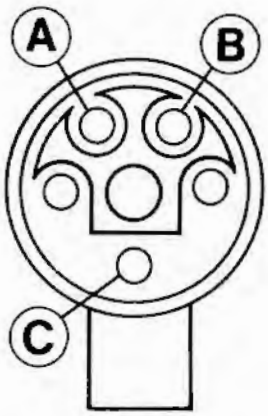
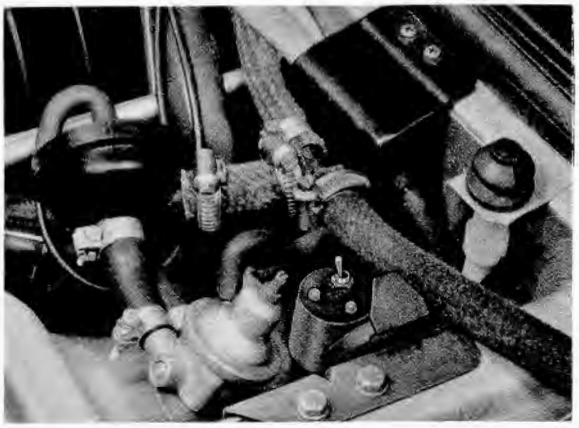
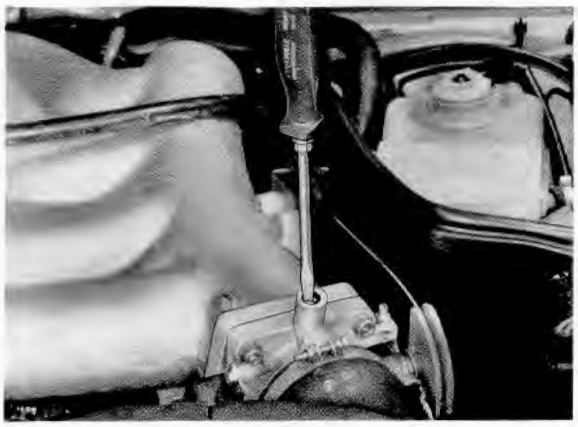


b. Instead of a wire lead, Special Tool 9246 (test relay) can also be used. The idle charging control is out of operation when the green test lamp lights up.



c. Check and, if necessary, adjust engine idle speed with VAG tester 1367 (for example).

5. Turn control screw (bypass) on throttle housing until specified speed of 840 ± 40 rpm is reached.



6. Restore operation of idle charging control after finishing adjustments by removing wire lead or test relay from diagnosis socket.

7. Recheck settings.

8. Close access boring to CO adjustment screw with plug ET-No. 944 606 935 01 (blue).

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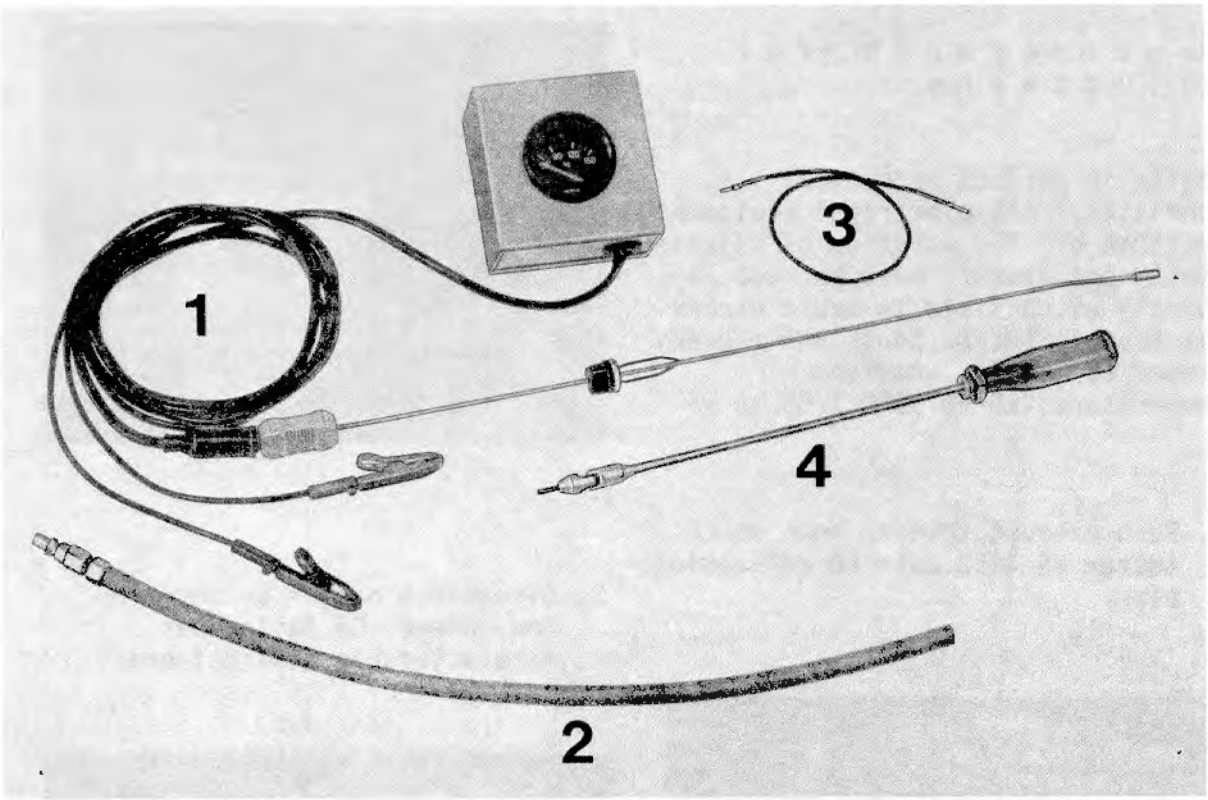
IDLE ADJUSTMENTS - USA and catalytic converter models

T o o l s



No.	Description	Special Tool	Remarks
1	Oil temperature tester with sensor	9122 + 9122/2	
2	Exhaust tester	US 4492	
3	Wire lead		Made locally, or use test relay 9246
4	Articulated screw-driver	9230	

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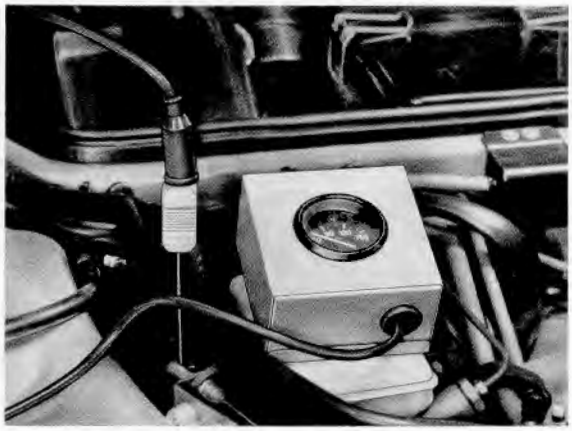
IDLE ADJUSTMENTS - USA and catalytic converter models

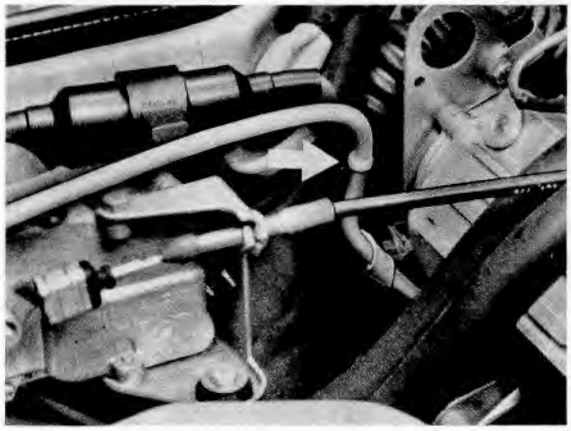
Anmerkung: PLEASE TRANSLATE THIS

Requirements for Adjustments:

Engine in perfect mechanical condition. All electrical equipment switched off for duration of adjustment. Adjustments must be made as quickly as possible to avoid excessive heat in intake ports and thereby skewed CO levels. Ambient temperature: 15 to 35°C / 59 to 95°F.

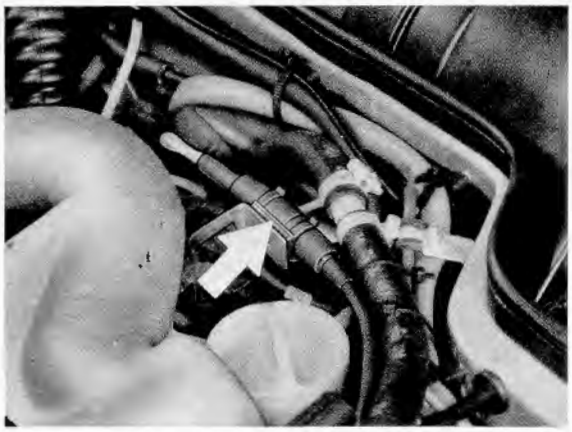


1. Push exhaust take-up hose or CO tester US 4492 onto CO collecting pipe.



2. Run engine to operating temperature (oil temperature 70 to 90°C / 158 to 194°F). Use Special Tool 9122 and 9122/2 to monitor oil temperature.

3. Disconnect oxygen sensor plug and connect CO tester per manufacturer's instructions.



4. Check CO level. If CO level is not within specified range, correct setting on air flow sensor. Use Special Tool 9230 (articulated screwdriver).

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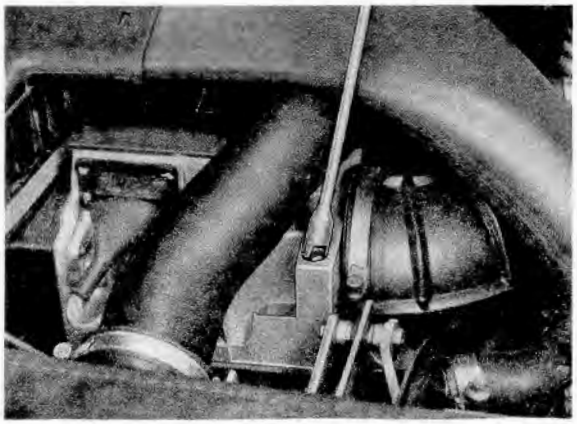
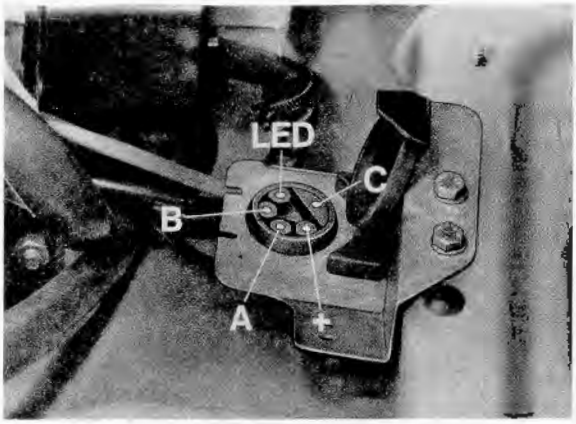




CO adjustment level: 0.6 ± 0.2%
Clockwise turn = richer mixture
Counter-clockwise turn = leaner mixture

Note

If it is necessary to correct the CO level at the air flow sensor, the plug in the access bore to the idle speed CO setting screw has to be removed, which requires removing the air flow sensor.

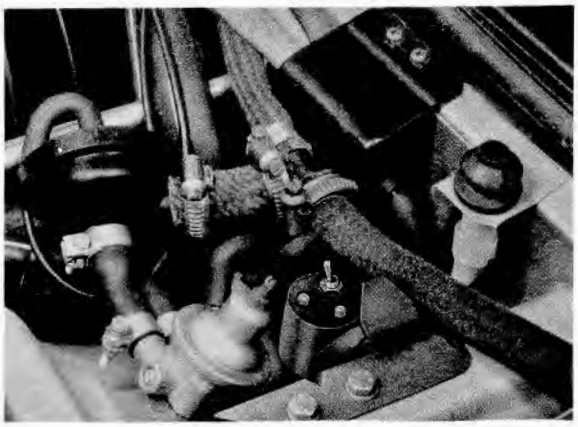
5. Connect oxygen sensor plug and close CO sampling tube in engine compartment after finishing adjustments.

6. Connect a separte tachometer per instructions supplied with unit. Idle speed adjustment level: 840 ± 40 rpm.

7. Check and, if necessary, adjust engine idle speed. This requires stopping the operation of the idle speed charging control.

a. Jumper round female plugs B and C on diagnosis socket with wire lead. This stops operation of the idle charging control.

b. Instead of a wire lead, Special Tool 9246 (test relay) can also be used. Idle charging control has been put out of operation when the green test lamp lights up.



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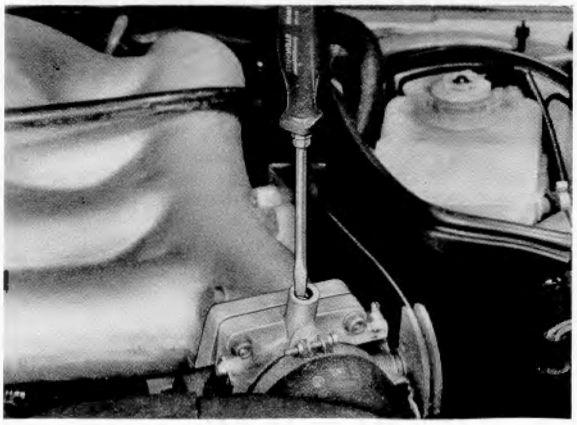
c. Check and, if necessary, adjust idle speed (for example with VAG tester 1367).

8. Turn control screw (bypass) on throttle housing until specified speed of 840 ± 40 rpm is reached.



9. Restore operation of idle charging control after completing adjustments by removing wire lead or test relay from diagnosis socket.

10. Recheck settings.

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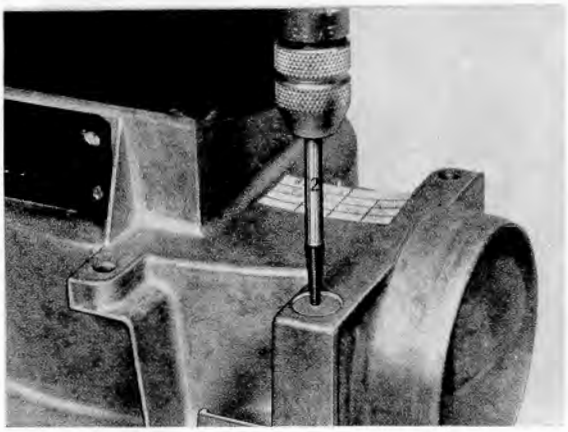
CORRECTING CO LEVEL ON AIR FLOW SENSOR IN USA AND CATALYTIC CONVERTER MODELS

N o t e

If the CO level is not as specified, the plug in the access bore to the idle speed CO setting screw must be removed, requiring the removal of the air flow sensor.

R e m o v a l

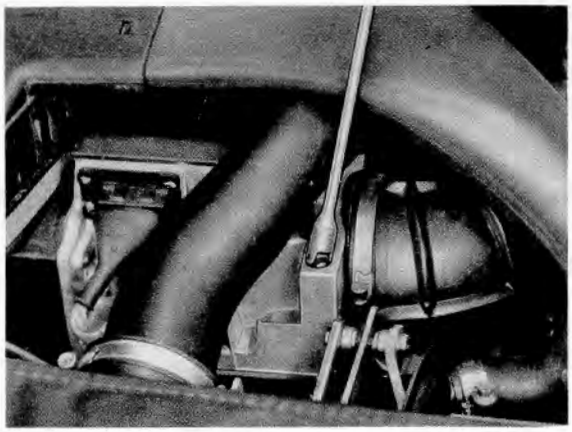
1. Remove air flow sensor.
2. Drill a 2 mm dia. hole in plug down to stop (steel insert).
3. Pull out plug using size 2 screw extractor.



I n s t a l l a t i o n

1. Install air flow sensor.
2. Adjust CO level and engine idle speed. Turn CO setting screw using Special Tool 9230 (articulated screwdriver).

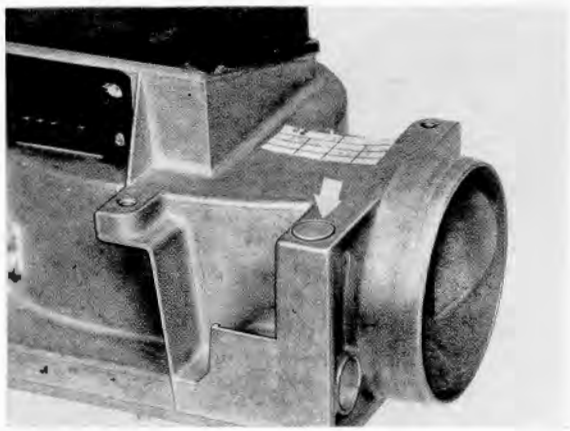
Clockwise = Richer mixture
Counter-clockwise = Leaner Mixture



3. After completing adjustments, close access bore to CO setting screw with new plug. Press in plug flush.

N o t e

Never reuse a drilled plug!



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REMOVING AND INSTALLING IDLE ACTUATOR

R e m o v a l

1. Disconnect battery ground lead.

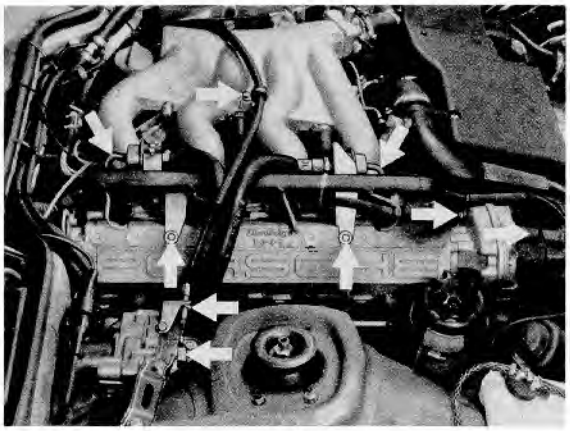
2. Disconnect cable on cruise control motor. Pull off vacuum hoses on pressure regulator and pressure damper.

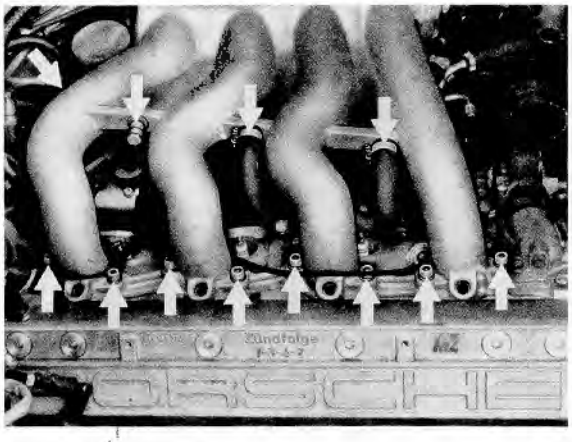
3. Remove spark plug connectors. Unscrew distributor cap. Unscrew fuel distribution pipe with fuel injectors and ignition leads on intake air distributor and camshaft housing.

4. Carefully remove fuel distribution pipe with fuel injectors and ignition leads from intake air distributor and set aside.

5. Disconnect throttle operating cable. Loosen and remove vacuum hoses from intake air distributor.

6. Remove intake air distributor with throttle housing, and cover intake ports leading to intake valves.





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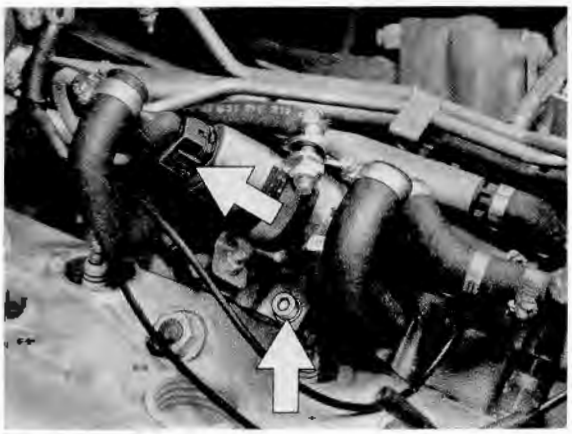
7. Disconnect electric plug connection on idle actuator. Unscrew Allen head bolt M 8 on crankcase and take out idle actuator with bracket. Loosen hose connection from charging air guide pipe and remove.



Installation

1. When installing idle actuator, take note of flow-through (arrow) direction. Arrow points to intake air distributor.

2. Take care to position vacuum hoses and hose clamps correctly. Always replace seals for intake air distributor and hollow-core bolt. Tightening torque of hollow-core bolt is 10 Nm (7 ftlb).

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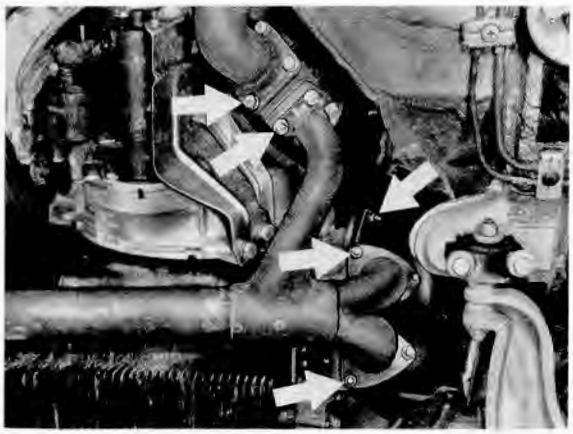
CHECKING TIGHTNESS OF EXHAUST SYSTEM FLANGES

1. Check tightness of exhaust flanges as well as checking complete exhaust system for leaks.

2. Check tightness of hex nuts on exhaust manifold / cylinder head flange.

3. Check tightness of all flange connections from exhaust system/ turbocharger and bypass valve.



4. Check tightness of bolts on primary muffler (catalytic converter) / final muffler flange. Check exhaust system suspension points.

Tightening torque for bolts and nuts:

M 8 20 + 2 Nm (14 + 1.4 ftlb)
M10 40 + 5 Nm (29 + 3.6 ftlb)

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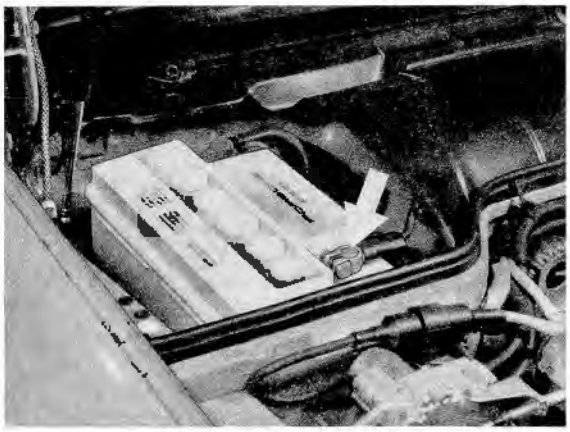
CHECKING BATTERY

N o t e

Due to the danger of short circuits, it is important to always disconnect the battery when working on the electrical system. However, the battery must never be disconnected while the engine is running.

1. Open engine hood and remove battery cover.

2. Loosen and remove ground lead.



C h e c k i n g A c i d L e v e l

1. Unscrew all caps and check acid level in each cell.

2. If acid level is below the mark, pour in distilled water only. Never raise acid level above this mark.
   An insufficient acid level will shorten the battery's service life.

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Checking Acid Density

The acid will normally indicate the charge condition of the battery.
Measure acid density with an areometer.

The following values must be reached:

Charge Condition	Normal Climates		Tropical Climates	
	kg/ltr	Be	kg/ltr	Be
Fully charged	1.28	32	1.23	27
Half charged	1.20	24	1.16	20
Discharged	1.12	16	1.08	11

Checking Battery Voltage

Measure voltage of battery under load with a suitable tester.

The voltage must not drop below a minimum of 9.6 V with a load current of approx. 110 A.

If the voltage is lower at this load (approx. 8 to 10 seconds), the battery has either been discharged or is defective.

Charging Battery

Note

Never smoke or use open flame in rooms where batteries are charged.

1. Disconnect battery from car's electrical system for charging.
2. Unscrew all caps prior to charging.
3. Connect positive pole of battery with positive pole of charger, and negative pole of battery with negative pole of charger.

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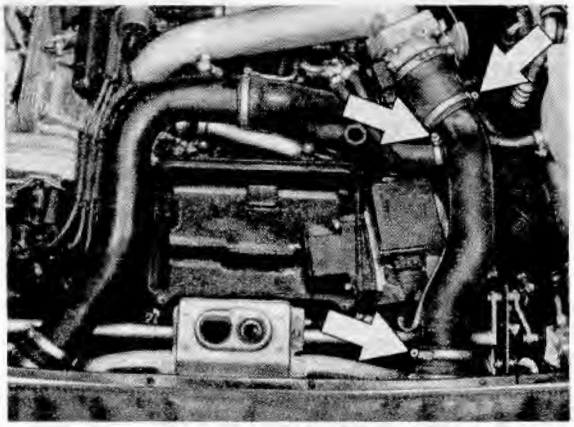
Alternator, removing and installing

1. Disconnect the battery.

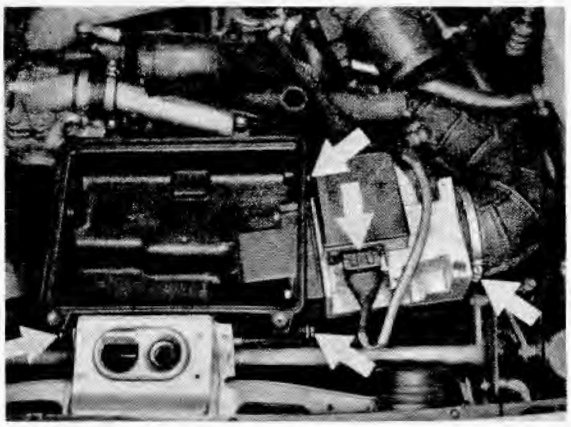
2. Disconnect top part of the air filter and remove with air induction funnel and filter insert.

3. Remove the left-hand charge-air guide tube.



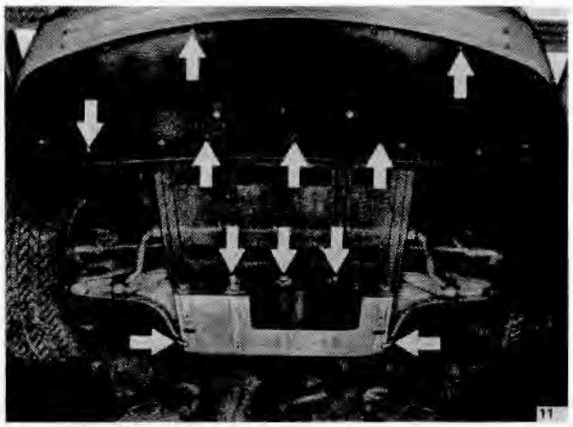
85/15B

4. Remove the lower part of the air filter with air-flow sensor.



85/13

5. Remove the lower part of the front spoiler and sump guard.

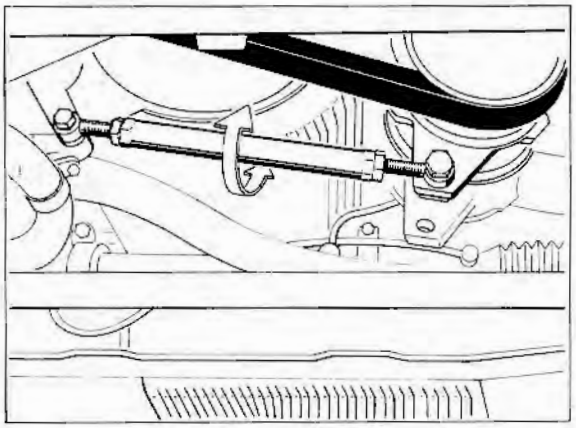


85/11

6. Open the coolant drain plug and drain off coolant.

7. Pull off the ventilation hose for the alternator.

8. Release the tension on the poly-rib belt and remove.



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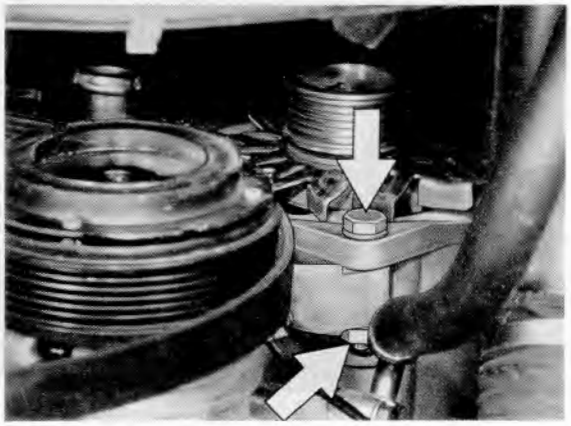
9. Undo lower fastening screw.



88/12

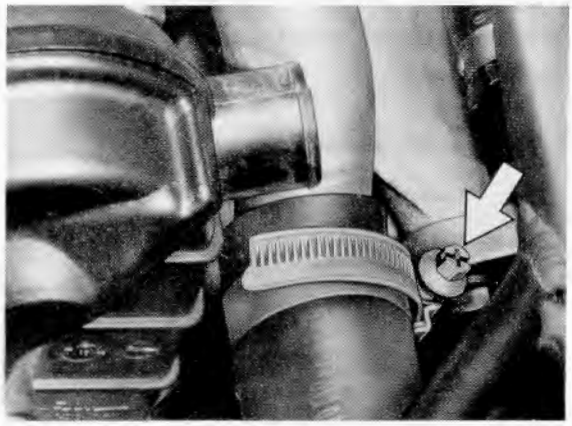
10. Disconnect the radiator hoses from the coolant pipe (cross-strut) and remove cross-strut.

11. Detach the inlet air box between air-flow sensor and turbo charger (compressor housing) and put on one side.

Note

Seal the compressor housing with a suitable plug.

12. Undo hose clip.



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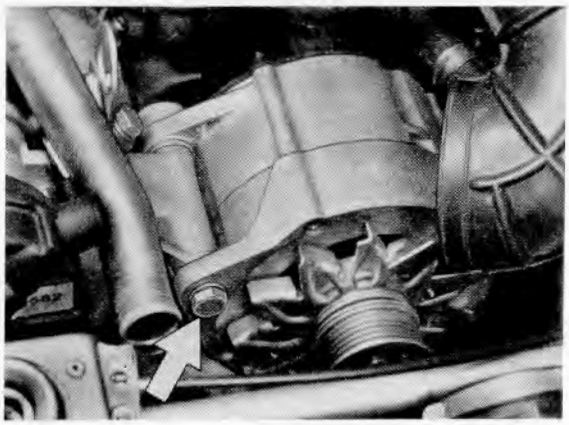
13. Undo the upper fastening screw.



88/13

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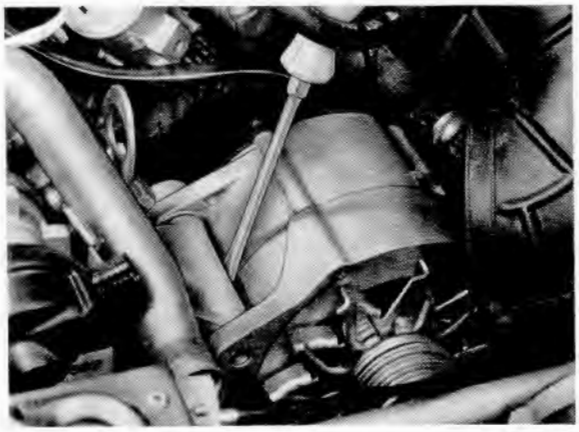
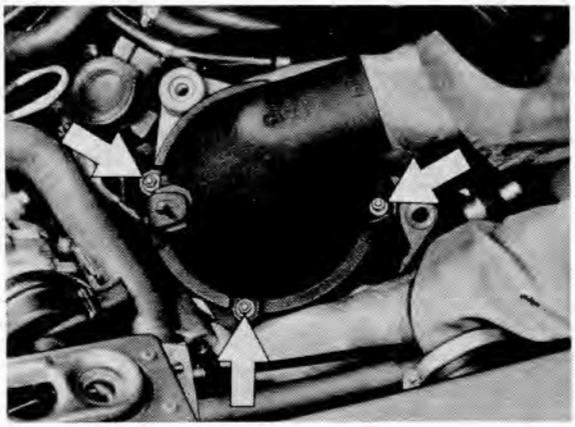
14. Using a screwdriver, press the alternator out of the console.



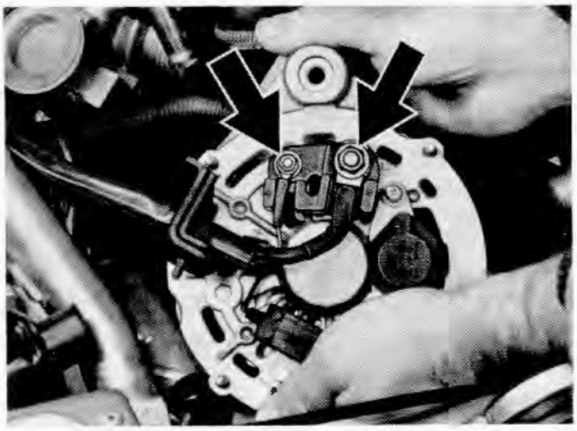
88/14

15. Put the alternator on one side and remove the air box.



88/15

16. Undo connectors.



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Installation

- Poly-rib belt tension adjustment, see Page 13 - 2.

- Fill with coolant and bleed, see Workshop manual 944, Page 19 - 2.

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EQUIPMENT SURVEY

I g n i t i o n C o i l

Type / Model	Version	Remarks
944 turbo	944 602 115 00 Bosch No. 0 221 118 322	Without ballast resistors

D i s t r i b u t o r (Cap)

Type / Model	Version	Remarks
944 turbo	944 602 251 00 Bosch No. 1 235 522 325	Only high voltage distribution

S p a r k P l u g s

Type / Model	Version	Remarks
944 turbo	999 170 158 90 Bosch WR 7 DC Champion RN-9YC	Electrode gap: 0.7 + 0.1 mm

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DME - Control Unit

Type / Model	Version	Remarks
944 turbo	951 618 121 02 Bosch No. 0 261 200 075 951 618 121 08	installed as from 11.8.87

Knock/Charging Pressure Control Unit

Type / Model	Version	Remarks
944 turbo	951 618 113 02 Bosch No. 0 261 201 013	

Knock Sensor

Type / Model	Version	Remarks
944 turbo until mod. 87	951 606 141 00 Bosch No. 0 261 231 001	Tightening torque: 9 Nm as from mod.88 Use specified mounting bolt (without washer).
944 turbo as from mod. 88	944 606 145 00 Bosch No. 0 261 231 006	

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Timing Valve

Type / Model	Version	Remarks
944 turbo	951.606.117.00	

Spark Plug Terminal

Type / Model	Version	Remarks
944 turbo	928.609.105.03 Beru No. 0.300.322.101	Without auxiliary spark gap

Revolution Sensor

Type / Model	Version	Remarks
944 turbo	944.606.115.00	

Reference Mark Sensor

Type / Model	Version	Remarks
944 turbo	944.606.115.00	

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ACCIDENT HAZARDS WITH ELECTRONIC IGNITION SYSTEMS

The increased requirements placed by modern engines on ignition systems and the desire for freedom from maintenance led some time ago to the introduction of electronic ignition systems as standard equipment. As a rule, the ignition power of electronic systems is higher than that of conventional systems, and further increases in power are in store. Electronic ignition systems hereby have reached a level of power high enough to be fatal if live parts or terminals are touched (both primary and secondary sides).

In this connection we refer the reader to VDE regulations, in particular VDE 0104/7.67, or the applicable regulations in each country, concerning working with and testing ignition systems.

Always switch off the ignition (disconnect ignition or power supply) before working on ignition systems. This includes work such as:

- Connecting engine test equipment (stroboscope lamps, dwell angle/rpm testers, ignition oscilloscopes, etc.).

- Replacing ignition system components (spark plugs, ignition coil, distributor, ignition leads, etc.).

If it is necessary to turn on the ignition for ignition tests or engine adjustments, there will be dangerous voltage throughout the entire system.

Consequently, accident hazard exists not only on the various equipment parts of the ignition system (for example, distributor, ignition coil, control unit,
ignition tackle), but also on wire harnesses (e.g. tachometer connection, diagnosis plug), plug connections, and test equipment.

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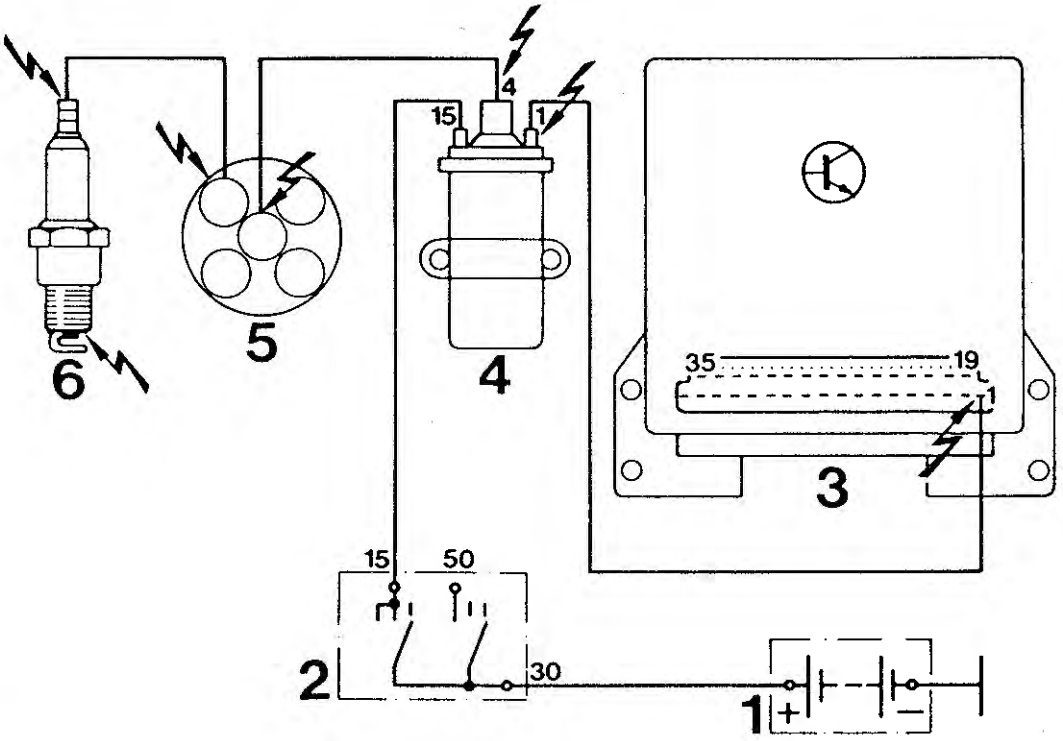

1 = Battery
2 = Ignition lock
3 = DME Control unit
4 = Ignition coil
5 = Distributor
6 = Spark plug

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IMPORTANT INFORMATION

In order to prevent damage to the DME and knock/charging pressure system, the following safety rules should be observed:

1. Do not start engine without battery being firmly connected.

2. Incorrect polarity in supply voltage, for instance as a result of reversed battery connection, can cause the destruction of the control units.

3. Do not disconnect battery while engine is running.

4. Do not use a quick charger for starting the engine. Starting assistance should only be given with a second 12 V battery.

5. Before quick charging, disconnect battery from vehicle's electrical system.

6. Make sure ignition is switched off or battery disconnected before carrying out resistance measurements.

7. When testing compression, pull out control unit plug or firmly connect ignition coil terminal 4 to a ground with auxiliary cable, to preclude hazardous high voltage and damage to insulation on ignition coil, high voltage distributor, and ignition tackle. The auxiliary cable must be shielded with a shielding sleeve of at least 2 kOhm.

8. The specified ignition coil must not be replaced by another ignition coil.

9. Suppressor condensors must not be connected to terminals 1 and 15 on the ignition coil.

10. Terminal 1 of the ignition coil must not be connected to ground for anti-theft purposes ("ignition on" would destroy ignition coil).

11. A battery + current must not be connected to ignition coil terminal 1. The same applies to test lamps.

12. The ignition lead from ignition coil terminal 4 to high-voltage distributor terminal 4 must not be removed during operation.

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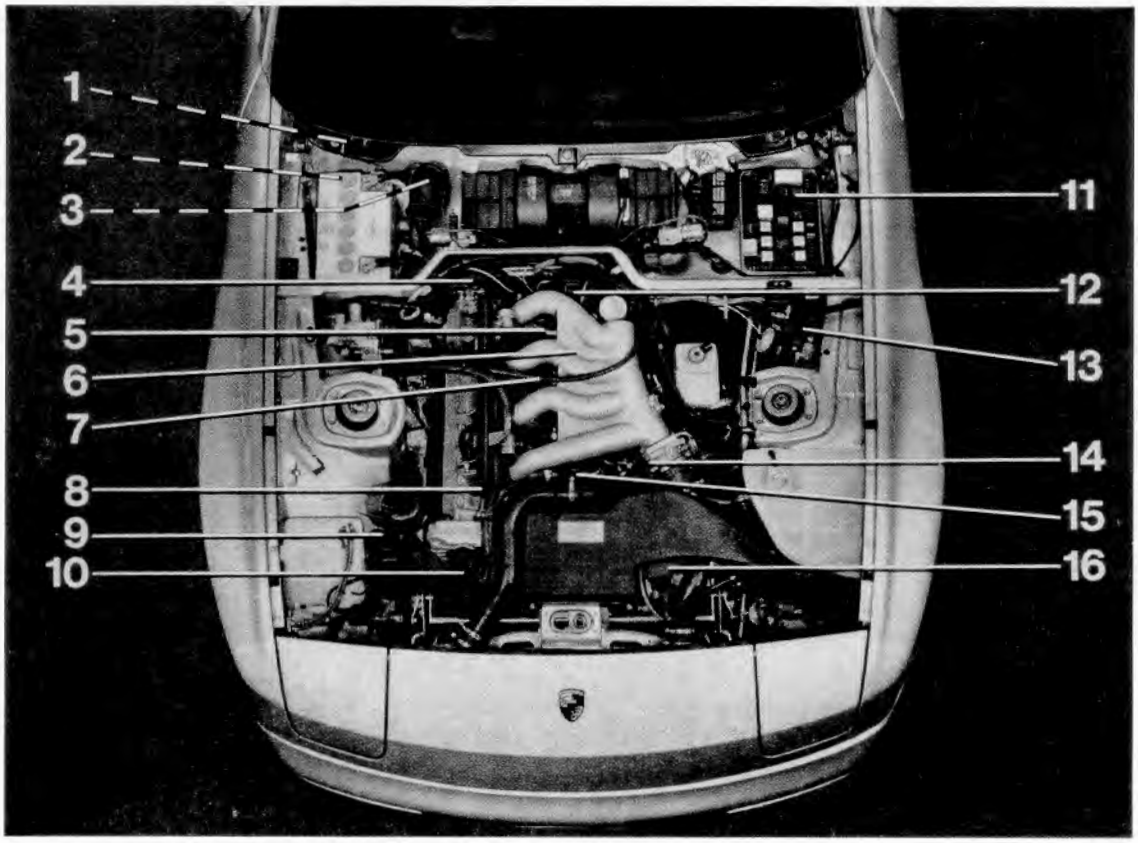
COMPONENT INSTALLATION POSITIONS



1 - Altitude correction box (in footwell of passenger compartment, passenger side)

2 - Knock/charge pressure control unit (in footwell of passenger compartment, passenger side)

3 - DME control unit (in footwell of passenger compartment, passenger side)

4 - OT sensor connection

5 - Timing valve

6 - Idle actuator (under intake air distributor)

7 - Knock sensor

8 - Fuel pressure test connection

9 - Ignition coil

10 - Distributor cap

11 - DME relay

12 - Plug connection for reference sensor, rpm sensor, and oxygen sensor

13 - Test socket for knock/ charging pressure control

14 - Throttle switch/ potentiometer

15 - Temperature sensor NTC II

16 - Air flow sensor

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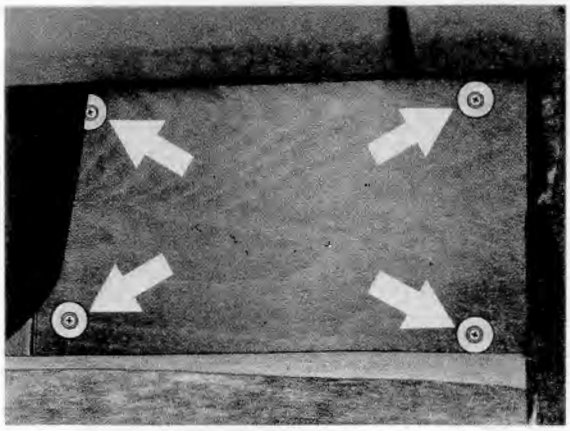
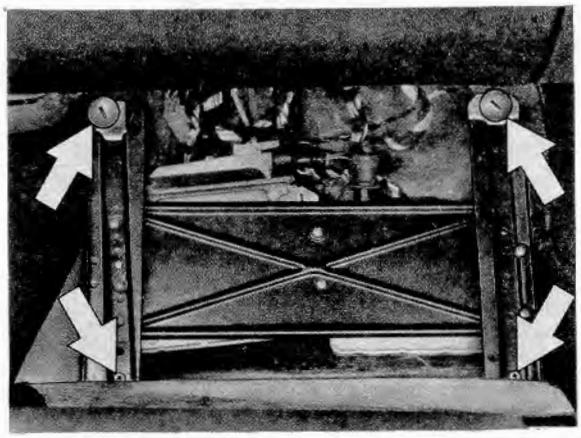
REMOVING AND INSTALLING DME AND KNOCK/CHARGING PRESSURE CONTROL UNITS

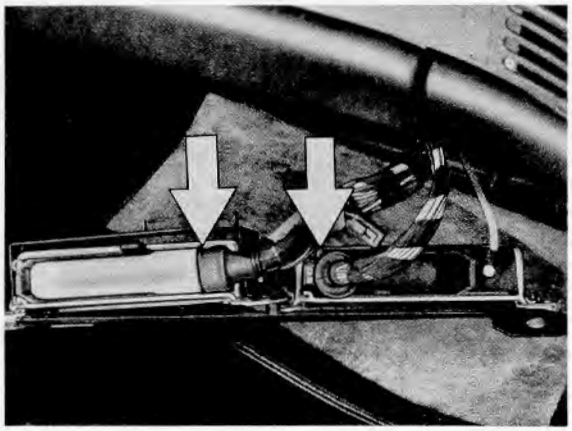
1. Fold back mat in passenger side footwell. Unscrew and remove footwell cover.



2. Unscrew control unit bracket and fold forward.



3. Pull out control unit plug and unscrew control unit.



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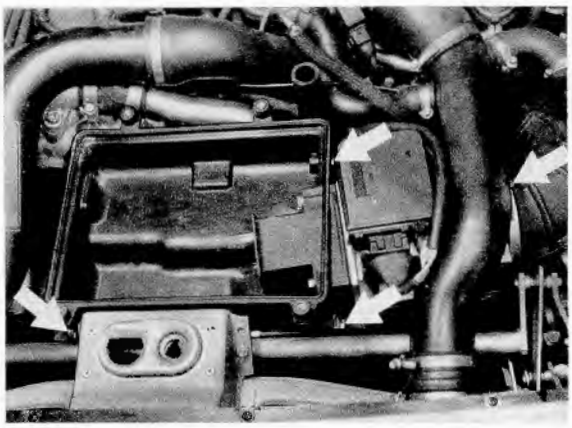
REMOVING AND INSTALLING AIR FLOW SENSOR

1. Unscrew air filter upper section and pull out along with filter cartridge.

2. Loosen and remove intake air cowl on air flow sensor.
   Unscrew air filter housing lower section and remove plug connection on air flow sensor.

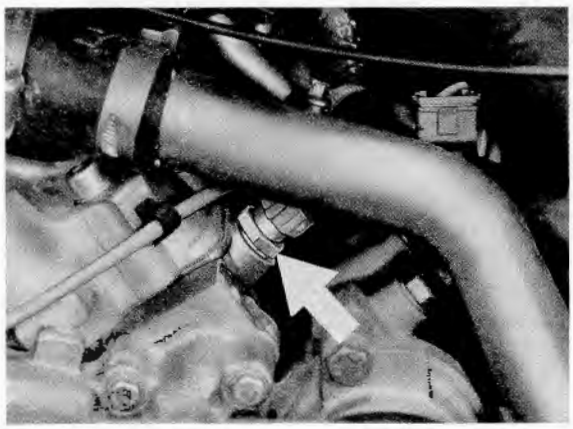


3. Take out air filter housing lower section and unscrew air flow sensor.

REMOVING AND INSTALLING TEMPERATURE SENSOR (NTC II)

1. Remove air filter housing with air flow sensor.

2. Detach plug connection on temperature sensor and unscrew temperature sensor.



Tightening torque 15 Nm (11 ftlb).

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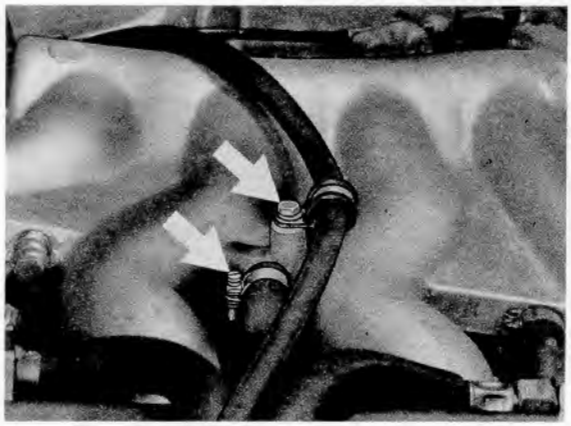
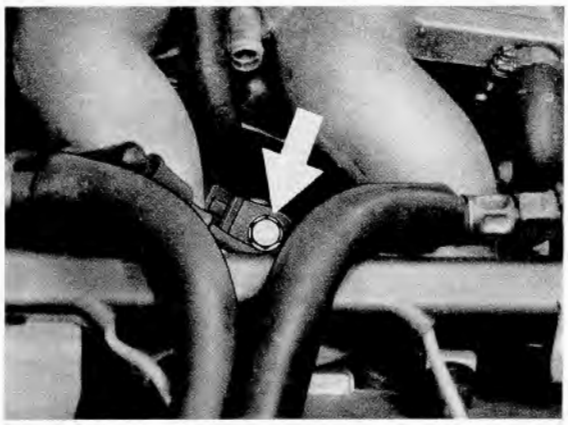
REMOVING AND INSTALLING KNOCK SENSOR

1. Loosen cruise control cable and hose on air intake distributor and set to one side. Detach spark plug connector for cylinder 3.



2. Unscrew knock sensor and pull upwards. Disconnect plug connector.



N o t e

Use new original bolt (micro-encapsulated) without washer.

Tightening torque: 9 Nm, as from mod. 88 20 Nm.

Use care when working on knock sensor. For instance, the knock sensor should not be allowed to fall onto a hard floor from a great height, as otherwise the piezoelectric crystal could be damaged.

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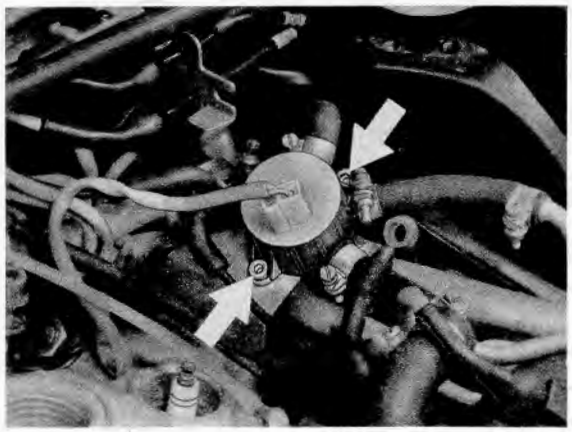
REMOVING AND INSTALLING TIMING VALVE

1. Remove intake air distributor.

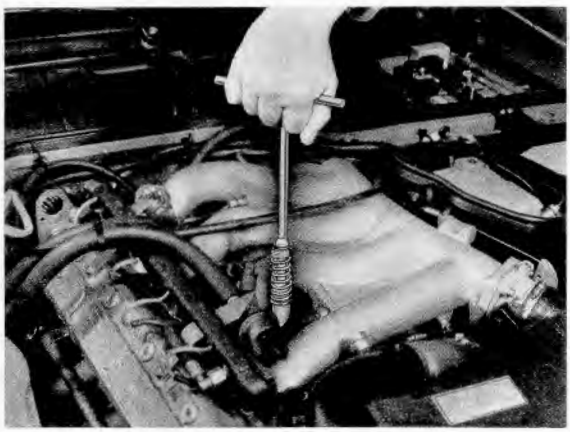
2. Disconnect plug connector on timing valve. Loosen hose connections and unscrew fastening bolt on timing valve.



REPLACING SPARK PLUGS

1. Pull off spark plug connector.

2. Unscrew spark plug with a standard wrench. A spark plug wrench is part of the tool kit supplied with the vehicle.



3. Lightly coat spark plug threads with graphite grease or a similar product, e.g. Molykote White HTP paste.

Tightening torque: 25 - 30 Nm (18 - 22 ftlb).

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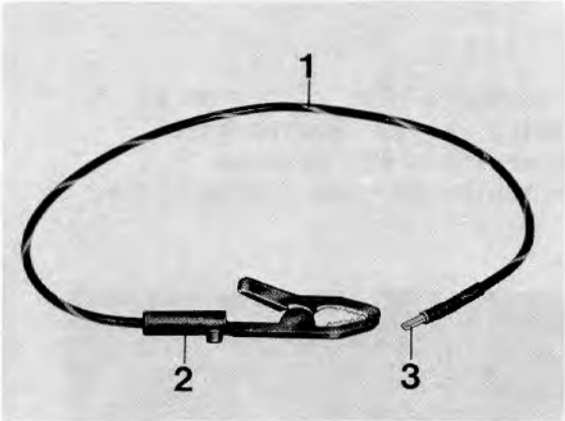
TROUBLESHOOTING DME AND KNOCK/ CHARGING PRESSURE CONTROL

TEST EQUIPMENT AND TOOLS

- Engine tester with oscilloscope, e.g. 1010/1090, Bosch MOT 300/400
- Multiple tester (internal resistance at least 20 kOhm/V)
- Pressure pump (VAG 1274)
- Vacuum hand pump (9160)
- Adapter lead (Bosch "L-Jetronic" No. 1684 463 093)
- Pressure gage (VAG 1318)
- Two auxiliary electric leads (locally made) for tests on multiple pin plug of control units and on plug connections with the same contacts.

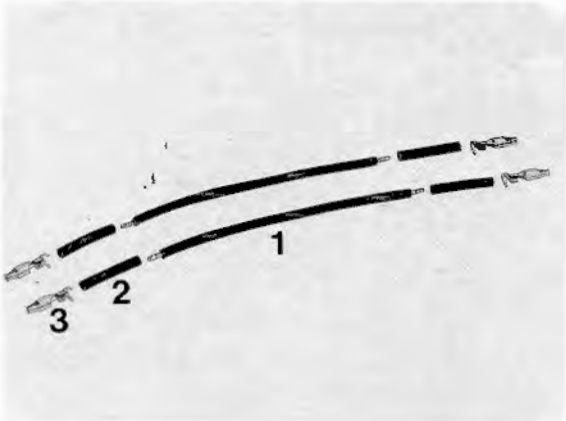


1 - Highly flexible line

2 - Alligator clips (as commonly used)

3 - Flat male plug 2.8 (N 17.457.2)

- 2 Adapters - auxiliary leads (locally made)



1 - Highly flexible line, 10-20 cm long

2 - Insulating tubing

3 - Flat contact N 17.182.2

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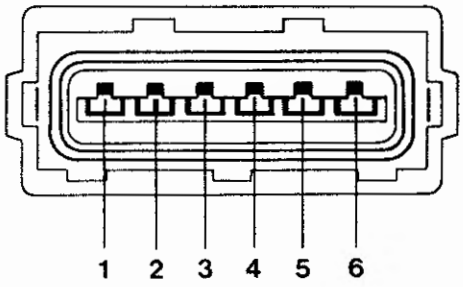
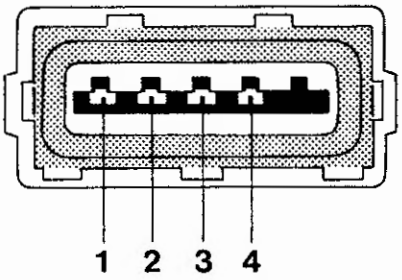
PLUG CONNECTIONS

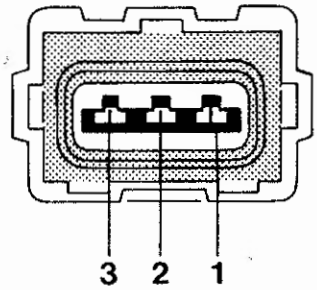
Throttle switch (view of disconnected plug connector)



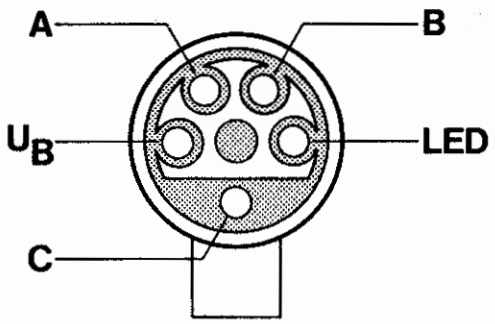
Air flow sensor (view of disconnected plug connector)



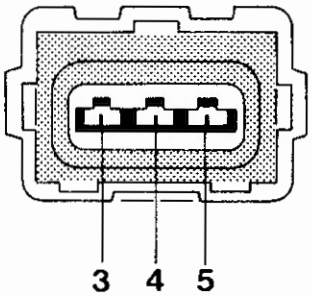
Reference mark/rpm sensors (view of disconnected plug connector)



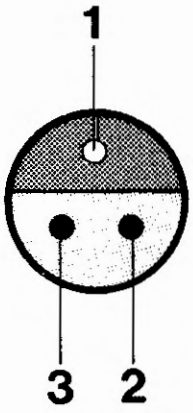
Test socket



Idle actuator (view of disconnected plug connector).



Oxygen sensor



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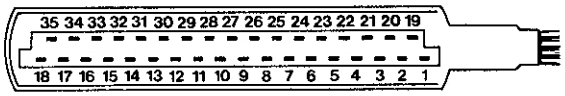
DME control unit



1 - Ignition impulse at ignition coil terminal 1

2 - Throttle switch idle contact terminal 6

3 - Full-load signal from K/CP control

4 - Starting signal (ignition lock - 50)

5 - Ground and shielding, reference mark sensor

6 - Air flow sensor - 4 (NTC I)

7 - Air flow sensor - 2 (air flap potentiometer)

8 - RPM sensor

9 - Air flow sensor - 3

10 - Map change (on for Switz., Swed., Austria, New Zeal., Cal., Japan)

11 - 4-pole separation point terminal 1 (consumption indicator)

12 - Test socket (A) (USA lead-free engines)

13 - NTC II

14 - ti-signals, injection valves 3 + 4

15 - ti-signals, injection valves 1 + 2

16 - Ground

17 - Ground

18 - Voltage supply relay G5 - 87

19 - Ground

20 - Ground routing relay G5-85b

21 - 4-pole separation point terminal 2 tachometer - 1 K/CP - terminal 9

22 - Air flow sensor - 1 (NTC I)

23 - Shielding (rpm sensor/oxygen sensor)

24 - Oxygen sensor (USA/lead-free engines)

25 - Reference mark sensor

26 - Reference mark sensor

27 - RPM sensor

28 - Ground

29 - A/C compressor (+)

30 - Altitude compensation box (USA/lead-free engines) map re-switching plug

31 - Trigger signal for K/CP control

32 - Input TD* final stage of K/CP von control

33 - Idle actuator - 3

34 - Idle actuator - 5

35 - Supply voltage relay G5 - 87

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K/CP control unit

2 - Timing valve (output)

3 - LED

5 - Vacuum pipe pressure signal (pressure indicator output)

6 - U (Battery)

9 - Ignition signal (input)

10 - Ignition signal shield

11 - Knock sensor

12 - Ground, knock sensor shield

13 - Knock sensor

14 - Vehicle ground

16 - Ignition signal (output)

18 - Test socket / full-load signal (output)

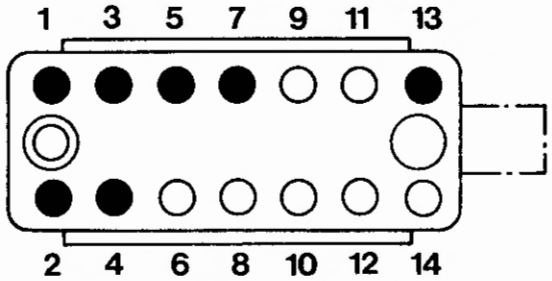
20 - Vehicle ground (electronic ground connection)

21 - Angle sensor - supply
22 - Angle sensor - pick-up
23 - Angle sensor ground, angle sensor line shielding

Throttle Position

24 - tr-signal / input

Plug connector in engine compartment (14 pole)



1 - Ignition coil terminal 1
2 - DME relay terminal 87
3 - DME relay terminal 87
4 - DME relay terminal 87 a
5 - DME relay terminal 85 b
7 - Ignition lock terminal 50
13 - A/C compressor +

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TROUBLESHOOTING CHART

		1. Engine will not or is hard to start	2. Poor idling	3. Poor pick-up	4. Misfiring	5. Excessive fuel consumption	6. Insufficient power
Oxygen sensor function	16		x			x	
Ignition signal	15						x
Altitude compensation box	14		x				
Vacuum-pressure system sealing	13	x	x	x	x	x	x
Knock/charging pressure control (Blink code)	12	x	x	x	x	x	x
Injection valves	11	x	x	x	x	x	x
Temperature sensor (NTC II)	10	x	x		x	x	x
Throttle switch	9	x	x	x	x	x	x
Idle actuator	8		x	x	x	x	
Fuel pressure	7	x	x	x	x	x	x
Air flow sensor	6	x	x	x	x	x	x
Ignition system	5	x	x	x	x	x	x
Reference mark sensor	4			x	x	x	x
RPM sensor	3			x	x	x	x
Supply voltage control unit / fuel pump	2			x			x
Ground and plug connections	1	x		x	x	x	x

TEST CONDITIONS:

Engine in good mechanical condition
Battery charged

"x" = check with suitable test equipment

see Test Chart

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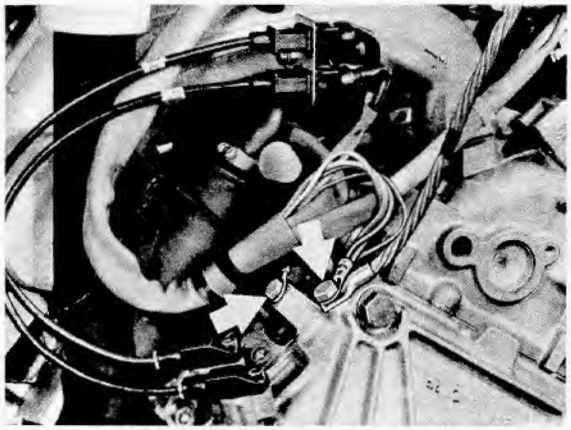
N o t e

The test points should be run through in the sequence given, especially when the cause of trouble is poor running or no running of the engine.

TEST POINT 1

Ground and Plug Connections

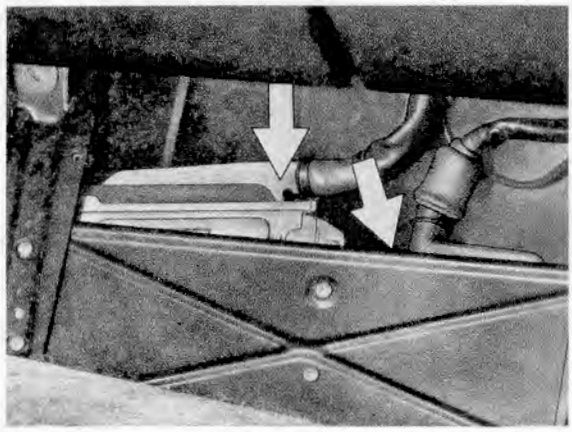
Check ground connections on engine flange and clutch housing, and ground cable from body to engine, for firm seating, good contact, and cleanliness.



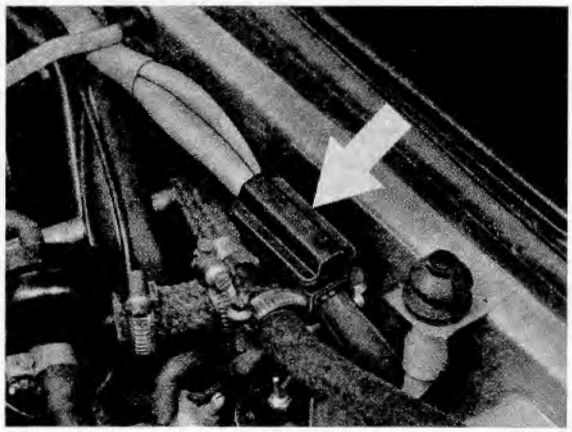
N o t e

Never start engine with disconnected engine-body ground cable! This would immediately destroy the control unit.

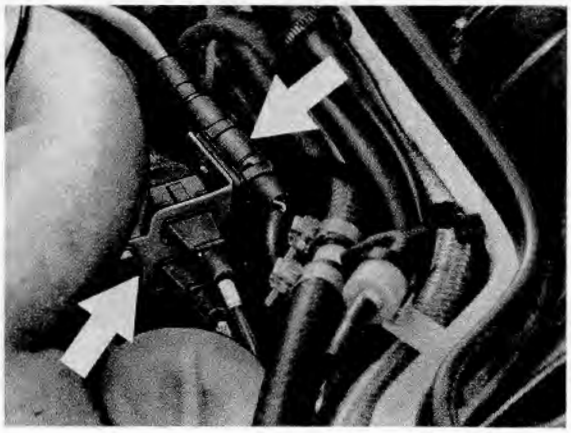
Check plug connection for DME and K/CP control unit behind passenger side footwell cover.



Check 14-pole plug connection in engine compartment over power brake unit.



Check plug connection for reference and rpm sensors and oxygen sensor.



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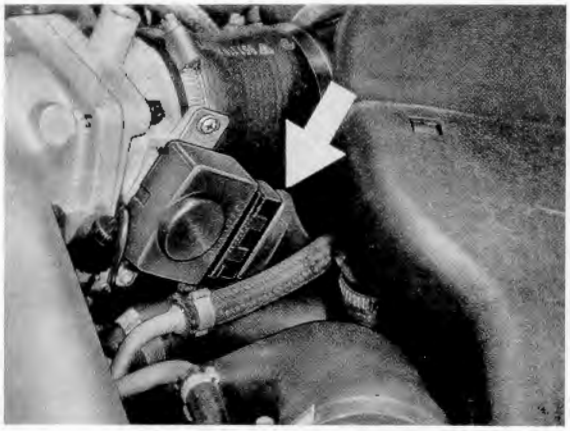
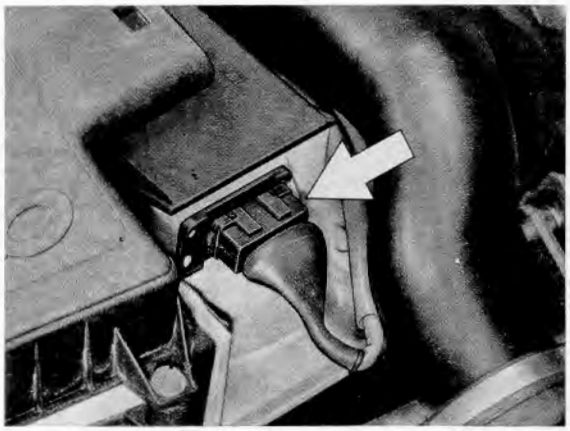
Plug connection for throttle switch / potentiometer

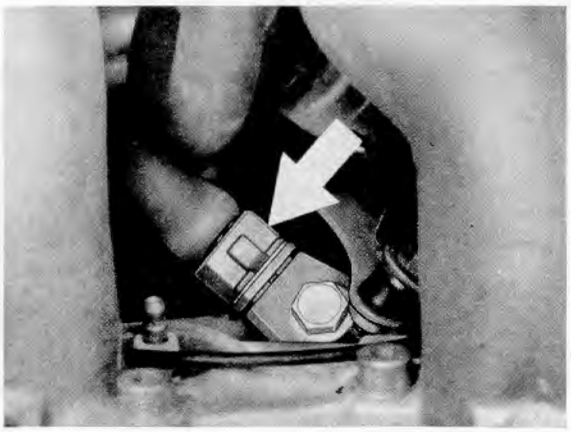


Plug connection for timing valve

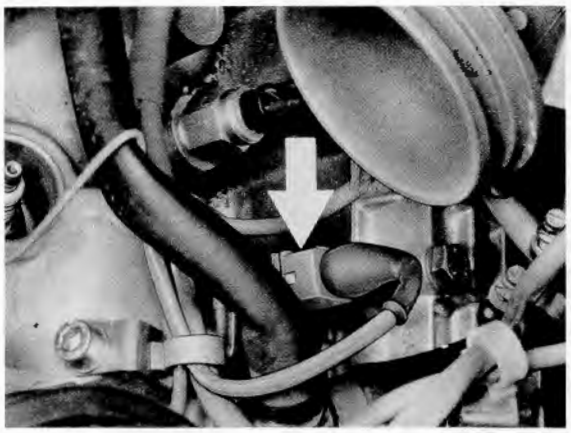
Plug connection for air flow sensor



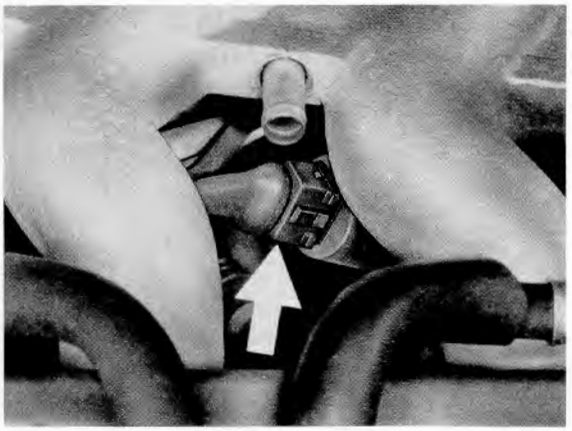
Knock sensor (between cyls. 2 and 3)



NTC II in engine block (at cyl. 1)



Plug connection for idle actuator



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TEST POINT 2

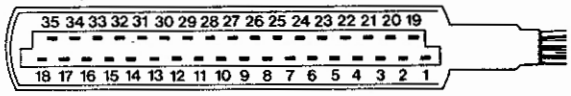
1. Voltage supply for DME and K/CP control unit.

N o t e

Ignition must be switched off before disengaging control unit plugs!

1.1. Pull out plug connections on both control units.

1.2. Switch on ignition and measure voltage at DME plug between terminals 35 and 5 and again between terminals 18 and 5.

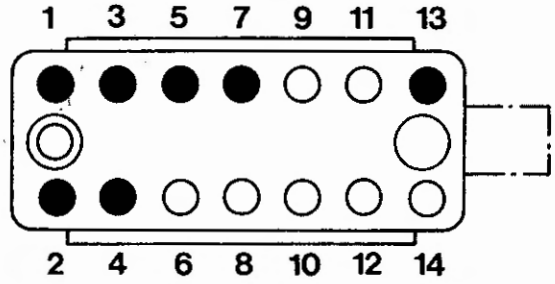


Indication = Battery voltage

1.3. Measure voltage on K/CP plug between terminals 6 and 14.

Indication = Battery voltage

If there is no indication, disconnect 14-pole plug connection in engine compartment and measure voltage between terminal 3 (pin bushing side) and ground.



Indication = Battery voltage

If there is no indication, check DME relay in central electric system.

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2. Voltage supply, fuel pump

2.1 Start engine. During the starting procedure the fuel pump must engage.
The action of the fuel pump can be heard and felt at the fuel tank next to the pump; if necessary connect pressure gage for fuel pressure.

2.2 If the pump does not operate, remove DME relay in central electric system and bridge terminals 30 and 87 b on the relay socket.

The fuel pump should run. If not, check fuel pump and leads to fuel pump.

TEST POINT 3

RPM Sensor

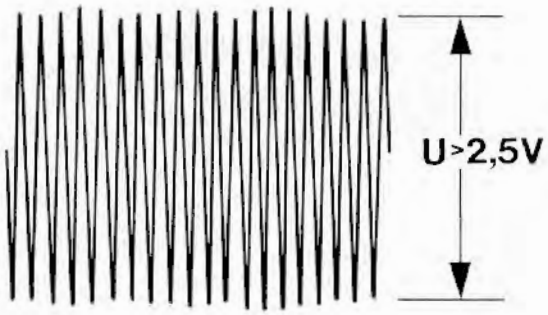
N o t e

The function of the rpm and reference mark sensors can only be tested with an oscilloscope.

1. Set oscilloscope per manufacturer's instructions.

2. Connect DME control unit plug terminals 8 and 27 with the tester.

3. Start engine. A sine wave with an amplitude greater than 2.5 V should become visible on the screen.



If the voltage signal is too small, the sensor interval (0.8 ± 0.3 mm) must be checked. See Workshop Manual 944, Page 28 - 14.

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If no sensor signal is visible, despite proper connection and setting of the oscilloscope, check rpm sensor for power flow and insulation.

4. Detach plug connection in engine compartment and carry out test with oscilloscope once again.

Coil resistance terminals 1 and 2
Control value: 0.6 to 1.6 Kohms

Insulation resistance terminals 2 and 3
Control value: greater than 1 Mohms

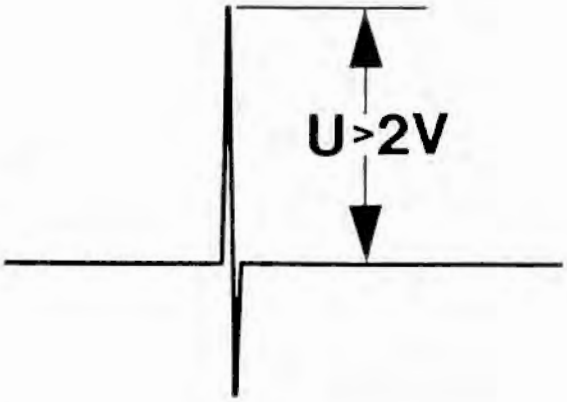
If necessary, replace sensor.

TEST POINT 4

Reference mark sensor

1. Carry out testing as for rpm sensor. Connection to control unit plug: term. 25 positive connection
   term. 26 negative connection

2. Start engine. A single sine wave should become visible on the screen. It is important that the wave starts with a positive slope and shows more than 2 V on the screen scale at a starter speed of at least 200 rpm.



If the voltage signal is too small, the sensor interval to the reference mark (0.8 ± 0.3 mm) must be checked. See Workshop Manual 944, Page 28 - 14.

If there is no sensor signal, proceed as in Test Point 3 (rpm sensor). The same control values apply.

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TEST POINT 5

I g n i t i o n S y s t e m

1. Set secondary image on oscilloscope. Connect testing cables per manufacturer's instructions.

N o t e

If a defect is displayed for all cylinders, it will be in the primary or secondary circuit from the ignition coil to the distributor motor. If a defect is displayed for only one cylinder, it will lie after the distributor rotor.

2. Check spark plug connectors and leads for damage and burned spots.
   Shielding resistance: 1 Kohm

3. Check distributor cap and rotor for damage, burnt spots, and dirt.
   Shielded resistance: 1 Kohm.

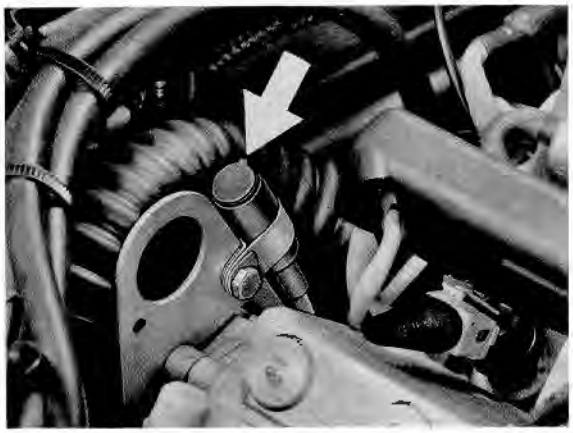
4. Check ignition coil.
   Primary resistance terminals 1 - 15 = 0.4 - 0.6 ohm
   Secondary resistance terminals 1 - 4 = 5 - 7.2 Kohm

5. Ignition timing check
   An adjustment of ignition timing is not necessary. Engine should be at operating temperature.

Ignition timing at 840 ± 40 rpm = 5° ± 3° BTDC

Control value at 2500 rpm = 35° ± 3° BTDC

The TDC sensor system can be used for testing (with a suitable tester).



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TEST POINT 6

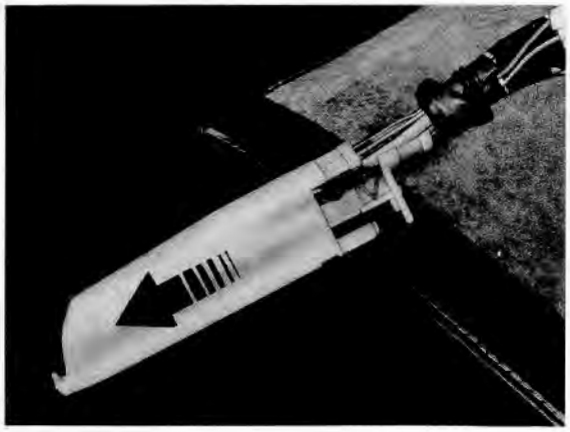
A i r F l o w S e n s o r

N o t e

The sealing of the plug connector on the air flow sensor has been improved. For this reason it is no longer possible to take a measurement while the plug is connected. Testing must therefore be carried out on the control unit plug in an opened and connected condition.

1. Loosen and fold down control unit bracket in passenger side footwell. Pull out and remove plug connector on DME control unit.

2. Remove upper section of plug connector, cutting cable band and loosening fastening screw. Pull plug upper section away lengthwise.



3. Check supply voltage of air flow sensor. Connect a voltmeter to terminals 9 and 5 (ground) on the reverse of the control unit with suitable measuring tips.

Control value: 5 $\pm$ 0.5 V

4. Dismount air filter and connect voltmeter with terminals 7 and 5 (ground) on control unit plug. Check voltage drop on air flow sensor.

Control value approx. 250 - 260 mV

5. Push air flap to full load through air intake opening.

Control value full load approx. 4.6 V

6. Check temperature sensor (NTC I intake air temperature). Connect terminals 22 and 6 on the pulled control unit plug with an ohmmeter (on the pulled plug of air flow sensor terminals 1 and 4).

Control value at 15 to 30°C (59 to 86°F): 1.4 - 3.6 Kohms
At 40°C (104°F): 1 - 1.3 Kohms

N o t e

Break on temperature sensor causes richer mixture.
Short circuit on temperature sensor causes leaner mixture.

7. Carefully assemble upper section of plug connector and re-connect.

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TEST POINT 7

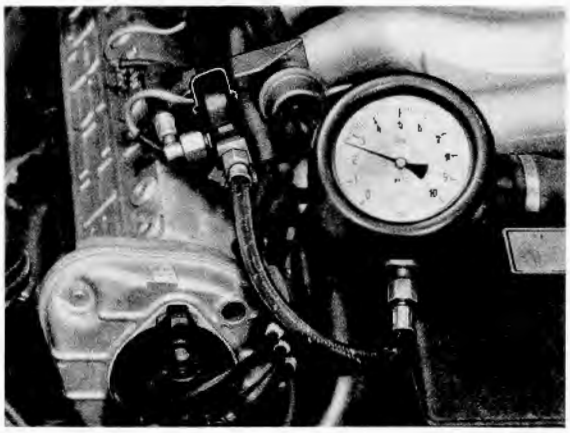
FUEL PRESSURE

1. Disengage covering cap and fold upward, and unscrew cap nut on test connection of fuel distribution line.

N o t e

When removing cap nut be careful that sealing ball does not fall out.

2. Connect pressure gage to test connection with hose from pressure tester P 378 or VW 1318.



3. Remove DME relay from central electric system and bridge terminals 30 and 87 b with auxiliary cable. Fuel pump should now operate.

4. Test values:

   Engine off 2.3 to 2.7 bar (DME relay bridged)

   Engine idling approx. 2 bar

Tightening torque of cap nut 22 Nm (16 ftlb).

5. Slowly pinch off return line with hose clamp. If pressure remains under 4 bar, check fuel filter, if necessary replace fuel pump.

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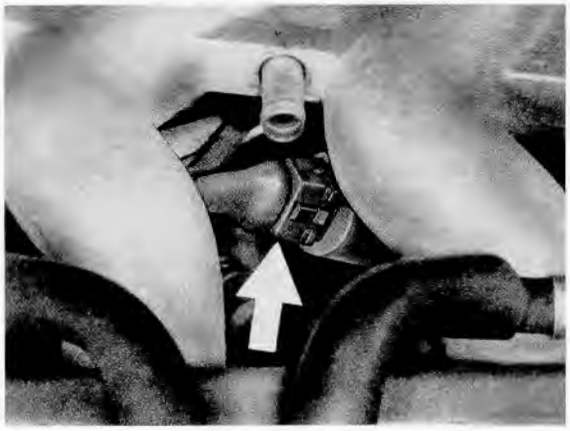
TEST POINT 8

Idle Actuator

1. Remove plug connection on idle actuator.



Switch on ignition and connect voltmeter to the middle contact of the plug connector and to ground.

Indication: Battery voltage

2. Re-connect plug connector on idle actuator and connect revolution speed tester. Idle engine (840 + 40 rpm).

3. During stable idling, screw in throttle air circulation bolt. After a short deviation, the idle speed should re-adjust itself to approx. 840 rpm.

4. In order to check the activation of the idle actuator by the control unit, connect a new or correctly-functioning idle actuator to the plug connector, and switch on ignition. The idle actuator should vibrate due to frequency activation. Start engine and increase idle speed by screwing out air circulation screw. The idle actuator should turn in the direction of closing. After lowering idle speed, the idle actuator should turn in the direction of opening.

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TEST POINT 9

1. Throttle Switch (Idle Contact)

1.1 On cold DME control unit plug connect terminal 2 and ground with ohmmeter.
Indication:
Throttle closed = 0 - 10 ohm
Throttle open = ∞ ohm
(after approx. 1° of opening)

1.2 If there is no indication, carry out testing directly on throttle switch, terminals 4 and 6.

1.3 If the switch is okay, check power flow to DME control unit plug terminal 2.

2. Throttle Potentiometer

2.1 Remove plug connector on throttle switch. Connect voltmeter with terminals 1 and 2 on plug and switch on ignition.

Indication approx. 5 V

2.2 Switch off ignition and pull plug connector on K/CP control unit. Connect ohmmeter (preferably pointer-type instrument) with terminals 22 and 23.

Move throttle slowly to full load position. The instrument must swing continuously to the final value without breaks.

Indication:

Idle position	320 - 670 ohm
Full load position	2.7 - 4.7 Kohm

3. Checking Throttle Valve Cut-off

3.1 Pull off plug on throttle switch and bridge terminals 4 and 6 with auxiliary wire.

3.2 Start engine and increase speed to approx. 1600 rpm. The motor should begin to surge.

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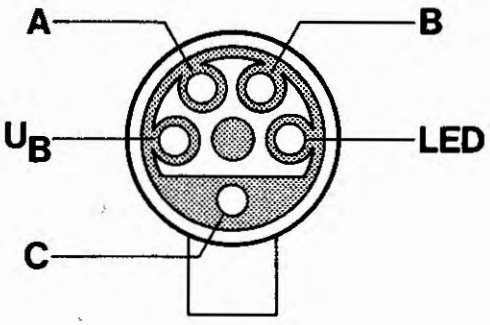
4. Checking Full Load Impulse

Note

Since the full load impulse is generated by the K/CP control unit at a throttle position of 65°, this test can only be carried out when the engine is running. In order to avoid overrevving the engine, remove 2 injection valve plugs.

4.1 Connect terminals B and C on testing socket with voltmeter.



Indication: approx. 5 V

4.2 Open throttle valve fully for a short period (do not overrev engine).

Indication: voltage goes back to 0 V.

4.3 If no indication follows, check connection between terminal B on test socket and terminal 18 on K/CP control unit plug.

4.4 If the connection is okay, replace K/CP control unit.

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TEST POINT 10

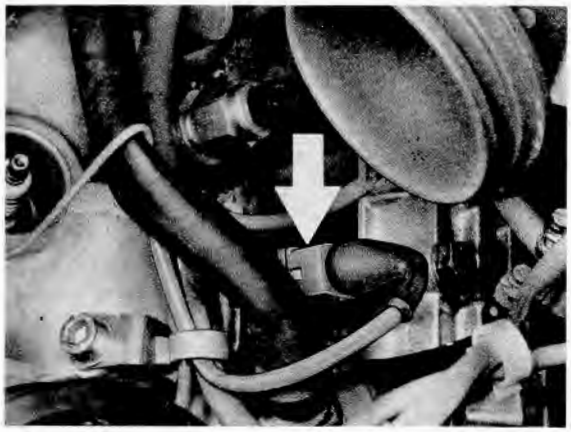
T e m p e r a t u r e S e n s o r (NTC II)

1. Pull out DME control unit plug and connect ohmmeter with terminal 13 and ground.

Sensor control values:

at 0°C/32°F	= 4.4 - 6.8	Kohm
15-30°C/59-86°F	= 1.4 - 3.6	Kohm
40°C/104°F	= 1 - 1.3	Kohm
80°C/176°F	= 250 - 390	ohm
100°C/212°F	= 160 - 210	ohm

If the control values are not reached, carry out measurement directly on temperature sensor.



N o t e

Break on temperature sensor causes richer mixture.

Short circuit on temperature sensor causes leaner mixture.

2. Allow warmed-up engine to idle. Pull off plug connector on temperature sensor. The engine should cut off due to over-enrichment. Re-insert plug.

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TEST POINT 11

Injection Valves

1. If engine can be run, disconnect plugs on injectors separately. If injectors are intact, engine speed will drop each time.

2. If engine cannot be run, measure voltage on plug connections of injectors.

Indication: Battery voltage

3. Measure coil resistance on flat male plugs of injection valves.

Control value: 3,5–5,5 ohms

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TEST POINT 12

KNOCK/CHARGING PRESSURE CONTROL

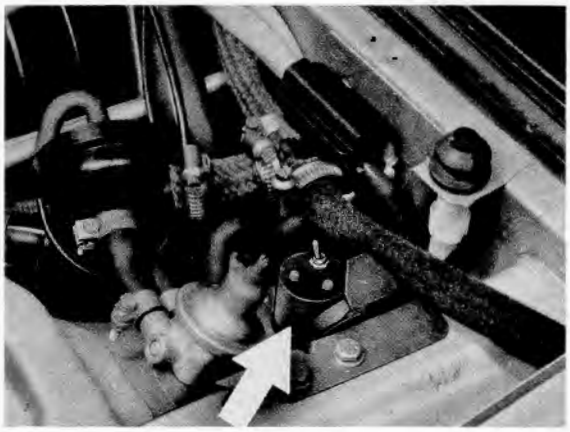
The knock/charging pressure system includes a self-monitoring system, which can output a recognized defect with the help of a test adapter.

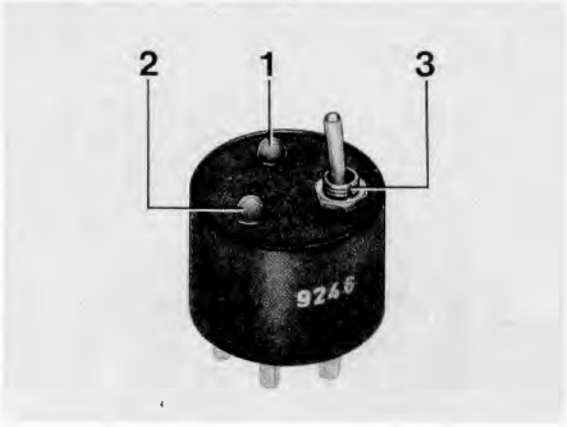
The output is in the form of a blink code, similar to morse code.

If a defect has been found, the engine will operate on a safety system (basic charging pressure up to approx. 0.3 bar overpressure and 6° later ignition), which means significantly reduced performance.

N o t e

A defect stored in memory is erased when ignition is switched off. For this reason, the defect must be read out directly after a test drive without switching off ignition.





1 = LED red (blink code)

2 = LED green (lights up when terminals B and C are bridged)

3 = Switch for bridging terminals B and C

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Blink code	Problem	Possible Defect
1 - 2	Supplied voltage smaller 10.2 V	Battery, alternator, control unit, wiring

Testing

Voltage drop at plus and ground terminals; Battery discharged;
Alternator or control unit defective.

2 - 1	Knock sensor monitoring	Knock sensor supplies excessively large signal or K/CP control unit is defective.
2 - 2	Knock sensor monitoring	Knock sensor supplies excessively small or no signal, or K/CP control unit is defective.

Testing

1. Check plug connection on knock sensor for correct seating and inspect spring contacts.

2. Remove plug connector on K/CP control unit. Connect ohmmeter to terminals 11 and 13.

Control value: 270 - 330 Kohm

If 0 ohms or ∞ are indicated, check wiring connections (including ground contact). Exact inner resistance of the knock sensor does not rule out a defect in the sensor. If necessary, replace knock sensor.

3. Check fastening of knock sensor. Be sure to observe tightening torque, and use fastening bolt without washer.

Tightening torque: 9 Nm, as from mod. 88, 20 Nm

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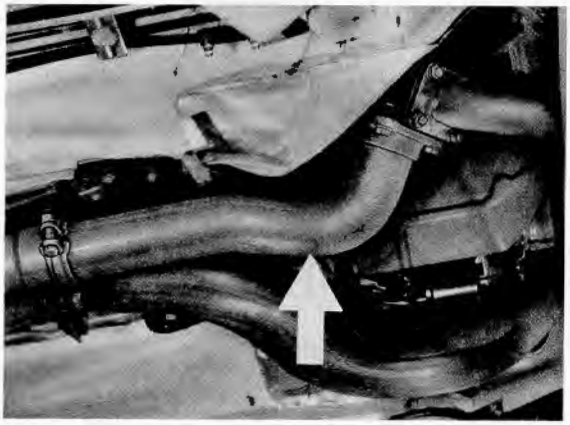
Blink code	Problem	Possible Defect
2 - 3	Knock control unit defective	Exchange knock control unit
3 - 1	Charging pressure too low or no charging pressure	Charging pressure regulator valve stuck in open position.

Testing

The exhaust system should be cold for testing the charging pressure control valve.

1. Lift vehicle, start engine, and let idle.

2. Check bypass pipe for warming.



If the bypass pipe heats up, the charging pressure control valve is defective, i.e. is stuck in the open position. Remove bypass pipe, and check and if necessary replace charging pressure control valve.

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Blink code	Problem	Possible Defect
3 - 1	Charging pressure too low: 0.3 bar (positive pressure) basic charging pressure available	Localising defect

N o t e

The "charging pressure too low" problem is only stored in memory when the difference in pressure from normal pressure is 0.45 bar; this problem can thus exist without setting off a blink code defect indication.

T e s t i n g

1. Pinch off actuating line to charging pressure control valve with hose clamp.

2. Test-drive vehicle and measure charging pressure with pressure gage P9103/2. If charging pressure is available and climbs above 0.7 bar (positive pressure) following systems can be considered to be in good order:

   - Charging pressure control valve
   - Exhaust turbocharger
   - Air intake system
   - Air circulation valve

3. The cause of the problem must then be located in the timing valve area.

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- Checking timing valve

The function of the timing valve and of actuation can be acoustically checked.

1. Start engine and give a quick spurt of gas at the throttle. When the air flap in the air flow sensor swings more than 60%, the actuation of the timing valve begins. A light clicking should be audible from the timing valve, or should be able to be felt with a metal rod.

2. If no function of the timing valve can be heard, measure voltage supply to valve. Remove plug connector at timing valve and connect red/green lead and ground on voltmeter.

Indication: Battery voltage

3. Apply battery voltage and ground to timing valve.

   The valve must audibly switch.

Timing valve inner resistance 18 - 45 ohms.

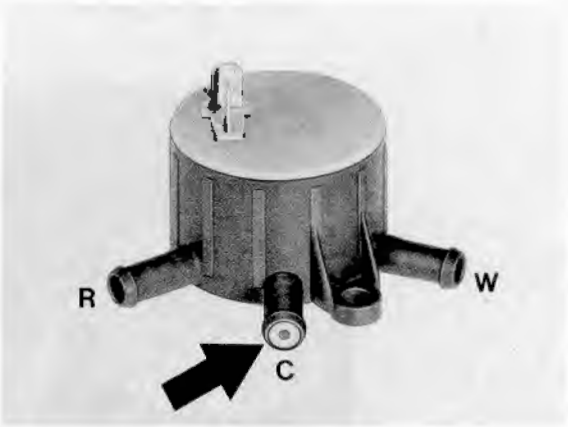
4. Check blue/red lead from timing valve to K/CP control unit terminal 2.

If all functions are okay, replace K/CP control unit.

N o t e

Actuation of the timing valve does not occur with simultaneous presence of a defect code on test adapter.

5. Check exhaust line from solenoid valve connection "R" to intake air cowl for ease of flow.



C - Connection to pressure pipe

R - Return to intake side

W - Control lead to charging pressure control valve

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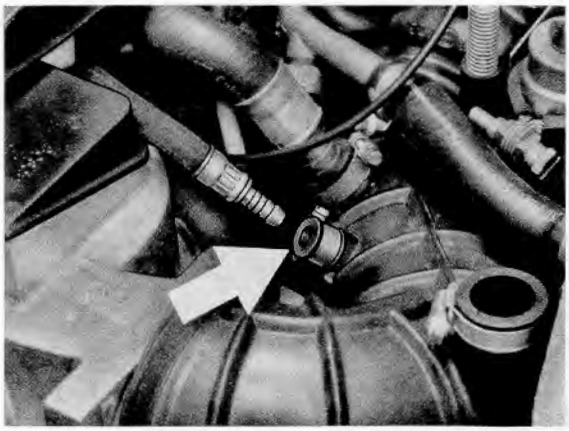
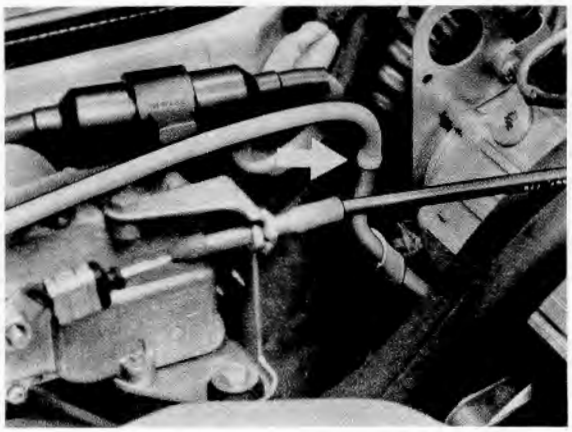
6. Visually inspect connection at intake air cowl for rubber residue (reduction of cross-section).



If no charging pressure is obtained despite cutting off the control line to the charging pressure control valve, other causes must be investigated.

- Check exhaust system for leaks.
- Exhaust system obstructed (catalytic converter models)

1. Connect pressure gage P9103/2 at exhaust collection pipe in engine compartment.



2. Test-drive vehicle. Test values: At full load with engine speed of 3500 rpm and approx. 0.7 bar charging pressure, exhaust pressure should be 0.8 ± 0.1 bar.

- Check sealing of suction and charging pressure system (see Test Point 13).

  Check throttle for complete opening.

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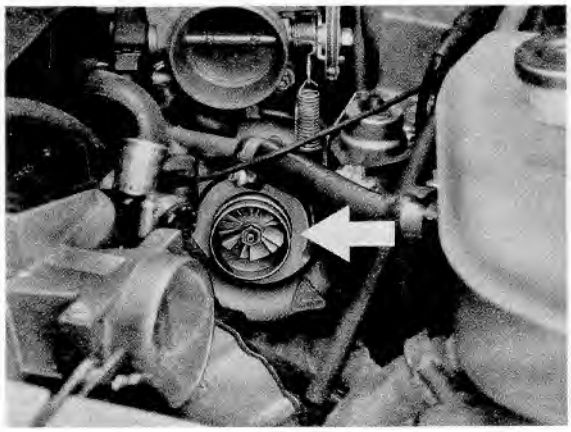
- Check turbocharger

1. Remove intake air cowl and check compressor impeller of turbocharger for damage.



2. Check turbocharger shaft by hand for ease of motion and excessive play.

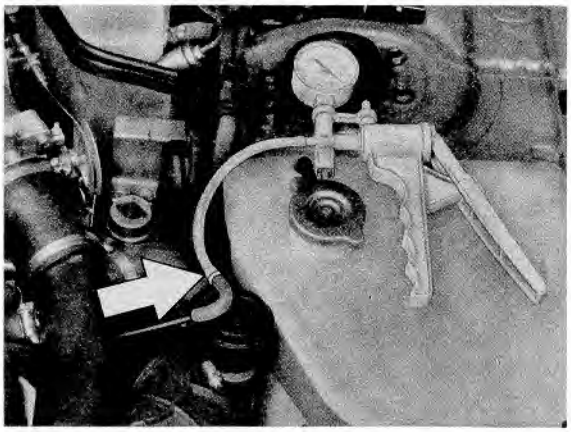
3. The turbine (exhaust side) can be checked only after dismantling turbocharger.

- Check bypass-air valve for function.

1. Remove bypass-air valve and apply approx. 0.5 bar negative pressure with vacuum hand pump.

The bypass-air valve should open with the applied negative pressure remaining present.

2. Install bypass-air valve, start engine, and allow to idle. Connect vacuum hand pump to connection line of air circulation valve.



The suction system negative pressure must be present at the connection. This means that when engine is in operation with charging pressure, the bypass-air valve is acted upon by the charging pressure and remains closed.

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Blink code	Problem	Possible Defect
3 - 2	Excessive charging pressure	Charging pressure control valve is not being actuated

Testing

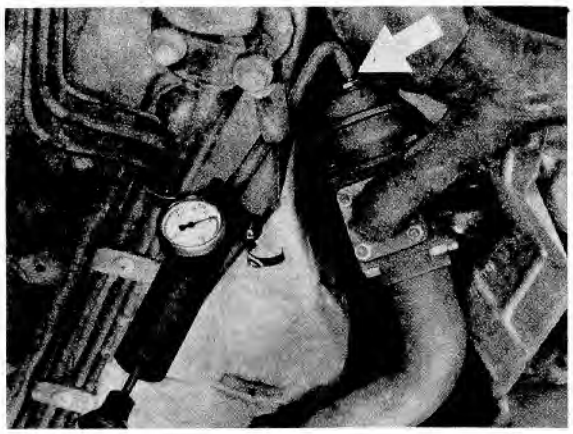
Check actuation line to charging pressure control valve for flow-through and damage.

Charging pressure control valve sticks in closed position or the membrane leaks.

Testing

The exhaust system should be cold during testing of the charging pressure control valve.

1. Lift vehicle. Disconnect actuating line to charging pressure control valve and connect pressure pump (VAG 1274).



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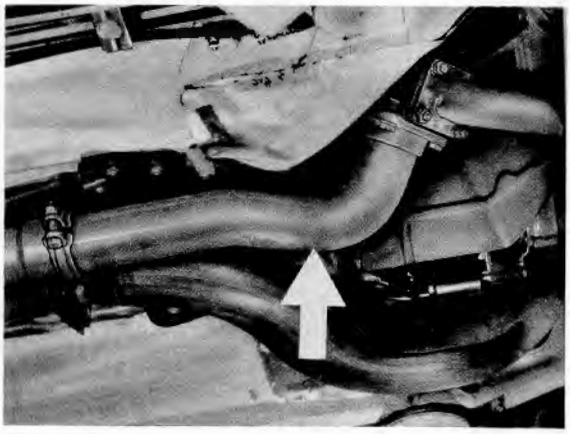
2. Start engine and allow to idle. After a short time the exhaust pipe to the charging pressure control valve should heat up while the bypass pipe remains cold (charging pressure control valve closed).



3. Apply approx. 0.6 bar pressure (max. 1.0 bar) to charging pressure control valve with the hand pump. The bypass pipe should then likewise heat up (charging pressure control valve open).

When the applied pressure is suddenly removed, the valve should close with an audible "click".

If functioning is not as described, replace charging pressure control valve.

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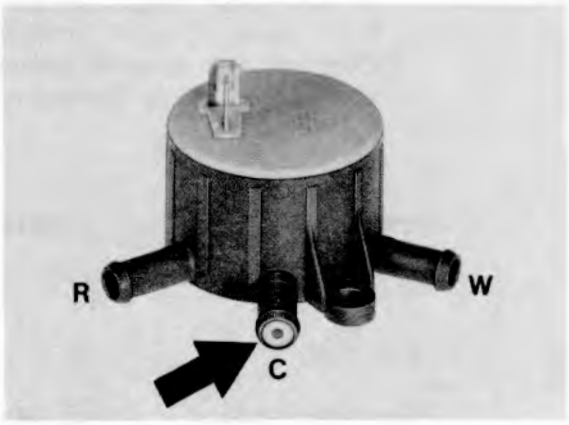
Blink code	Problem	Possible Defect
		Actuation line to timing valve is broken or throttle at connection "C" of timing valve is blocked.

Testing

1. Remove timing valve and check throttle at connection "C".



2. Check lead from pressure pipe to timing valve for flowthrough or interruption.

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Blink code	Problem	Possible Defect
		Timing valve has continuous current

Testing

1. Remove plug connector at timing valve and switch on ignition.

2. Connect both contacts of plug connector with test lamp.
   If the test lamp lights up, the lead to the K/CP control unit (red/blue term. 2) must be checked for ground connection or the K/CP control unit is defective.

3 - 3	Pressure sensor in K/CP control unit defective	Replace control unit

N o t e

Flashing code 3 - 3 may be caused by a detective throttle valve potentiometer. Therefore, first check the throttle valve potentiometer in accordance with Item 9 before replacing the control unit.

4 - 1	Throttle potentiometer	Plug connector has fallen off; supply line to potentiometer has ground contact; potentiometer is defective.

N o t e

If defect signal 3 - 3 is present at the same time, the pressure sensor is in good condition.

4 - 2	Throttle potentiometer	Check leads to potentiometer for short circuits. Potentiometer defective.

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TEST POINT 13

Intake Pressure System Sealing

1. Check all connection points after air flow sensor for tight fit and sealing.

2. Using the locally-made tool (see Workshop Manual 944, page 24-15), build up 0.5 bar pressure in intake system and check sealing.

TEST POINT 14

Altitude Correction Box

(Test below 1000 m/3300 ft above sea level)

The altitude correction box is located above the K/CP control unit.

1. Let engine idle. Remove oxygen sensor plug connector and measure CO before catalytic converter.

2. Remove plug connection of altitude correction box and bridge plug connections with a suitable wire.

   The CO test value should change approx. 1% towards leanness.

3. Connect plug connection on altitude correction box with ohmmeter.

   Control value: ∞ ohms (switch open)

   Above approx. 1000 m/3300 ft above sea level, the switch in the altitude correction box is closed.

Control value: 0 ohms

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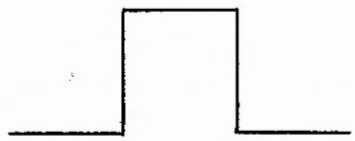
TEST POINT 15

Ignition Signal from DME to K/CP Control Unit

1. Pull off plug connector on K/CP control unit. Connect oscilloscope at plug terminal 9 and ground.

2. Start engine.
   A square wave signal should become visible on the screen.



If no signal is present, replace DME control unit.

Note

The engine can be operated without the K/CP control unit in an emergency or for troubleshooting purposes.

In order to do this, the ignition signal must be bridged at the K/CP control unit plug terminals 9 and 16 with an auxiliary wire.

The engine will then run with reduced power.

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TEST POINT 16

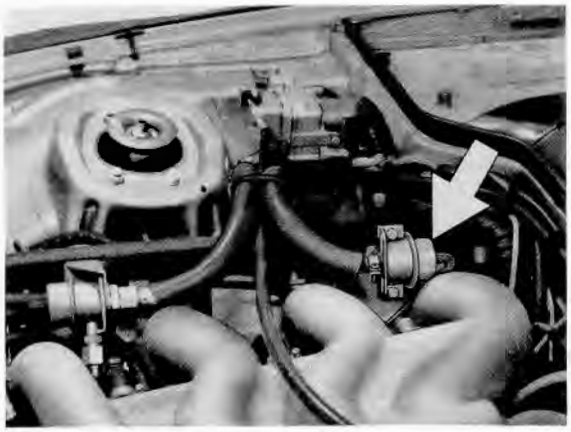
Oxygen Sensor Function

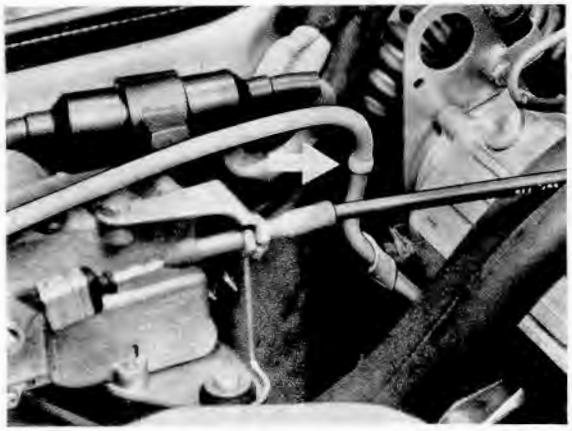
(Short test)

- Engine at operating temperature

- Idle speed correctly set.

1. Connect exhaust tester at collection nozzle in engine compartment.





2. Detach plug connection of oxygen sensor and note CO value.

3. Pull off negative pressure line from fuel pressure regulator and close with suitable stopper.

The CO value should rise.

4. Re-connect plug connection on oxygen sensor. The CO value should set itself to the control value of 0.6 ± 0.2%.

If there is no change in the CO level, there is a defect in the oxygen sensor or in the DME control unit.

DME Control Unit (Oxygen Control Function)

1. The same test requirements apply as for the oxygen sensor function test.

2. Temporarily connect terminal 1 on the oxygen sensor plug connector (plug half to control unit) to ground with an auxiliary lead.

The CO level should rise.

If there is no change in the CO level check connection to DME control unit (terminal 24 green), and if necessary replace control unit.

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Testing Oxygen Sensor (Sensor Voltage)

1. The same test requirements apply as for the oxygen sensor function test.

2. Disconnect oxygen sensor plug connector.

3. Connect voltmeter at terminal 1 (plug half to sensor).

The voltage should be in the area of 0.1 V to 1.0 V.

(Sensor voltage depends on oxygen content in exhaust).

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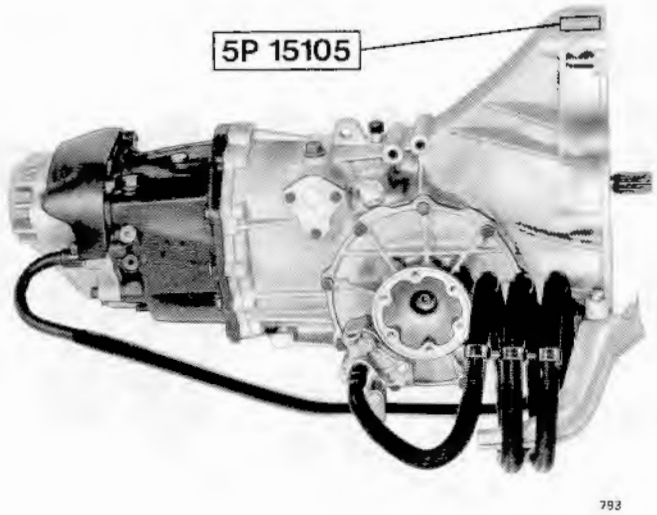
5-speed manual transmission 016 R/S for 944 turbo



Codes and date of mfg of transmission

Example: **5P** **15** **10** **5**

Code letter | Day | Month | Year of manufacture (1985)

Type	Code letter	Equipment	installed in:	Model year
016 R	5P	with oil cooler	944 turbo	until mod. '86 * as from Mod. '87 **
016 R	5R	with oil cooler and lim. slip differential	944 turbo	as from mod. '85 **
016 S	UY	without oil cooler	944 turbo	as from mod. '87 *
016 S	9U	without oil cooler but with lim. slip differential	944 turbo	as from mod. '87 **

* = standard ** = option

Apart from the oil pump with serpentine cooling pipe, transmission type 016 S is identical to transmission type 016 R with regard to construction and repair.

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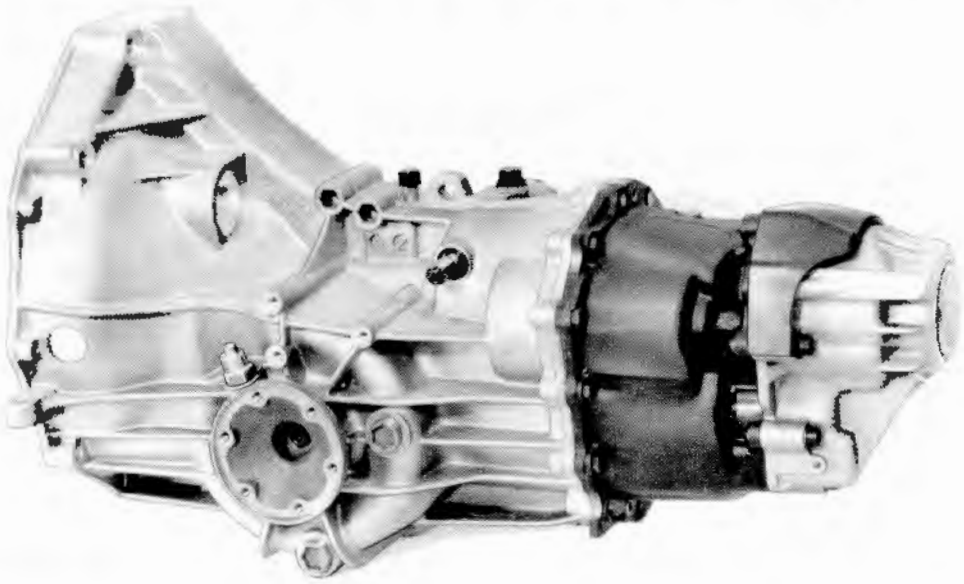
5-SPEED MANUAL TRANSMISSION 083 D FOR 944 S (87 MODELS ONWARD)



Type	Code	Installed in vehicles for:
083 D	AGP	rest of the world
083 D	AGR	rest of the world (with limited-slip diff.)

As regards design and repair work, there are only a small number of differences between the 083 D transmission and the 016 R turbo transmission.

The most important differences are:

- no transmission-oil pump can be supplied
- final drive ratio increased 9 : 35
- transmission case machined for ring gear
- design dimension "Ro" 58.15 mm (turbo transmission 59.65 mm)

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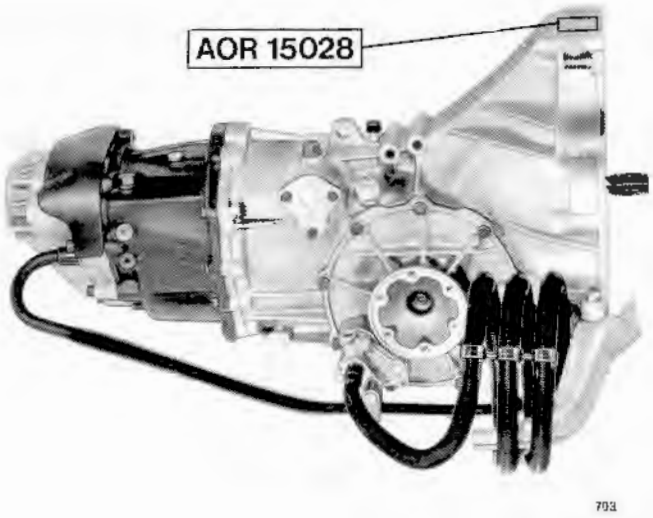
5-speed manual transmission 016 R for 944 turbo S



Codes and date of mfg of transmission
Example: AOR 15 02 8
Code letter | Day | Month | Year of manufacture (1988)

Type	Code-letter	Equipment	installed in:	Model year
016 R	AOR	with oil cooler and lim. slip differential	944 turbo S 944 turbo	as from mod. '88 mod. '89/'90/'91

Apart from a few deviations, transmission 016 R, code AOR, is identical to the turbo transmission 016 R, code 5R, with regard to construction and repair.

The most significant deviations are:

- transmission-oil cooling as standard
- limited slip differential as standard (with reinforced inner plates and molybdenum-coated differential
- shafts)
- gearwheels for first and second gear on the drive shaft are blasted for increased strength

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General data	5-speed manual transmission 016 R/016 S/083 D	
Ratios		
1st gear	10 : 35	i = 3,500
2nd gear	17 : 35	i = 2,059
3rd gear	25 : 35	i = 1,400
4th gear	29 : 30	i = 1,034
5th gear	35 : 29	i = 0,829
Reverse gear	12 : 42	i = 3,500
Final drive	Hypoid pinion set with 12 mm displacement	
Final drive ratio	8 : 27	i = 3,375 (944 turbo)
	8 : 27	i = 3,375 (944 turbo S)
	9 : 35	i = 3,889 (944 S)
Power train	Front-mounted engine and rear-mounted transmission bolted together via a torque tube to form a rigid drive unit. Front-mounted engine, clutch torsionally elastic shaft (25 mm dia.) to transmission running on 4 bearings in torque tube, rear-mounted transmission interlocked with final drive (transaxle), dual-joint drive shafts to rear wheels.	
Capacity	approx. 2,0 l hypoid transmission oil SAE 75 W 90 to API Class GL 5 or MIL-L 2105 B, or SAE 80 to API Class GL 4 or MIL-L 2105 (refer to page 34-1)	

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TIGHTENING TORQUES FOR MANUAL TRANSMISSION

Location	Description	Thread	Material	Torque Am (ftlb)
Oil filler plug to transmission housing	Plug	M 24	-	24 (17.7)
Oil drain plug to transmission housing	Plug	M 24	-	24 (17.7)
Selecter shaft cover to transmission housing	Hex bolt	M 6	8.8	8 (6)
End plate to transmission housing	Hex bolt	M 8	8.8	24 (17.7)
Ball bearing on input shaft	Bolt	M 17	10.9	150 (110)
Cover to end plate	Pan head bolt	M 8	8.8	24 (17.7)
5th gear to drive pinion	Hex bolt	M 10	8.8	70 (51)
Shift lock to end plate and transmission housing	Threaded sleeve	M 18	-	30 (22)
Shift travel stop to end plate	Stop screw	M 14	8.8	30 (22)
Operating lever to end plate	Phillips head bolt	M 10	8.8	35 (25)
Reverse gear shaft bolt to end plate	Hex bolt with collar	M 8	8.8	24 (17.7)

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Location	Description	Thread	Material	Torque Nm (ftlb)
Shaft flange to differential	Bolt	M 8	8.8	24 (17.7)
Side transmission cover to transmission housing	Hex bolt	M 8	10.9	24 (17.7)
Ring gear to differential housing	Hex bolt	M 10	12.9	90 (65)
Backup light switch to transmission housing	Switch	M 18	-	42 (30)
Speedometer socket to transmission housing	Speedometer socket	M 18	-	42 (30)
Cooling coil to cover and oil pump	Pan head/ hex bolt	M 8	10.9 8.8	24 (17.7)
Oil pump cover to side transmission cover	Hex bolt	M 6	8.8	8 (6)
Cooling coil bracket to transmission housing	Locknut	M 8	8	24 (17.7)
Cooling coil shackle to bracket	Pan head bolt	M 6	8.8	8 (6)
Drive shaft to flange	Allen head bolt	M 8	12.9	42 (30)

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General Data

Clutch

Design

Single plate, dry clutch with diaphragm springs, cold version, located on engine end, hydraulic operation

Pressure plate

GMFZ 240
Contact pressure 8700 - 9500 N (large dynes)

Clutch disc

TD 240 (steel spring torsion damper)

The clutch disc has a two-step steel spring torsion damper

944 turbo

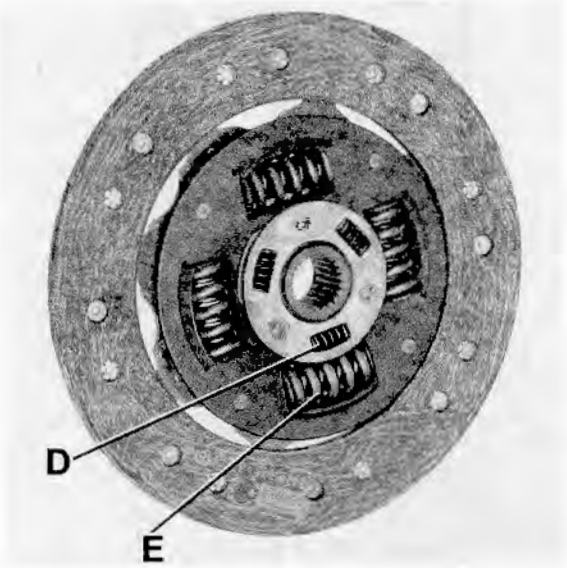
1st step: Three light compression springs D

2nd step: Four heavy sets of springs E

944 turbo S

1st step: Six light compression springs

2nd step: Four heavy sets of springs



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TIGHTENING TORQUE FOR CLUTCH, CENTRAL TUBE, TRANSMISSION SUSPENSION, AND SHIFT

Location	Description	Thread	Material	Torque in Nm (ftlb)
CLUTCH				
Guide sleeve on clutch housing	Hex bolt	M 7	8.8	15 (1,5)
Clutch and gear ring installation	Socket head bolt	M 8	8	25 (2,5)
Flywheel to crankshaft	Socket head bolt	M 10x1.25	10.9	90 (9,0)
Clutch housing to engine*	Hex bolt	M 12	8.8	75* (7,5)
Starter to clutch housing	Hex bolt	M 12		65 (6,5)
Protective panel to clutch housing	Hex bolt	M 10	8.8	42 (4,2)
Release lever shaft with clutch housing	Hex bolt	M 6x35	8.8	9.5 (0,95)
	Hex nut	M 6	8	7.5 (0,75)
Reference mark, rpm, and DC sensor bracket to clutch housing	Pan head / Hex bolt	M 8		20 (2,0)
Reference mark, rpm, and DC sensor to bracket	Pan head / Hex bolt	M 6	8.8	8 (0,8)
Slave cylinder to clutch housing	Hex bolt	M 8x28	8.8	21 (2,1)
Master cylinder to firewall	Hex nut	M 8	8	21 (2,1)
Clutch tube to clutch hose and to master and slave cylinders	Coupling bolt	M 12		16 (1,6)
* Grease hex bolt with Optimoly TA.				

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Location	Description	Thread	Material	Torque Nm /kpm (ftlb)
Central shaft to transmission input shaft (split ring)	Pan head bolt	M 10x46	12.9	80 /8.0 (60)
Central tube flange to clutch housing	Hex bolt	M 10x35	8.8	42 /4.2 (30)
Central tube housing to transmission housing	Pan head / Hex bolt	M 12 x 75 M 10 x 60	10.9 8.8	85 /8.5 (62) 42 /4.2 (30)
TRANSMISSION SUSPENSION				
Transmission mount to body	Hex bolt	M 10	8.8	46 /4.6 (34)
Transmission bearings to transmission mount	Hex bolt	M 8	8.8	23 /2.3 (17)
Bracket to transmission and transmission bearings	Hex bolt	M 8	8	23 /2.3 (17)
SHIFT				
Joint rod to transmission housing	Ball-end bolt	M 8	9 S Mn28K	14 /1.4 (10)
Joint rod to intermediate shift lever	Hex nut	M 8	8.8	21 /2.1 (15)
Shift rod	Bolt	M 8	9 S Mn28K	21 /2.1 (15)
Shift lever plate to central tube	Hex bolt	M 8x12	8.8	21 /2.1 (15)
Intermediate shift lever to shift shaft	Bolt	M 8		22.5 /2.25 (16.6)

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CHECKING CLUTCH PLAY

Due to the automatic hydraulic clutch adjustment, clutch play can not be checked at the clutch pedal.

However, for perfect clutch operation there must be a play of 0.5 mm between pressure rod and master cylinder piston.

This play cannot be measured and must be determined at clutch pedal by feel. It is about 3 mm at the pedal plate.

If necessary, correct play by adjusting piston rod.

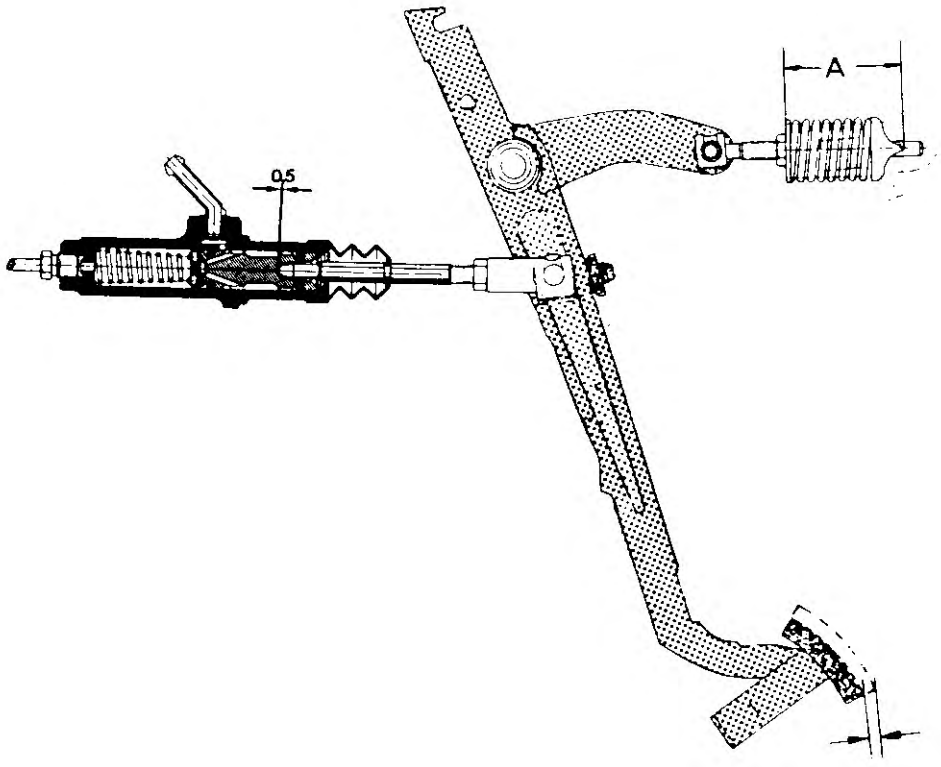
ADJUSTING CLUTCH SPRING

In order to reduce the amount of foot force required to operate the pedal, there is a spring which reduces pedal force. This spring has to be pre-tensioned to the correct level for this purpose.

Distance A is measured in engaged state (clutch pedal at final stop) between the outer edge of the plate and the knife-edge bearing.

- Distance A for green-coded spring (no longer available as spare part) = 60 mm (75 mm*)
- Distance A for blue-coded spring (harder spring rate/used as from Feb. 1986) = 55 mm (68 mm*)

If necessary, correct by turning hexagon nut.



* Value in brackets stands for distance A in assembled condition. Servo spring / guide rod pre-assembled with assembling wire (split pin Ø 3 mm).

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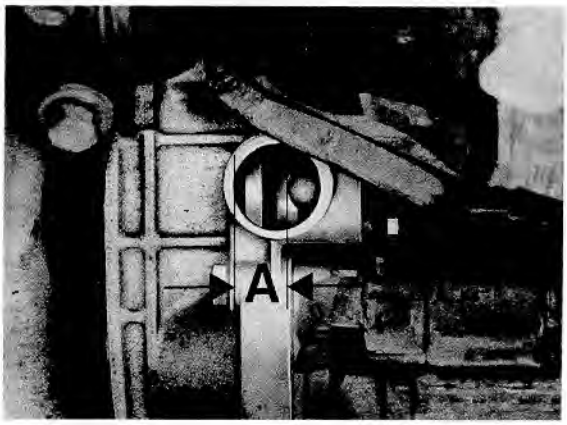
CHECKING CLUTCH DRIVE PLATE WEAR

Clutch drive plate installed

C h e c k i n g

Remove cap.

Measure distance "A" with suitable tool.



New part distance	18 mm
Wear limit	34 mm

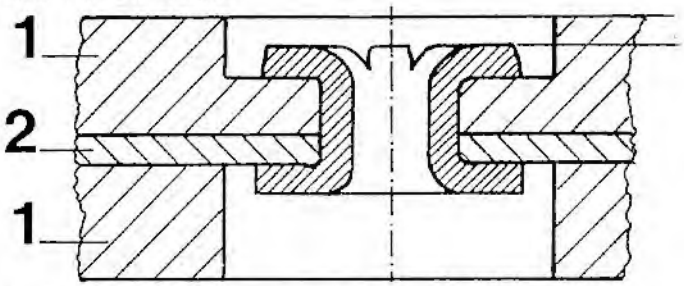
Clutch drive plate removed.

C h e c k:

Measure the distance between the surface of the lining and the head of the rivet with a depth gauge or slide caliper (dimension X).

N o t e:

Only measure on the beaded side of the rivet head.



1 lining 2 clutch lining

Wear limit 0.2 mm

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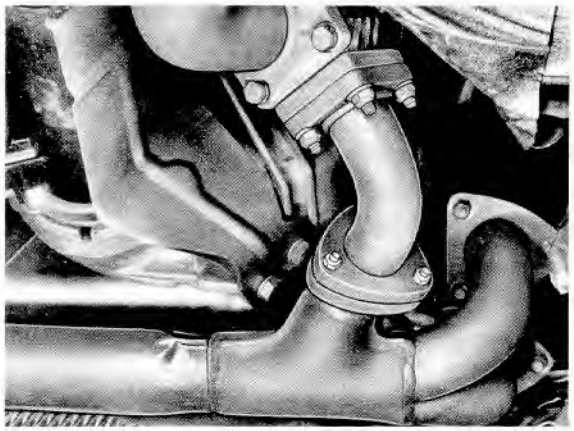
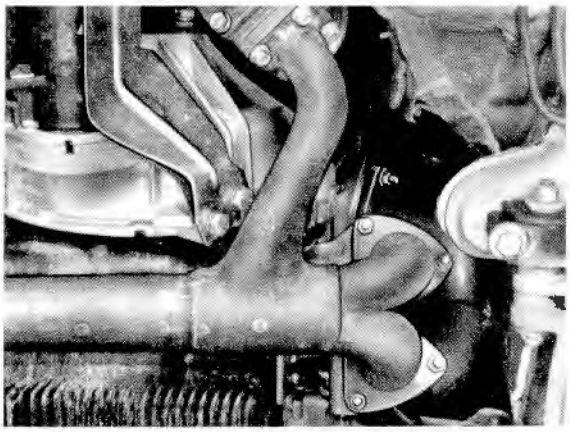
REMOVING AND INSTALLING CLUTCH

Cars with two-part exhaust cross pipe



Modified/current version



Original version

Note:

The following work must also be carried out on earlier cars with single-part exhaust cross pipe:

1. Remove and install intake-air manifold

2. Remove and install guard for brake master cylinder.

3. Remove and install single-part exhaust cross-pipe.

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Removing and installing clutch

Note

When performing operations on the transaxle system that require rotation or shifting of the transaxle tube, always wear leather gloves to avoid any risk of injury.

Removing

1. Align hoise beneath car an raise car on checking points.

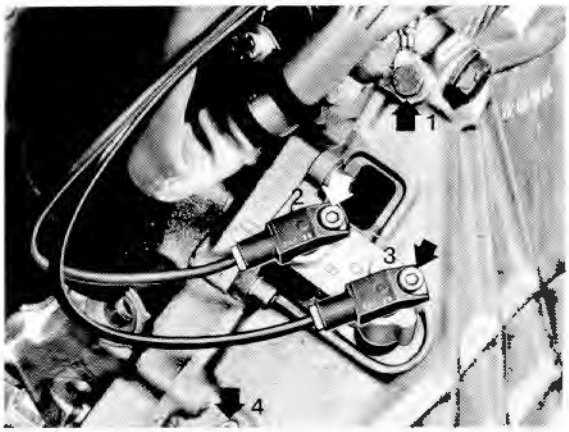
2. Place covers over fenders.

3. Disconnect ground lead from battery.

4. Disconnect ground cable from clutch housing (1). After removing hex bolts, remove reference-mark transmitter (2) and speed transmitter (3) for DME from holder. Detach cable bundle to starter at upper attachment point (4).

Note

Access to attachment point 4 (starter cable) is best once the central tube has been disconnected from clutch housing. See item 15.



5. Remove engine ground

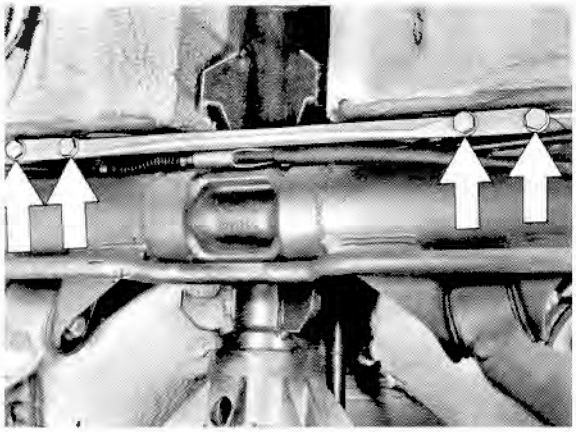
6. Detach both shields from starter and clutch housing and withdraw to rear.

7. Disconnect electrical connections to starter and remove starter, remove hose clamp on clutch housing. Remove clutch actuating cylinder without disconnecting line.

8. Remove exhaust system as a unit. Unbolt flange connection between turbo-charger and exhaust pipe and flange to bypass valve. Remove securing bolts from suspension points, remove exhaust system and shield at primary muffler.

10. Remove transmission.
    See 944 Repair Manual, Volume II Transmission, page 34 - 4.

11. Remove transverse strut between body and rear-axle carrier.



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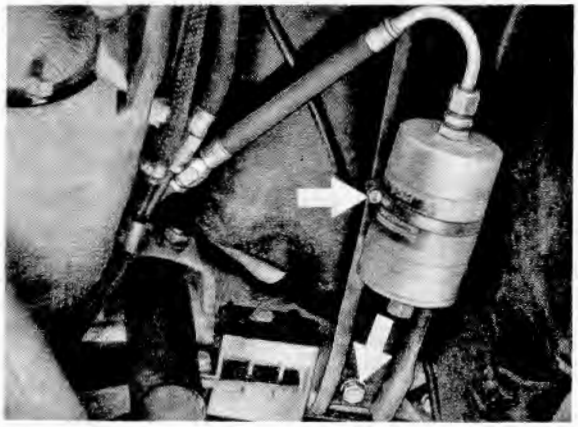
12. Slacken hose clamp on fuel filter and transmission carrier and remove.



13. Unbolt bypass valve with holder from central tube and sliding flange and remove.

14. Remove central tube/clutch housing mounting bolts (4). Slacken both suspension clamps of exhaust system, but do not remove.

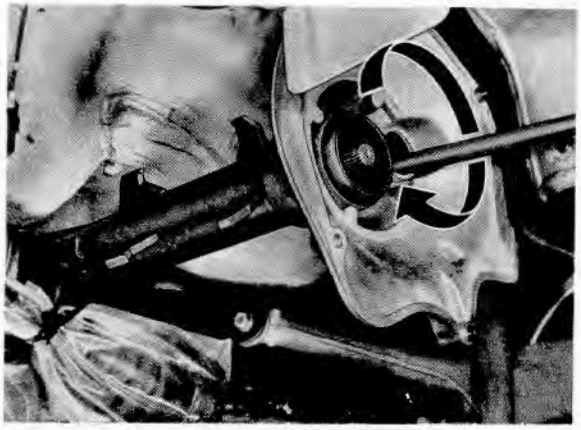
15. Unbolt shift lever with bearing bracket from central tube.

16. Separate central tube and clutch housing, pushing selector rod to rear at the same time.

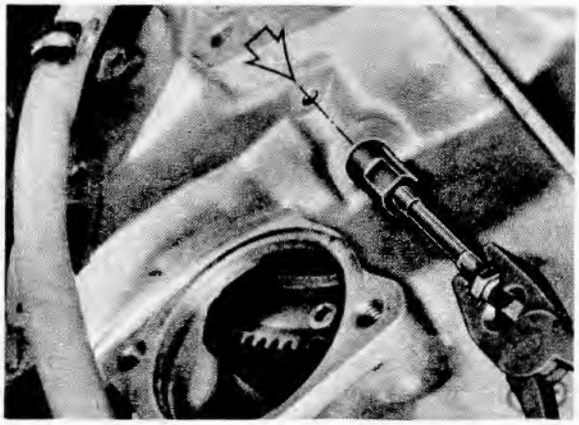
17. Turn central tube clockwise through 90° and pull to rear. Note position of catch hooks.

Note:

Do not damage insulation for shift linkage.



18. Withdraw release-lever shaft with 8 mm bolt after removing retaining bolt.



19. Unbolt clutch housing from engine and remove.

20. Uniformly unscrew bolts of clutch pressure plate and remove pressure plate with driven plate.

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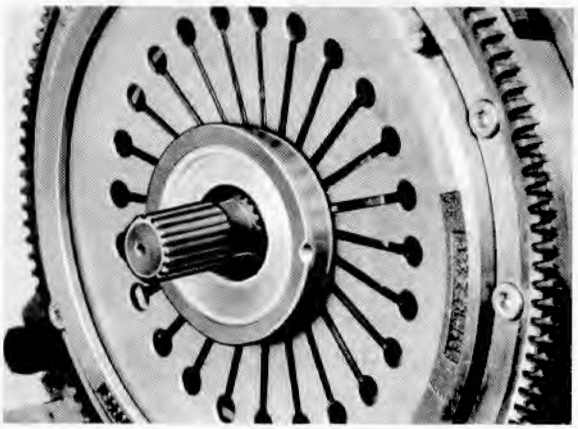
INSTALLING

1. Check flywheel, starter ring gear, grooved ballbearing in crankshaft, seal/crankshaft, release bearing, guide sleeve, release lever, pressure plate and clutch plate for wear or damage.

2. Coat guide sleeve with multi-purpose MoS_2 grease and apply a thin coat of MoS_2 multi-purpose grease to splines of central shaft and the grooved ballbearing/flywheel area. Lubricate release lever (fork, ball socket and needle sleeves) with white solid lubricating paste AOS 126 0006.

3. Install clutch. The friction surfaces must be clean and free of grease. Use central shaft 1 of a 928 (or a shortened central shaft from a damaged central tube) to center the clutch plate. Tighten bolts uniformly in diagonally opposite sequence. Tightening torque 25 Nm (18 ftlb). Counter by holding hex bolt of front pulley.



Note:

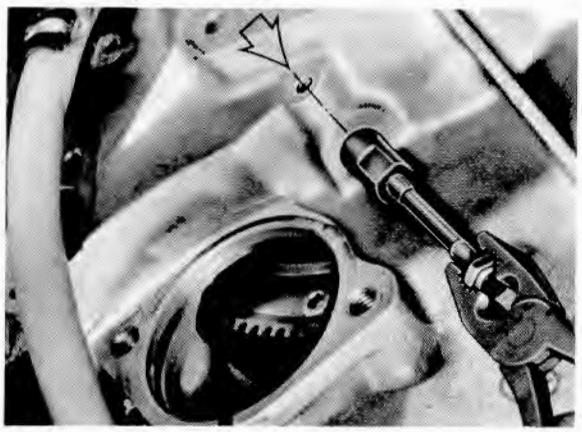
Replace the grounding point (hex bolt) on the clutch housing of earlier cars with a M8x15 mm stud bolt. Use adhesive, e.g. Loctite 270 to bond stud bolt.

4. Install clutch housing and release lever together on engine/release bearing. The bonded bolt in the flywheel for the reference mark transmitter must point down (to avoid damage).
Tighten clutch housing bolts.

Note:

Apply Optimoly TA to threads of clutch housing bolts.

5. Move release lever until needle sleeve and bore in clutch housing are aligned. Slide in release-lever shaft right way round (milled face toward securing bolt) as far as it will go. If necessary, move release lever back and forth. Never use force.



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6.With release-lever shaft correctly positioned, screw in mounting bolt and lock with hex nut.

7.The sequence for installing central tube, transmission, exhaust system etc. is the reverse of the removal sequence.

When installing, always note the following:

1.Always use new seal rings (packing rings).

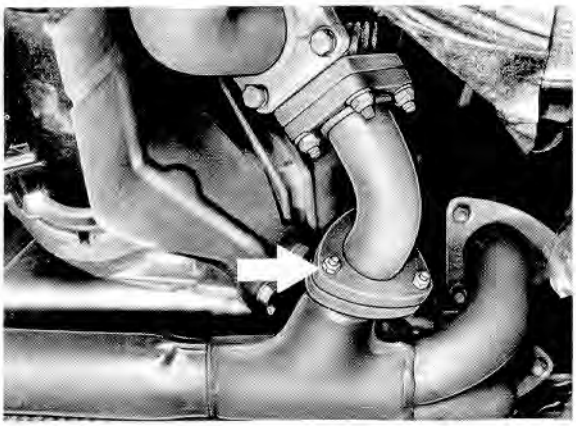
2.Once all the exhaust-system bolts have been inserted, tighten the flange connection between turbo-charger and exhaust system first.

3.Align bypass valve between clutch housing and body.

4.Tighten the M6 bolts connecting bypass line/exhaust cross pipe uniformly to the specified torque (10 Nm, 7 ftlb).

5.Test drive car (on road or roller dynamometer). Check exhaust system for leaks.

6.Allow exhaust system to cool down and retighten all accessible nuts and bolts of the system to the specified torque. It is particularly important to retighten the flange between bypass line and exhaust cross pipe.



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Checking oil levels / replacing transmission oil (type 016 R/S)

Capacity: Approx. 2.0 l hypoid transmission oil SAE 75 W 90 to API Class GL 5 or MIL-L-2105 B or SAE 80 to API Class GL 4 or MIL-L 2105 (refer to page 34 - 1)

1. Clean outside of filler and drain plugs, and then unscrew.

1 - Drain plug
2 - Filler plug

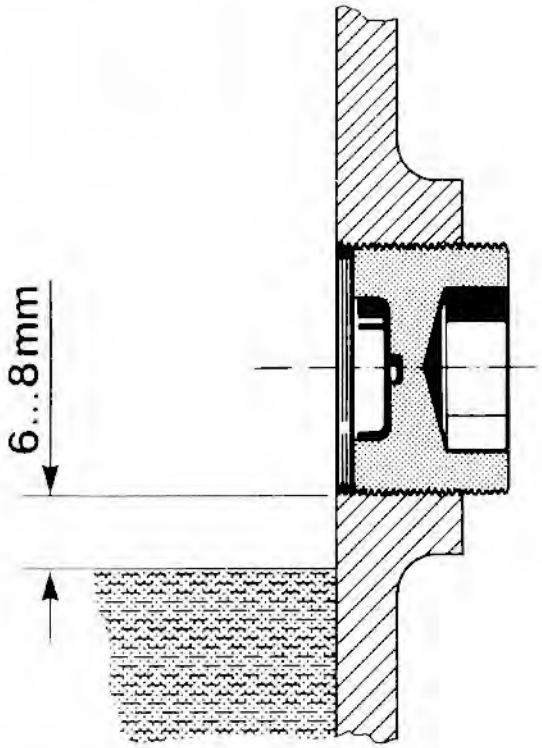
2. With car parked on level surface and transmission at operating temperature, drain oil from transmission.

3. Clean filler and drain plugs, and install. Tightening torque: 24 Nm (18 ftlb).

4. With car parked on level surface, for oil into transmission.

Note

The fluid level inside the transmission housings used in production is approx. 6 to 8 mm below the filler neck when 2 liters of transmission oil have been filled in.



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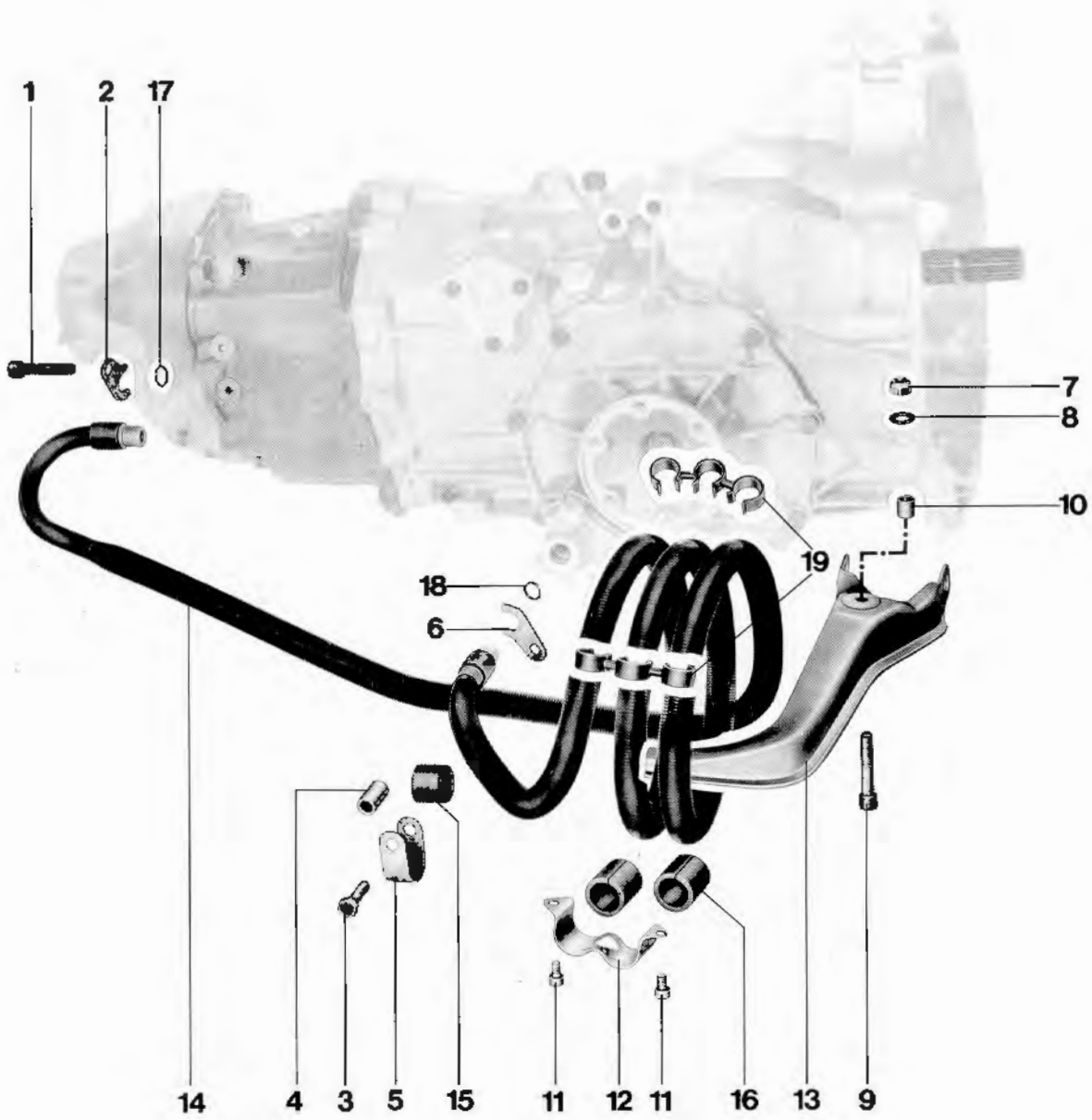
REMOVING AND INSTALLING COOLING COIL



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No.	Description	Qty.	Note When: Removing	Installing
1	Pan head bolt	1		Tightening torque 24 Nm (17.7 ftlb)
2	Holding panel	1		
3	Hex bolt	1		Tightening torque 24 Nm (17.7 ftlb)
4	Sleeve	1		
5	Shackle	1		
6	Holding panel	1		
7	Locknut	1		Tightening torque 24 Nm (17.7 ftlb)
8	Washer	1		
9	Pan head bolt	1		
10	Sleeve	1		
11	Pan head bolt	2		Tightening torque 8 Nm (6 ftlb)
12	Shackle	1		
13	Bracket	1		
14	Cooling coil	1		
15	Hose section	1		
16	Hose section	2		
17	O-ring	1		Replace, coat with transmission oil
18	O-ring	1		Replace, coat with transmission oil
19	Clip	2		

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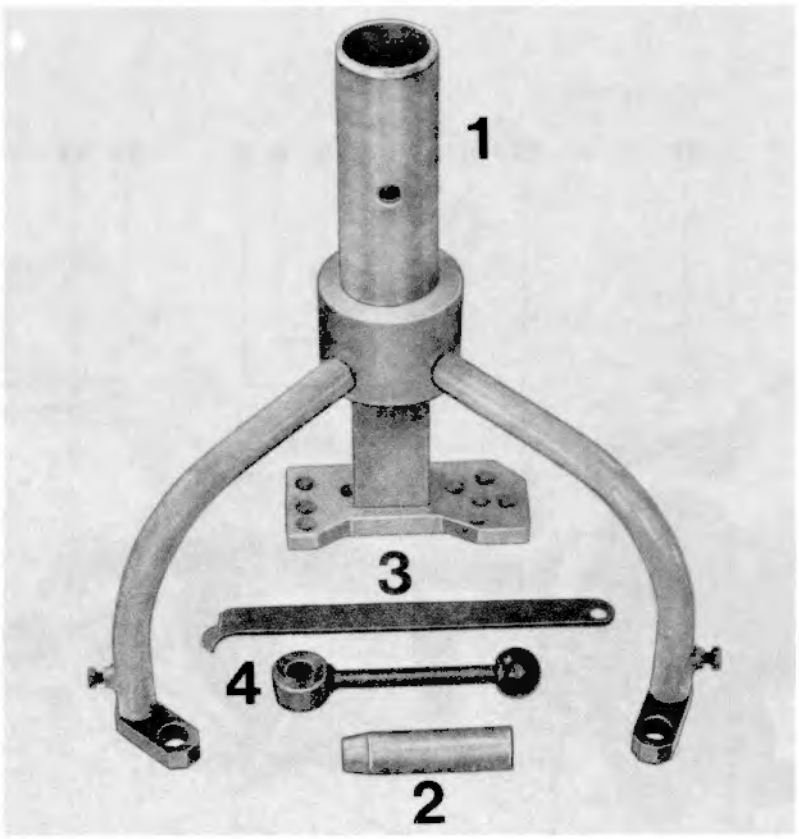
TOOLS



No.	Description	Special Tool	Remarks
1	Assembly stand	VW 540	
2	Assembly sleeve	9178	
3	Puller hook	VW 681	
4	Shift grip	9155	

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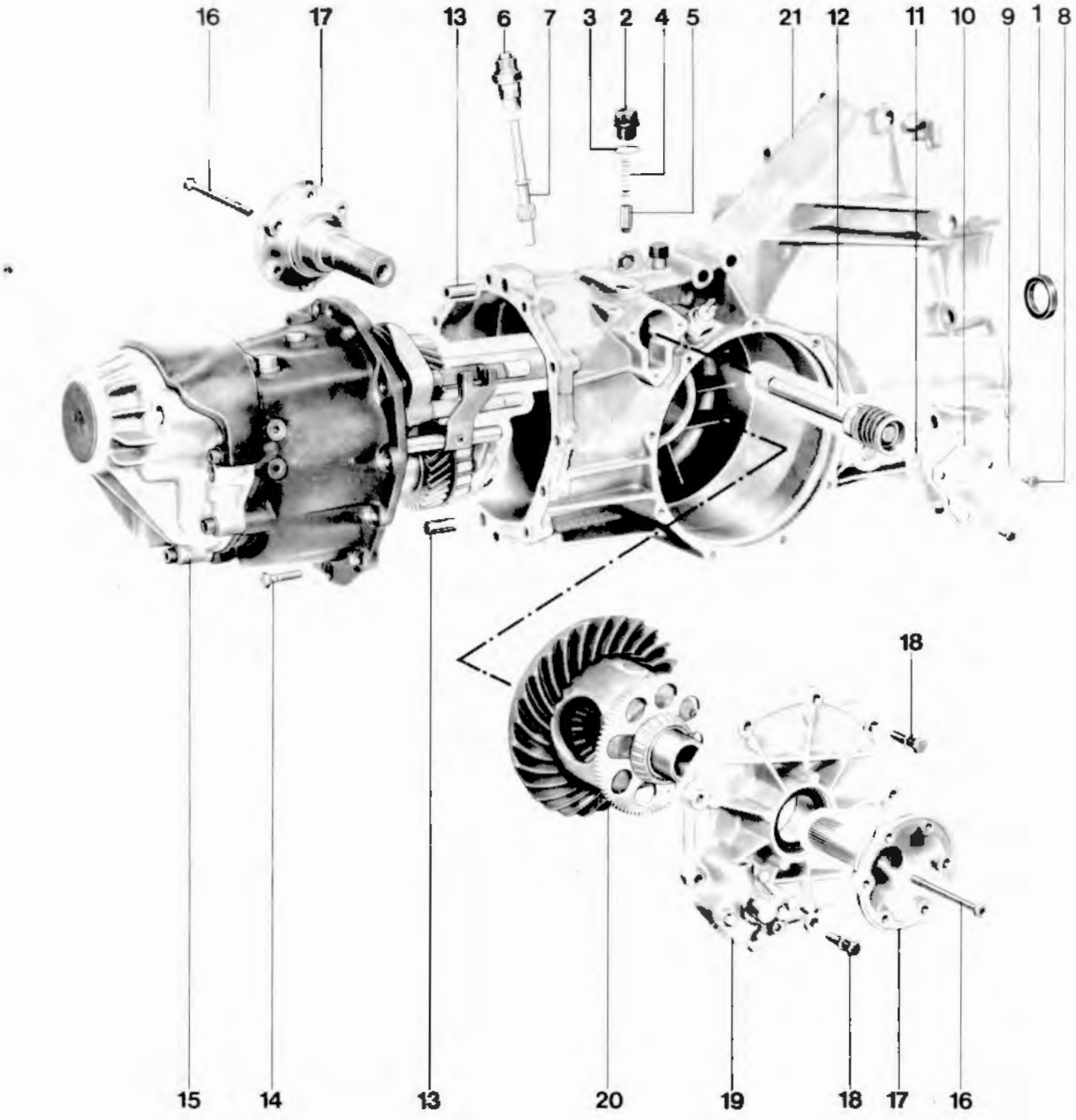
REMOVING AND INSTALLING GEARBOX



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No.	Description	Qty.	Note When: Removing	Installing
1	Sealing ring	1	Remove with VW 681	Install only after installing gear set. Oil sealing lip. Drive 1.5 mm into housing with Special Tool 9178 and suitable pipe section.
2	Threaded sleeve	1		Tightening torque 30 Nm (22 ftlb)
3	Gasket	1		Replace
4	Spring	1		
5	Sleeve	1		
6	Speedometer socket	1		Tightening torque 42 Nm (31 ftlb)
7	Speedometer gear	1		Oil pilot
8	Hex bolt	3		Tightening torque 8 Nm (6 ftlb)
9	Spring washer	3		
10	Cover	1		Install in correct position, manufacturer's symbol outward
11	Gasket	1		Replace
12	Selector shaft (complete)	1		
13	Dowel sleeve	2		
14	Hex bolt	12		Tightening torque 24 Nm (17.7 ftlb)

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No.	Description	Qty.	Note When: Removing	Installing
15	End plate	1		Coat sealing surface with Curil KIH
16	Allen head bolt	2		Tightening torque 24 Nm (17.7 ftlb)
17	Flange shaft	2		Coat shaft with oil
18	Hex bolt with washer	9		Tightening torque 24 Nm (17.7 ftlb)
19	Cover	1		Evenly coat sealing surface with Loctite 573 or 574.
20	Differential	1	Remove gearbox before removing	Light oil coat on tapered roller bearing and pinion teeth
21	Transmission housing	1	If transmission case is to be replaced and deviation "r" is not on ring gear, check location of drive pinion before removing gearbox (actual distance).	

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INSTRUCTIONS FOR REMOVING AND INSTALLING

R e m o v a l

N o t e

The differential need not be removed for work on the gearbox.

If the transmission housing or taper roller bearing for the drive pinion are to be replaced and deviation "r" is not given on ring gear, note location of drive pinion before removing gearbox (actual distance).

1. Clamp transmission in assembly stand with Special Tool VW 540 and drain oil.

2. Remove cooling coil.

3. Remove threaded sleeve and locking parts for reverse gear lock.

4. Take out selector shaft hex bolts and remove complete selector shaft (do not disassemble).

5. Knock back dowel sleeves on end plate.

6. Unscrew hex bolts on end plate and pull out end plate with gear set.

I n s t a l l a t i o n

N o t e

Install input shaft seal ring only after installation of gear set (danger of damage).

1. Coat end plates/transmission housing sealing surface with Curil KIH.

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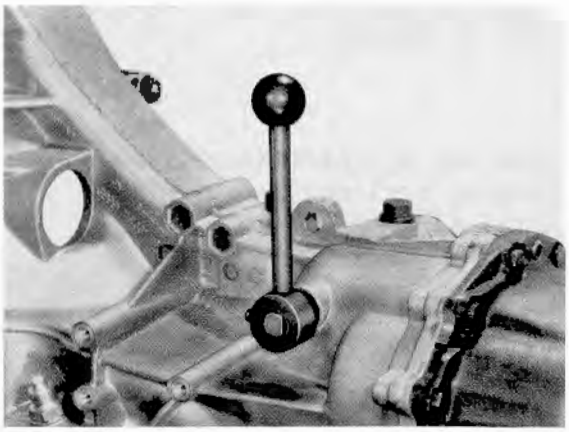
2. Knock in dowel sleeves and tighten mounting bolts to a torque of 24 Nm (17.7 ftlb).

3. Drive input shaft seal 1.5 mm into housing with Special Tool 9178 and suitable pipe section.

4. Run a check by shifting throgh all gears with Special Tool 9155.



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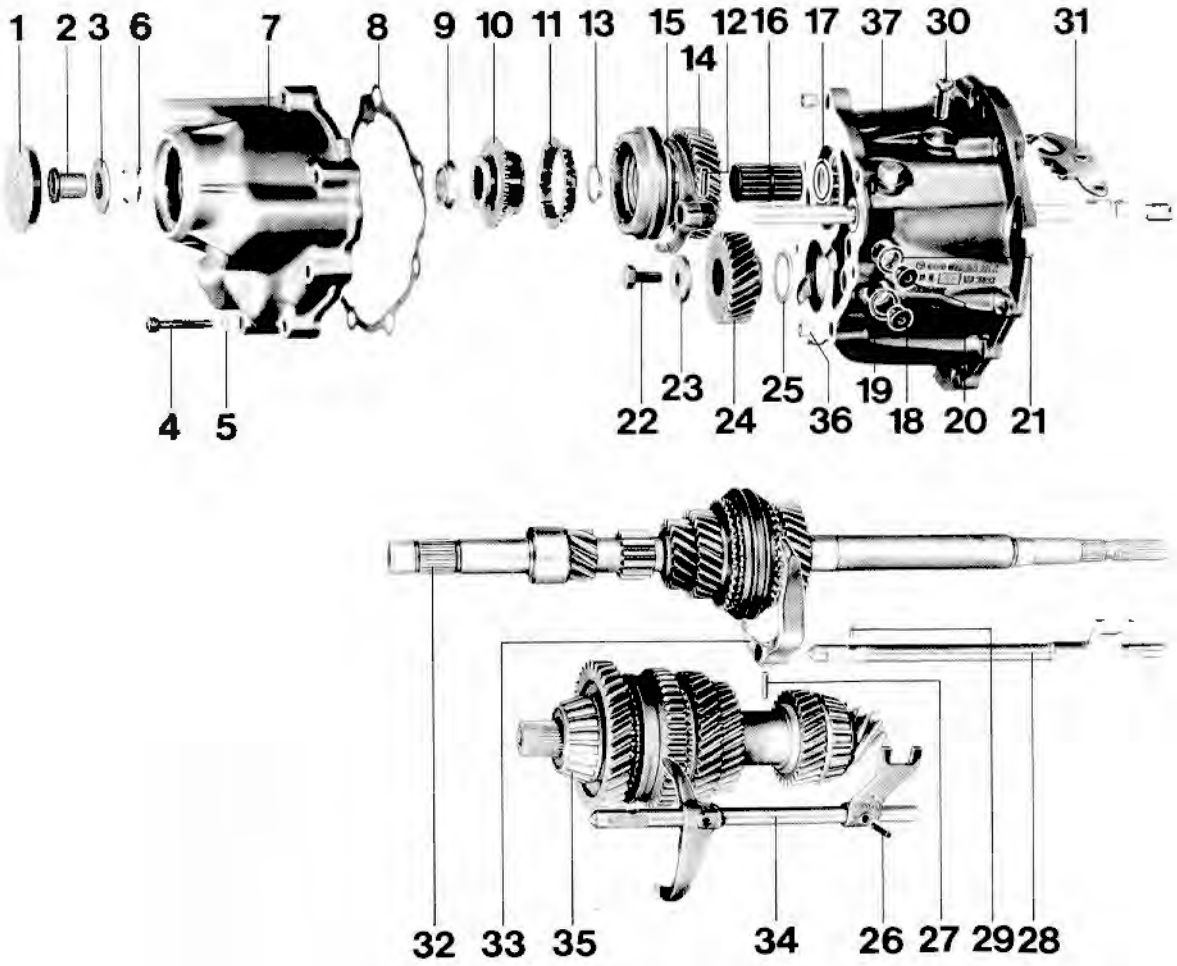
DISASSEMBLING AND ASSEMBLING GEARBOX



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No.	Description	Qty.	Note When: Removing	Installing
1	End cover deckel	1	Insert large screw-driver into center of rubber and pry out	Replace
2	Bolt (micro-en-capsulated)	1		Use only once; tight-ening torque 150 Nm (110 ftlb)
3	Saucer spring	1		
4	Pan head bolt 8 x 45	7		Tightening torque 24 Nm (17.7 ftlb)
5	Washer	5		Two bolts without washers for crash protection
6	Ball bearing/ inner race	1		
7	Cover	1	Knock off with plastic hammer	
8	Gasket	1		Replace
9	Ball bearing/ Inner race	1	Pull off with two-arm puller	Heat to about 120°C/ 248°F and knock on
10	Clutch body for 5th gear	1		
11	Synchromesh ring	1		Check for wear
12	Adapter sleeve	1		
13	Circlip	1		
14	5th gear wheel with sliding sleeve and synchronizer	1		Slide on sliding sleeve with short collar facing gear

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No.	Description	Qty.	Note When: Removing	Installing
15	5th gear selector fork	1		Available only with selector rod for 5th gear
16	Needle bearing	1		Install with gear lube
17	Thrust washer	1		
18	Stop bolt	1		Tightening torque 30 Nm (22 ftlb). Do not confuse with bolt position 20
19	Gasket (Paper)	1		0.2 mm thick, replace, do not confuse with seal ring position 21
20	Locking bolt	1		Tightening torque 30 Nm (22 ftlb), do not confuse with stop bolt position 18
21	Seal ring	1		Replace, do not confuse with gasket position 19
22	Hex bolt (micro-encapsulated)	1		Use only once, tightening torque 70 Nm (51 ftlb)
23	Washer	1		
24	Gear	1	Pull off with two-arm puller	Heat to about 120°C/ 248°F and install
25	Shim	1	Note thickness for reinstallation	If necessary, determine new thickness
26	Dowel sleeve	1		
27	Dowel sleeve	1		
28	Selector rod for 3rd and 4th gear	1	Do not lose small locking piece	

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No.	Description	Qty.	Note When: Removing	Installing
29	Small locking piece	1		Insert in selector rod with a little grease
30	Bolt for operating lever	1		Adjust operating lever and tighten to torque of 35 Nm (25 ftlb)
31	Reversing lever	1		Adjust before installing shaft
32	Input shaft	1		Remove roller bearing inner race from input shaft before installing
33	Selector fork for 3rd and 4th gear	1		
34	Selector rod with selector fork for 1st and 2nd gear	1		
35	Drive pinion	1		
36	Dowel sleeve	2		
37	End plate	1		Determine new shim thickness S4 when replacing

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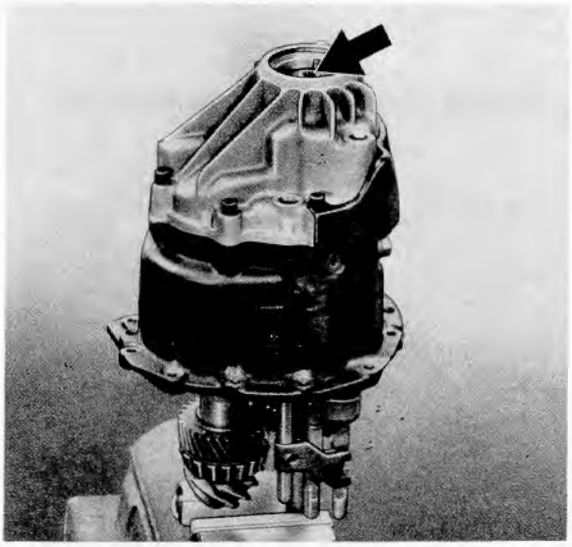
INSTRUCTIONS FOR DISASSEMBLY AND ASSEMBLY

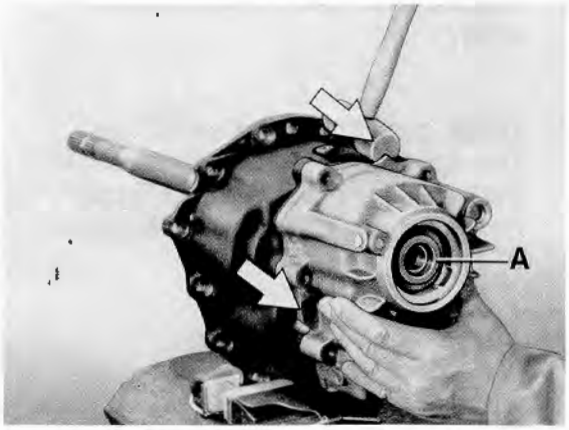
D i s a s s e m b l y

1. Remove end cover by puncturing center of rubber with a large screwdriver and prying off cover.

2. Clamp input shaft in a vice and unscrew input shaft bolt. Fit vice with soft jaws.



4. Knock off end plate cover with plastic hammer and remove 1st inner race/ball bearing (A).



3. Clamp gearbox in vice on end plate and unscrew cover fastening bolts.

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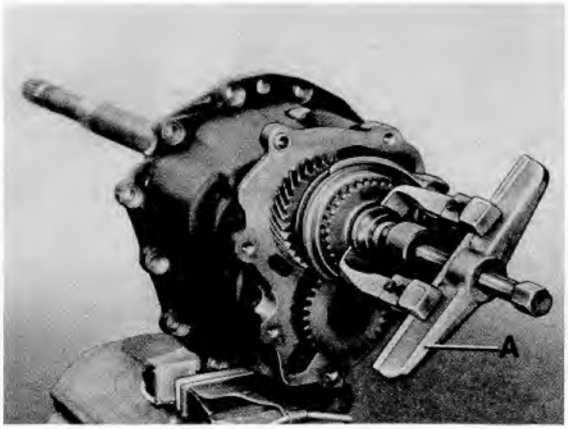
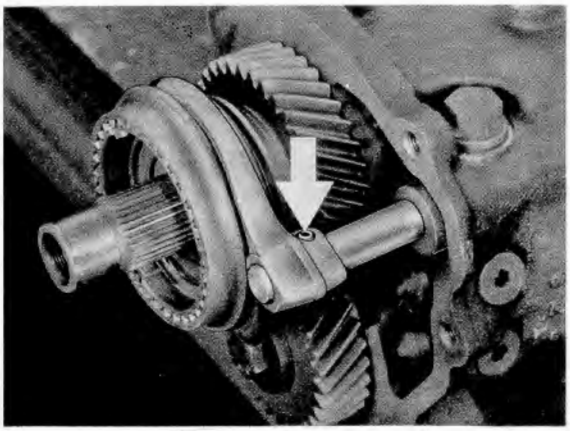
5. Pull off clutch and 2nd inner race/ball bearing with thrust piece VW 431.



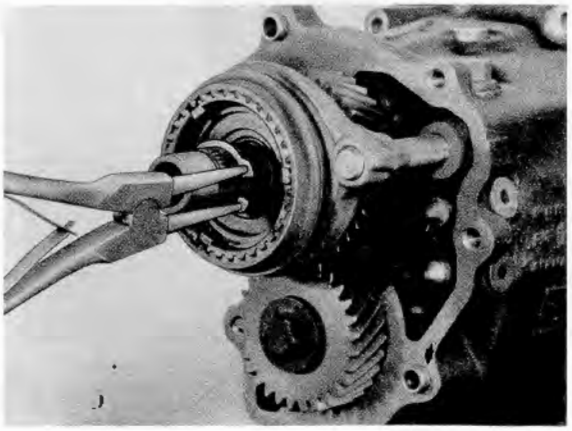
A - two-arm puller (as commonly used), for example Kukko 20/10

6. Remove 5th gear synchromesh ring.

7. Knock out 5th gear selector for dowel sleeve. Counterhold with hammer, so that selector rod bore in end plate is not widened.



8. Remove circlip for synchronizer.



9. Remove 5th gear wheel along with sliding sleeve and synchronizer, needle bearing and 5th gear selector fork.
Note that selector rod remains in end plate.

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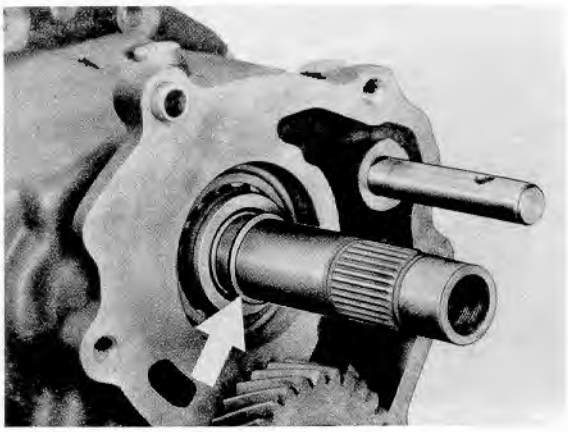
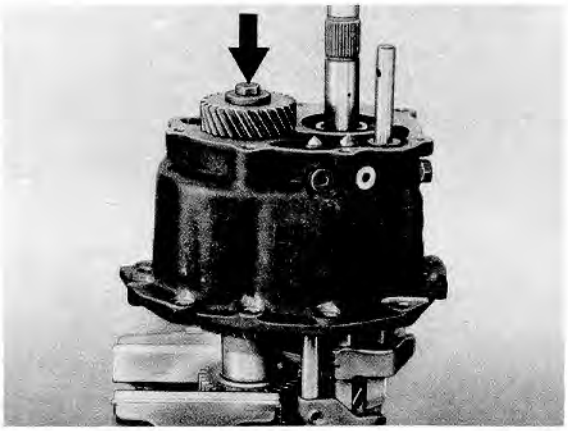
10. Remove thrust washer.

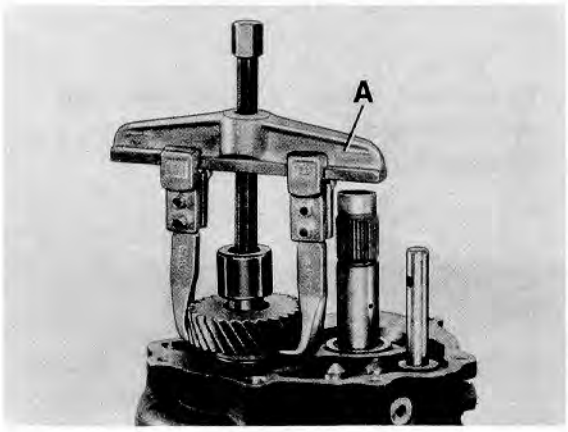


11. Unscrew stop and locking bolts for selector rods.

12. Clamp 4th gear/drive pinion in a vice and unscrew drive pinion hex bolt. Make sure vice is fitted with soft jaws!



13. Pull off 5th gear wheel with thrust piece VW 431.



A - Two-arm puller (as commonly used), for example Kukko 20/10, if necessary grind down claws slightly or pry away gear slightly with two tire irons.

14. Remove shim for 5th gear wheel.

15. Clamp end plate in vice with shafts forward.

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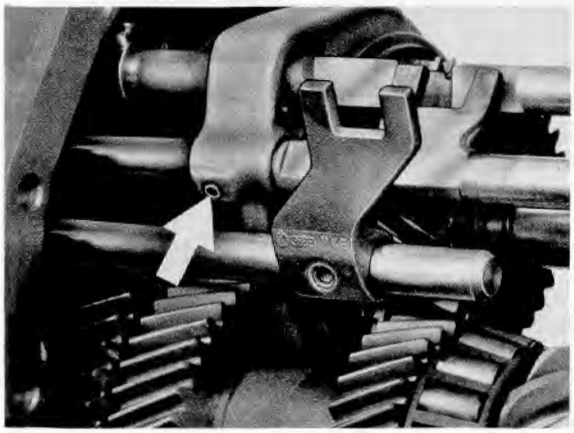
16. Knock out dowel sleeve for dog on 1st and 2nd gear selector rod. Counterhold with hammer. Turn dog to face upwards.

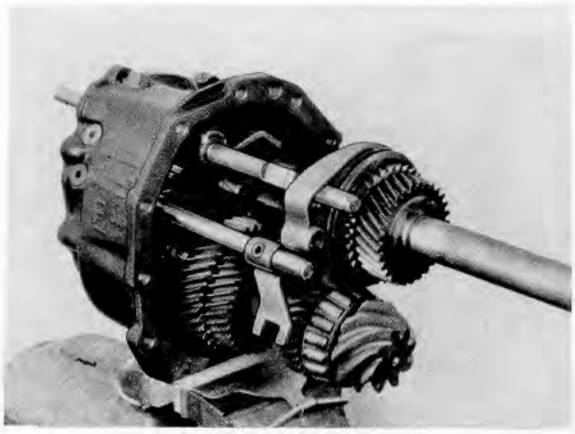
17. Drive out dowel sleeve for 3rd and 4th gear selector fork. Counterhold with hammer.



18. Pull out selector rod for 3rd and 4th gears (selector fork remains in sliding sleeve). Do not lose small locking piece!

19. Unscrew bolt for operating lever.

20. Pull drive pinion and input shaft forward slightly. Remove input shaft together with 3rd and 4th gear selector fork.



21. Disconnect spring clamp for reverse gear on pinion shaft end and turn to one side.

22. Pull drive pinion forward far enough so that selector rod and selector fork for 1st and 2nd gears can be removed.

23. Swing out drive pinion.

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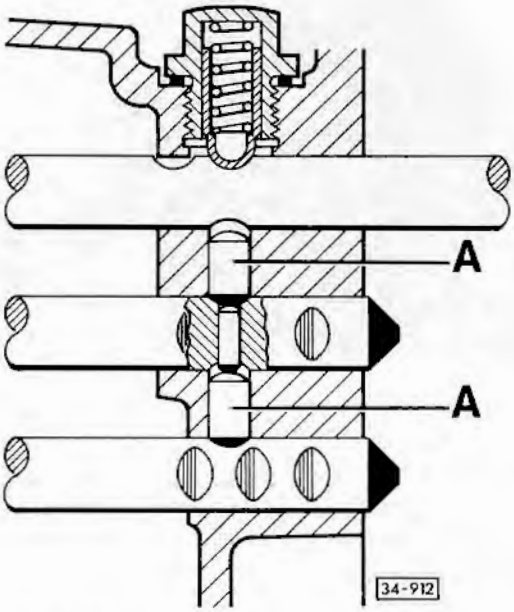
A s s e m b l y

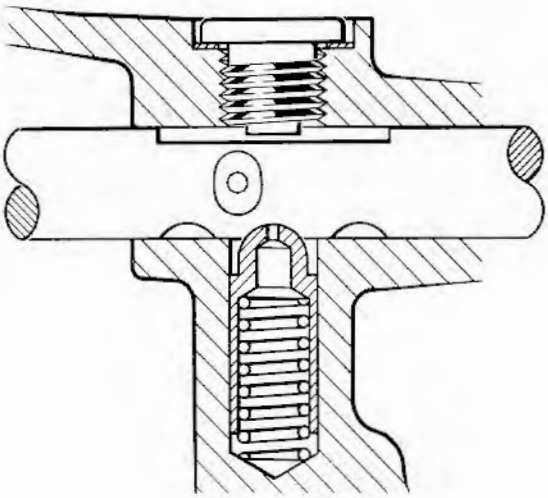
1. Complete end plate (see Page 34 - 27)

2. Check positioning of locking pieces.



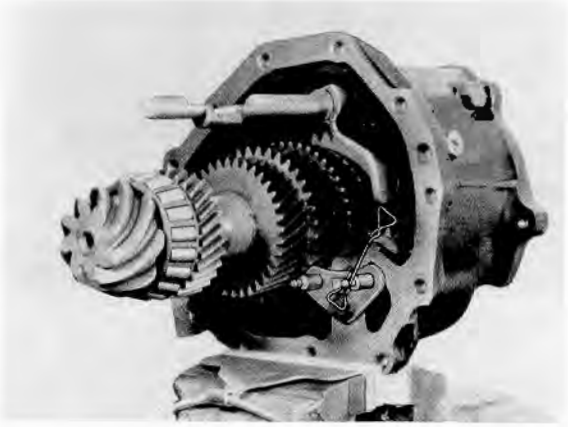
A - Locking pieces

3. Insert springs and sleeves for gear arrest (1st through 4th gears).



4. Install and adjust operating lever (see Page 34 - 32)

5. Engage reverse gear and disconnect spring clamp on one side, and then swing in drive pinion.



6. Insert 1st and 2nd gear selector fork and selector rod, and push drive pinion in fully.

7. Engage spring clamp and disengage reverse gear.

8. Slide in 3rd and 4th gear selector fork so as to be positioned correctly with opening in land on selector rod for 5th and reverse gears.

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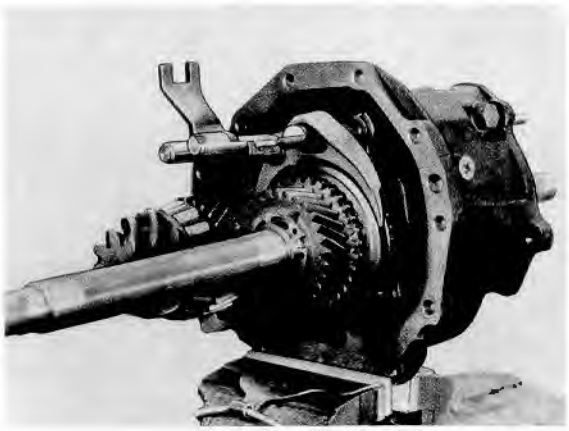
9. Insert input shaft, insert 3rd and 4th gear selector fork in sliding sleeve and push in input shaft completely.



N o t e

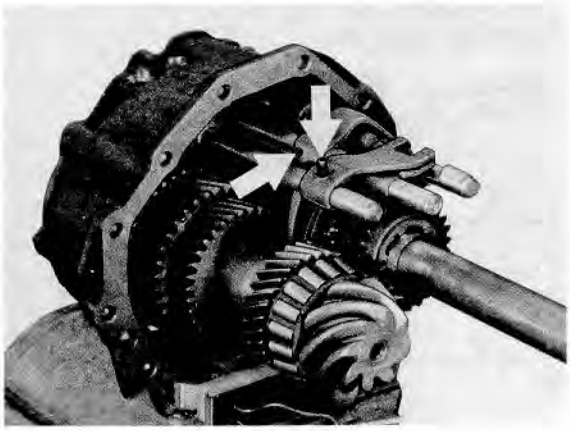
Pull cylindrical roller bearing inner race off of input shaft to make installation easier.

10. Put selector rods in neutral position and make sure lock pieces are positioned correctly (see Page 34 - 19).

11. Slide in 3rd and 4th gear selector rod with small lock piece (insert with grease).

12. Lock 3rd and 4th gear selector fork on selector rod with a pin, counter-holding with a hammer.

13. Lock dog for 1st and 2nd gear selector rod onto rod with a pin. Counterhold with hammer.



14. Screw in stop and locking bolts for selector rods with seals and tighten to a torque of 30 Nm (22 ftlb).

15. Clamp 4th gear/drive pinion in a vice. Make sure to use soft jaws!

16. Determine shim for 5th gear wheel.

Measure distance "a" with a depth gage and find thickness and part number of shim from the following table.

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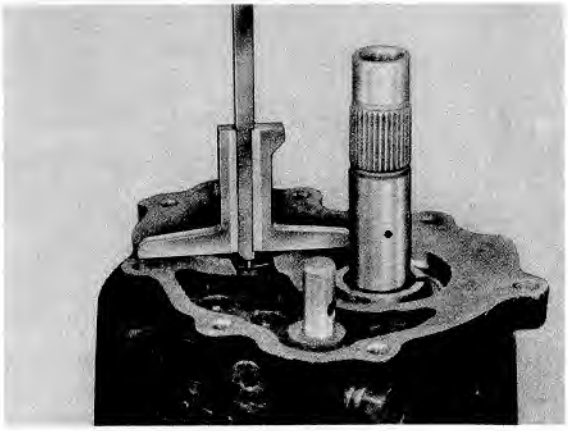
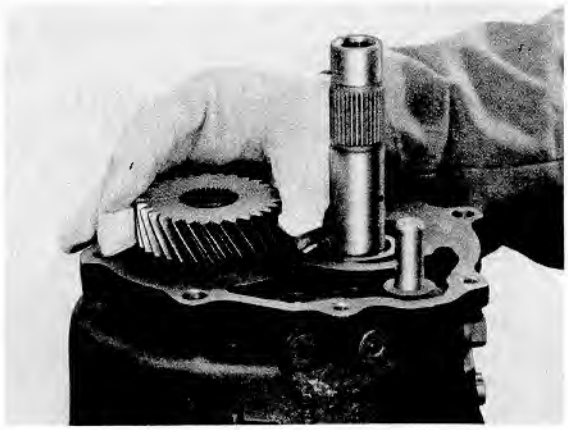
Distance "a" (mm)	Shim Thick-ness (mm)	Shim Part Number
8.35...8.64	1.1	016 311 391
8.65...8.94	1.4	016 311 391 A
8.95...9.24	1.7	016 311 391 B
9.25...9.54	2.0	016 311 391 C
9.55...9.84	2.3	016 311 391 D



17. Heat 5th gear/drive pinion to about 120°C/248°F and mount gear with collar facing drive pinion. If necessary, drive on against stop with a suitable mandrel.



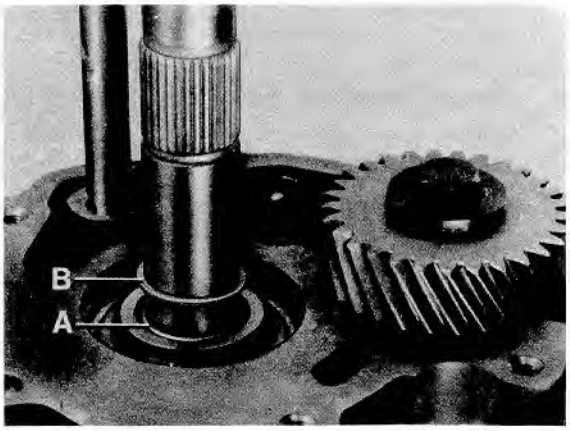
18. Tighten hex bolt for drive pinion to a torque of 70 Nm (51 ftlb).

19. Clamp input shaft in a vice so that shafts are vertical.

20. Lightly grease cylindrical rollers of input shaft bearing and press outward.

21. Center input shaft in bearing and slide on inner race of cylindrical roller bearing.

22. Insert circlip for cylindrical roller bearing inner race and put on thrust washer.



A - Circlip
B - Thrust washer

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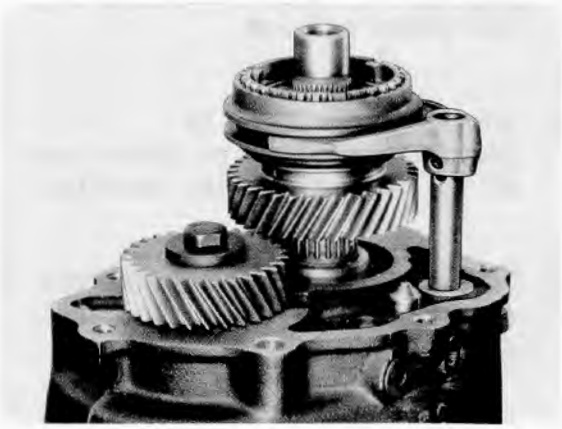
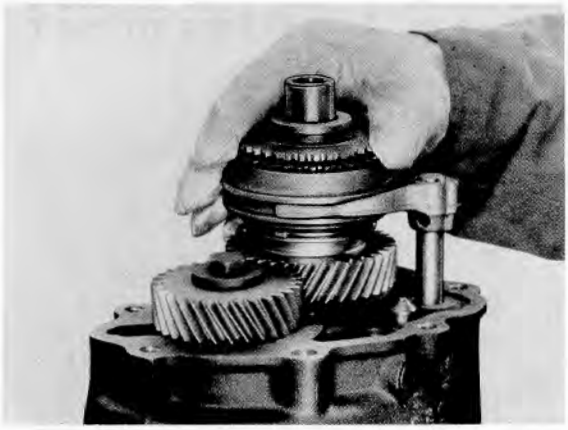
23. Mount 5th gear wheel with synchronizer and sliding sleeve, needle bearing, and selector fork. Lock selector fork onto selector rod with pin, counterholding with hammer.



24. Insert circlip for synchronizer.

25. Insert 5th gear synchromesh ring.

26. Heat clutch to about 120°C/248°F and mount, if necessary driving on until reaching the stop with a suitable pipe section.



27. Heat second ball bearing inner ring to about 120°C/248°F and install.

28. Install dowel sleeves, position gasket, and mount end plate cover.

29. Heat first ball bearing inner race to about 120°C/248°F and install.

30. Tighten bolt for input shaft to a torque of 150 Nm (110 ftlb).

31. Tighten cover/end plate bolts to a torque of 24 Nm (17.7 ftlb).

32. Press in new end cover.

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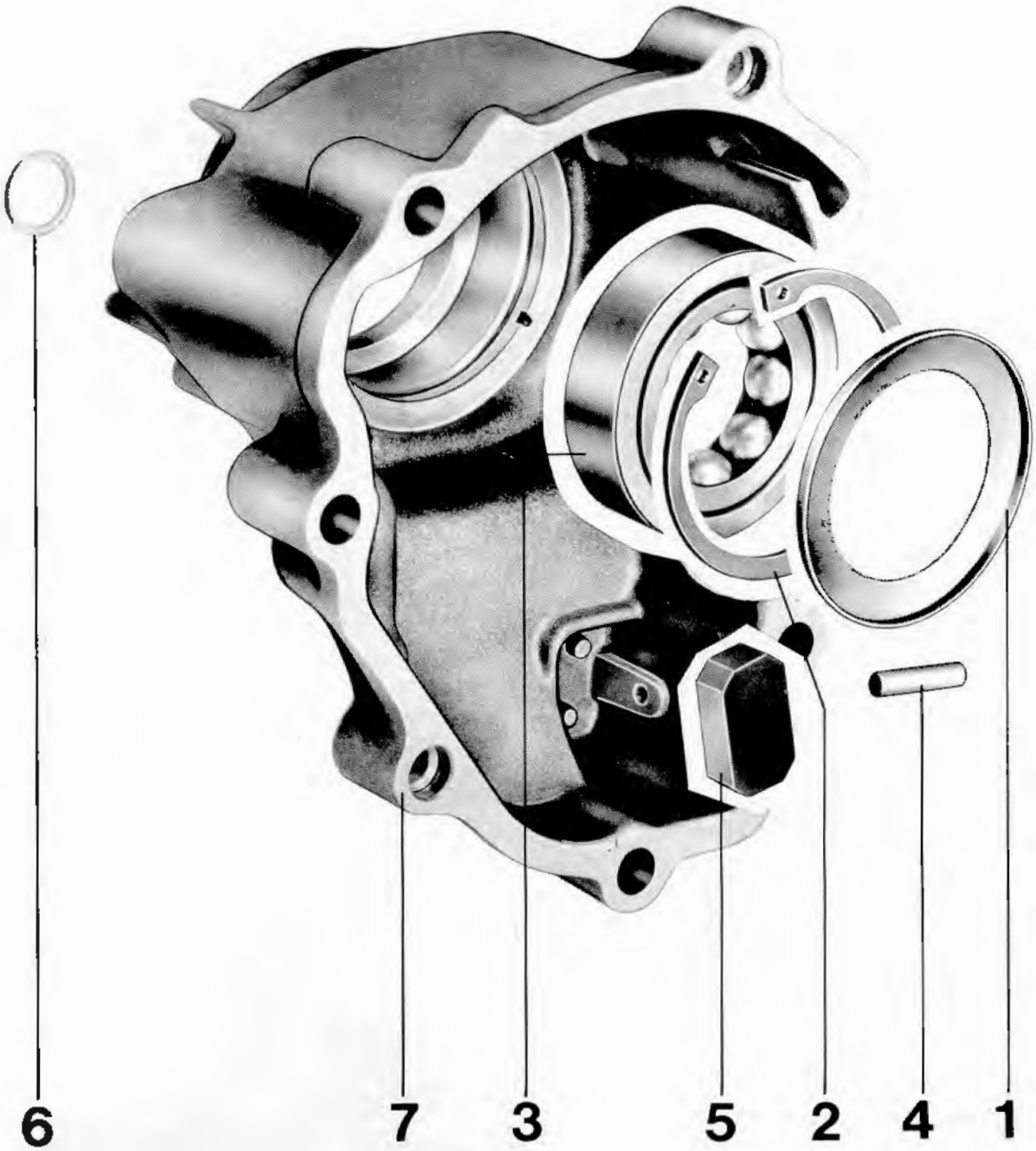
DISASSEMBLING AND ASSEMBLING REAR HOUSING COVER



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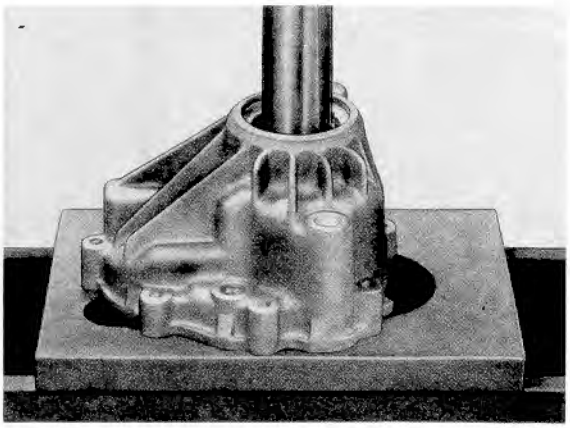
No.	Description	Qty.	Note When: Removing	Installing
1	Pressure plate	1	Knock out with a suitable mandrel	Caulk at three points
2	Circlip	1		
3	Ball bearing	1	Press out with inner race	Heat cover to approx. 120°C/248°F. Insert bearing and press in with VW 30-205.
4	Cylindrical pin	1		
5	Magnet	1		
6	O-ring	1		Replace, coat with lube oil
7	Cover	1		

DISASSEMBLY AND ASSEMBLY INSTRUCTIONS

D i s a s s e m b l y

1. Knock out pressure plate with suitable mandrel and remove circlip.

2. Press out ball bearing, inserting inner race of ball bearing for this purpose.



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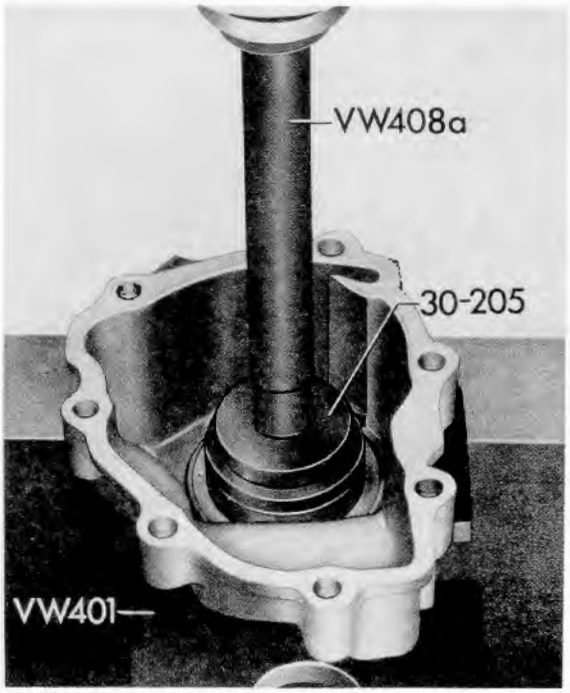
Assembly

1. Heat cover to approx. 120°C/ 248°F, insert bearing, and press in with VW 30-205.



2. Insert circlip into groove. Press in pressure plate and caulk three points to lock.

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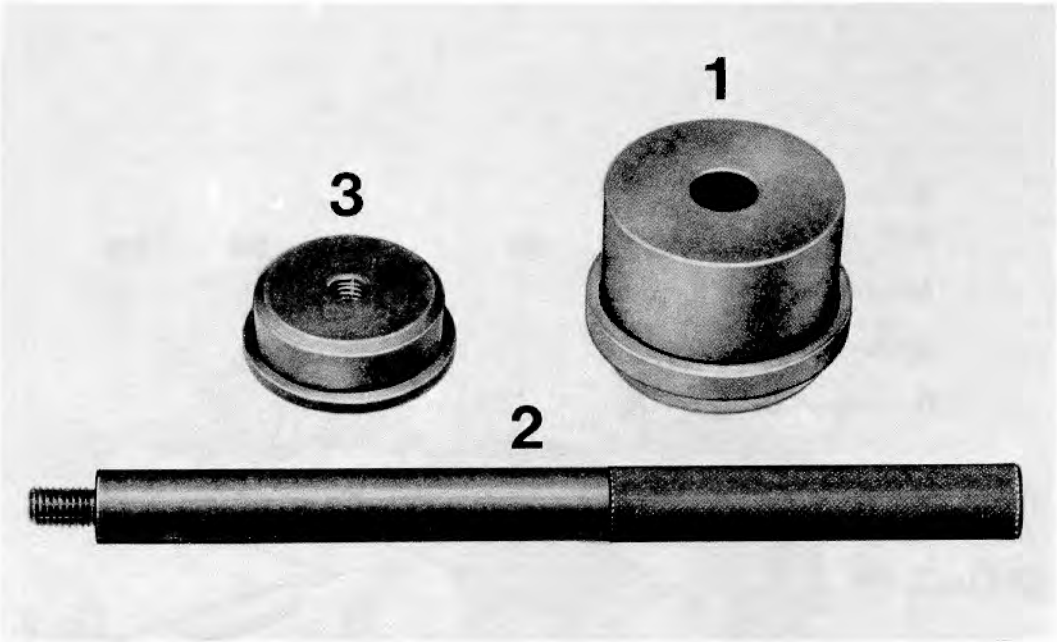
TOOLS



No.	Description	Special Tool	Remarks
1	Pressing tool	VW 472	
2	Pin	P 254	
3	Pressing tool	P 254 b	

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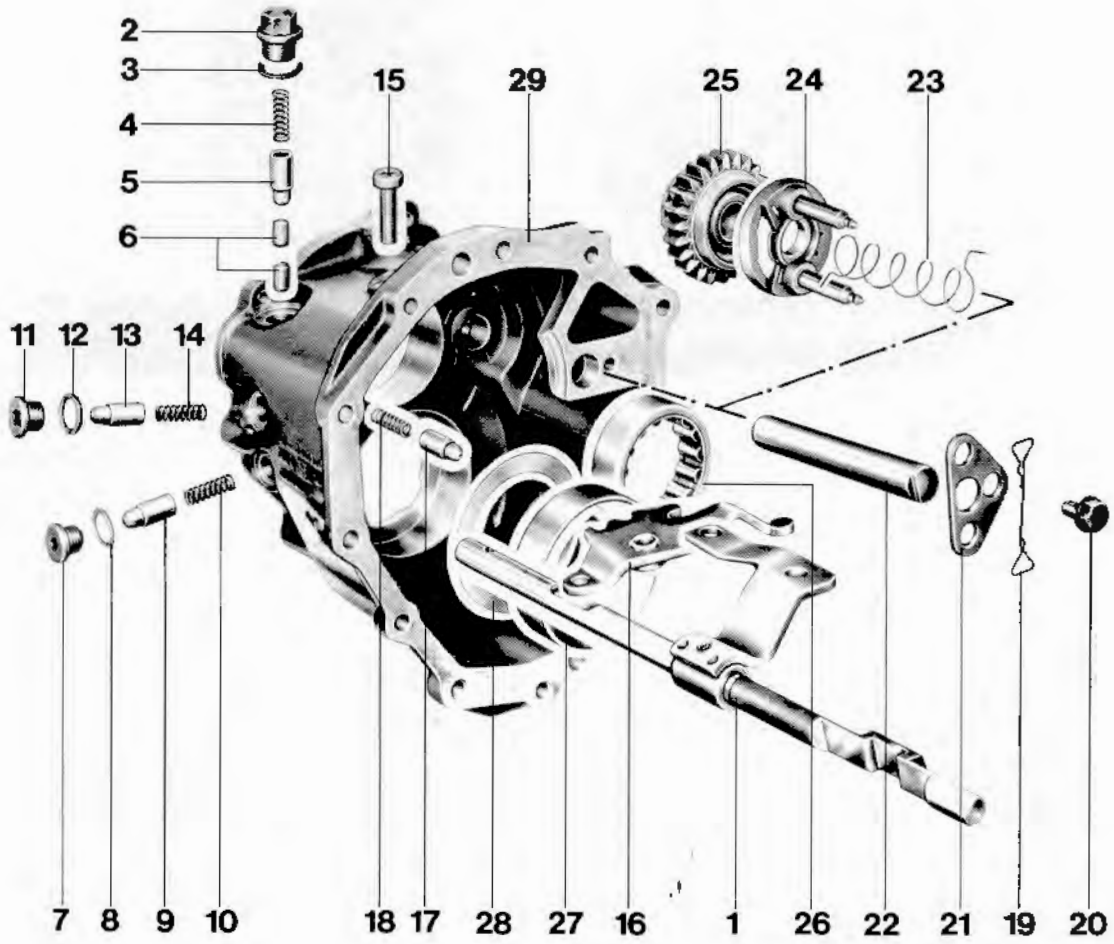
DISASSEMBLING AND ASSEMBLING END PLATE



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No.	Description	Qty.	Note When: Removing	Installing
1	Shift rod for 5th and reverse gears	1		Available only as complete spare part
2	Threaded sleeve	1		Tightening torque 30 Nm (22 ftlb)
3	Seal ring	1		Replace
4	Spring	1		
5	Bushing	1		
6	Locking piece	2		
7	Stop screw	1		Tightening torque 30 Nm (22 ftlb) Do not confuse with bolt position 11
8	Gasket (Paper)	1		Replace, do not confuse with seal ring position 12.
9	Sleeve	1		
10	Spring	1		
11	Locking bolt	1		Tightening torque 30 Nm (22 ftlb) Do not confuse with screw position 7.
12	Seal ring	1		Replace if necessary. Do not confuse with gasket position 8.
13	Sleeve	1		
14	Spring	1		
15	Pan head bolt	1		Adjust operating lever and tighten bolt to torque of 35 Nm (26 ftlb).
16	Operating lever	1		Adjust
17	Sleeve	1		
18	Spring	1		

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No.	Description	Qty.	Note When: Removing	Installing
19	Spring clamp	1		
20	Hex bolt with collar	1		Tightening torque 24 Nm (17.7 ftlb)
21	Holding plate	1		??????? of holes for locking pins towards end plate
22	Reverse gear shaft	1		
23	Spring	1		Locate single-angled end in recess of synchromesh ring. Turn double-angled end to the left and locate in opening in end plate.
24*	Synchromesh ring	1		Check for wear.
25	Reverse gear	1		
26	Cylinder roller bearing outer race	1	Press out with P 254 and P 254 b	Press into correct position with P 254 and P 254 b.
27	Tapered roller bearing outer race	1	Press out with suitable mandrel crosswise	Press in with VW 472
28	Shim S4	X	Note thickness for reinstalling	Determine new thickness if necessary
29	End plate	1		If replaced, determine new thickness for shim S4

*Install synchromesh ring in correct position. The flattened side must point to gear set (see Page 34 - 32).

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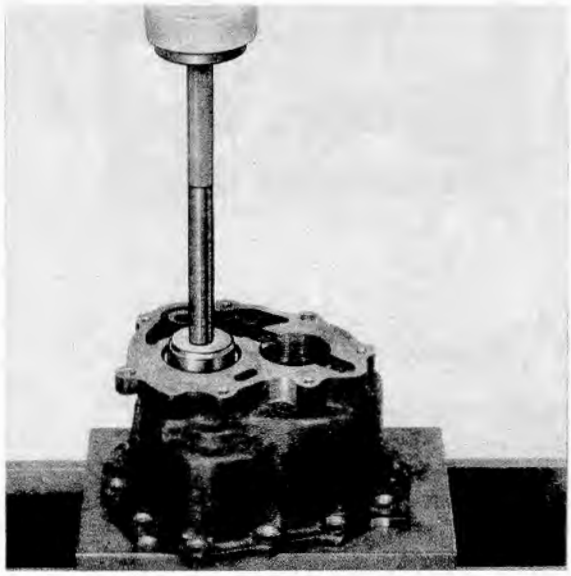
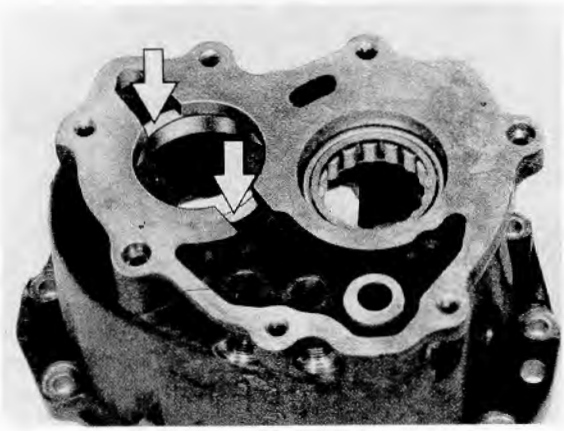
DISASSEMBLY AND ASSEMBLY INSTRUCTIONS

D i s a s s e m b l y

1. Press out cylindrical roller bearing outer race with P 254 and P 254 b.

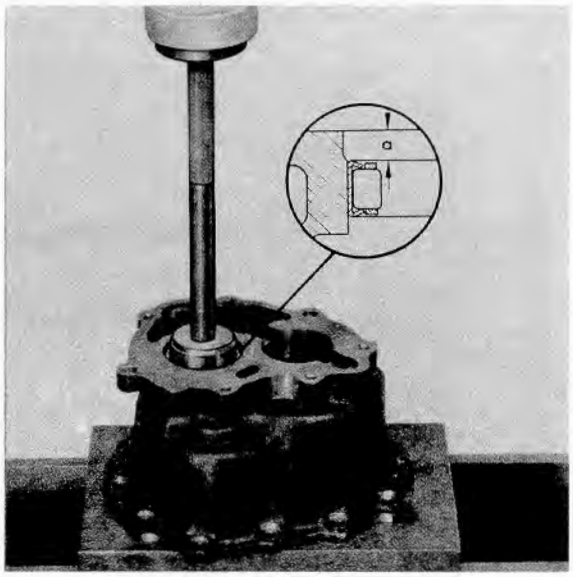


2. Press out tapered roller bearing outer race with suitable mandrel crosswise.

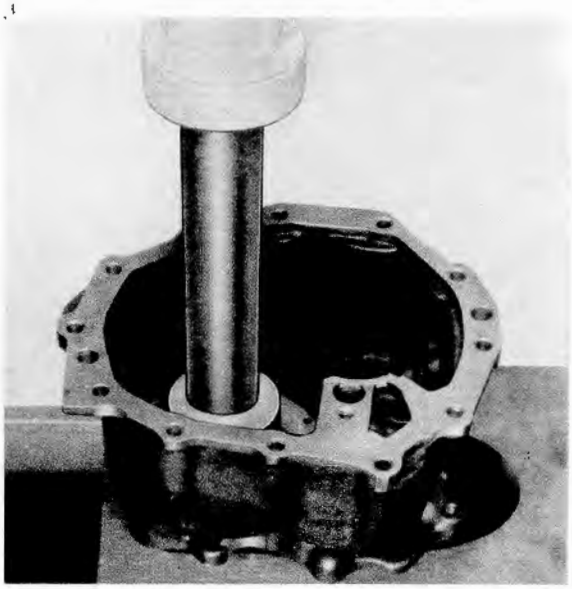


A s s e m b l y

1. Press in cylindrical roller bearing outer race to correct position with P 254 and P 254 b. Pressing depth a = 8.5 to 9.0 mm.



2. Press in tapered roller bearing outer race with VW 472.



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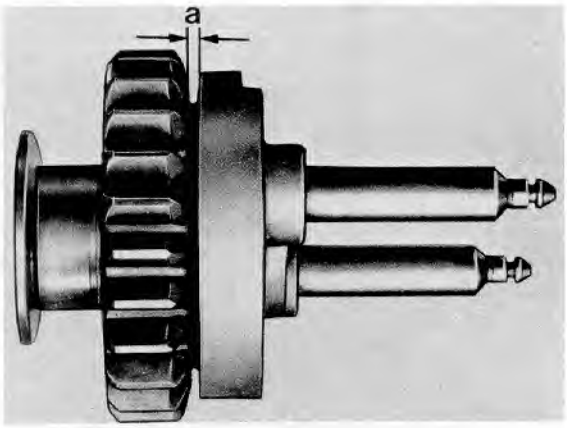
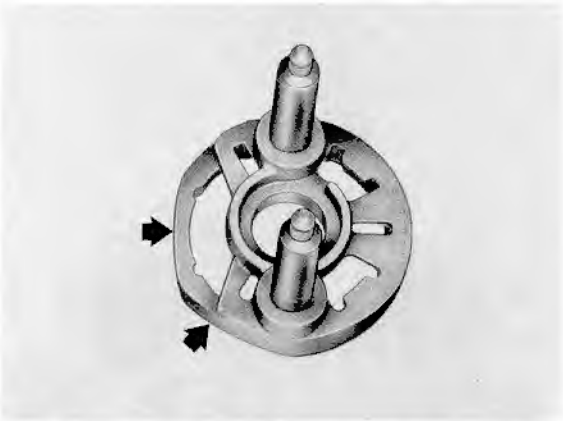
3. Check synchromesh ring. Press synchromesh ring on cone of gear and measure clearance "a" with a feeler gage blade.

Clearance "a"	New Installed Distance	Wear Limit
Reverse gear	0.75 to 2.3 mm	0.2 mm

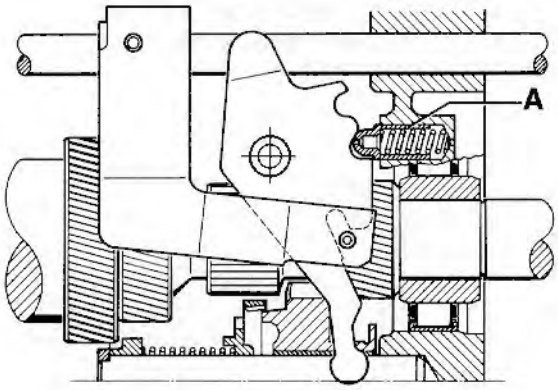


4. Install shifting gear for reverse gear along with synchronizer. The flattened side of the synchromesh ring must point to gear set.



5. Lightly grease locking piece and insert in correct position.

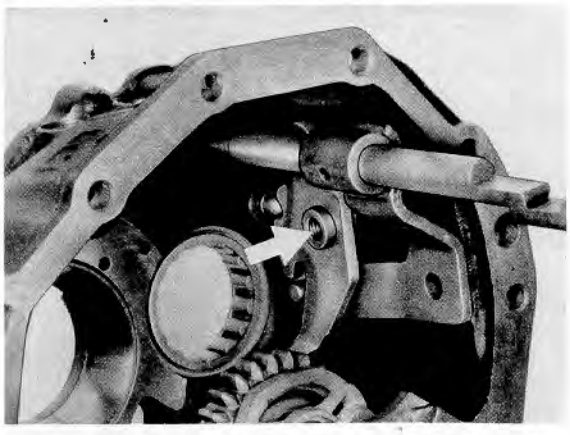
6. Adjust operating lever: Insert reverse gear arrest.



A - Reverse gear arrest

Insert selector rod for 5th and reverse gears as well as operating lever in correct position.

Press operating lever in direction of arrow until it rests on selector rod and in dog of shift gear.



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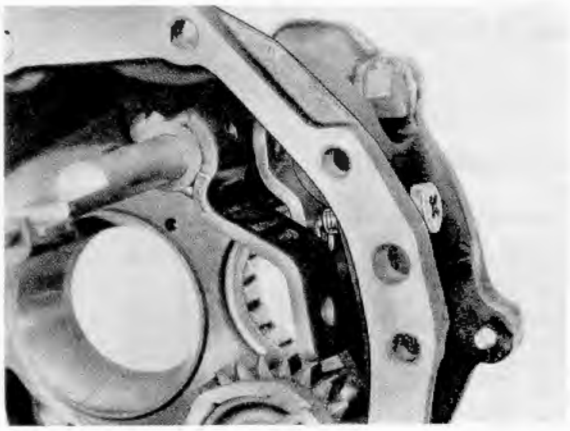
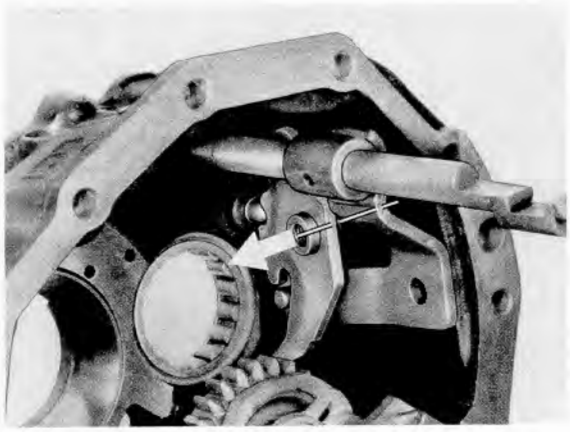
Screw in adjusting bolt until it stops on threaded sleeve.



Press operating lever against bolt and loosen bolt until the beginning of threading audibly meshes in threaded sleeve. (loosen at least 1/4th turn).



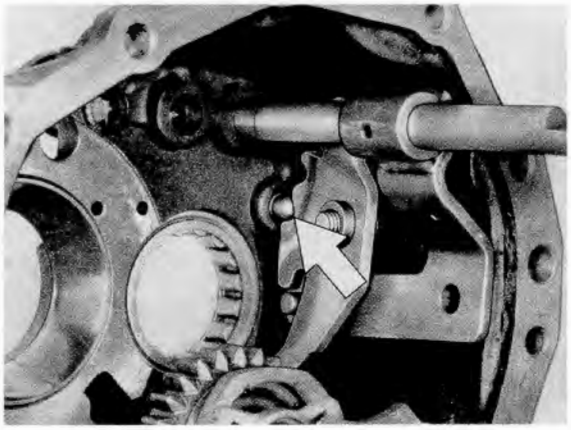
Screw in bolt and tighten to torque of 35 Nm (25 ftlb).

Install 5th gear arrest.

Engage reverse gear several times and check reversing mechanism for ease of movement at all points.

N o t e

Operating lever has been adjusted correctly when it is centered exactly above bushing for reverse gear arrest.



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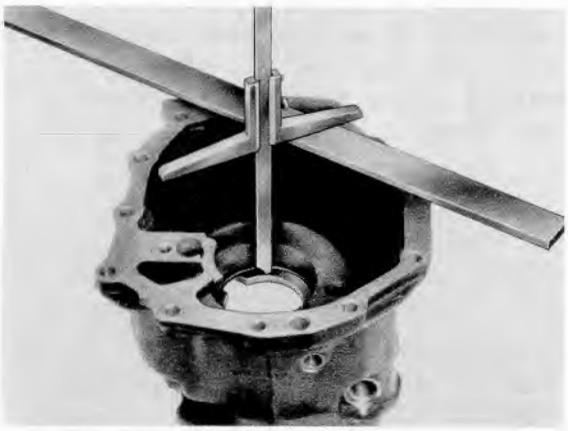
Determining New Thickness of Shim "S 4"

This procedure will be necessary when replacing the end plate. It provides preloading for the drive pinion tapered roller bearings.



Measure housing depth "a" of old and new end plates, and determine difference.

Example:

Old end plate housing depth "a"	=	119.10 mm
New end plate housing depth "a"	=	119.35 mm
		-
Difference		0.25 mm

If new end plate is deeper, install thicker shim S4.
If old end bracket is deeper, install thinner shim S4.

Example:

Old shim	0.95 mm
+Difference	0.25 mm
	-
New shim S4	1.20 mm

Replacement Part No.	Thickness (mm)
016 311 393	0.24
016 311 393 A	0.27
016 311 393 B	0.30
016 311 393 C	0.33
016 311 393 D	0.36
016 311 393 E	0.39
016 311 393 F	0.42
016 311 393 G	0.45
016 311 393 H	0.69
016 311 393 J	0.93
016 311 393 K	1.17
016 311 393 L	1.41

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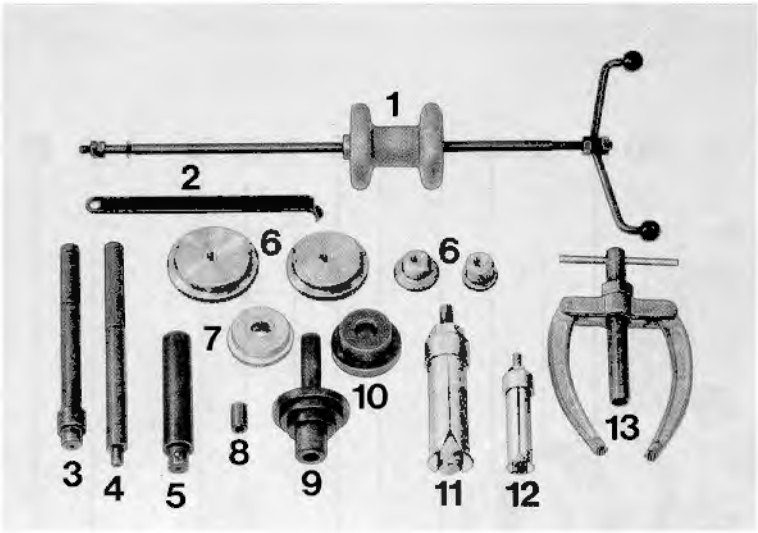
TOOLS



No.	Description	Special Tool	Remarks
1	Slide hammer	VW 771	
2	Puller	VW 681	
3	Mandrel	VW 295	
4	Pin	P 254	
5	Mandrel	30-505	
6	Thrust piece	9247/1-4	
7	Thrust pad	VW 30-205	
8	Threaded sleeve	VW 771/15	
9	Mandrel	VW 2062	
10	Thrust pad	VW 511	
11	Internal puller 46 - 56 mm	-	As commonly used
12	Internal puller 30 - 37 mm	-	As commonly used
13	Counter support	-	As commonly used

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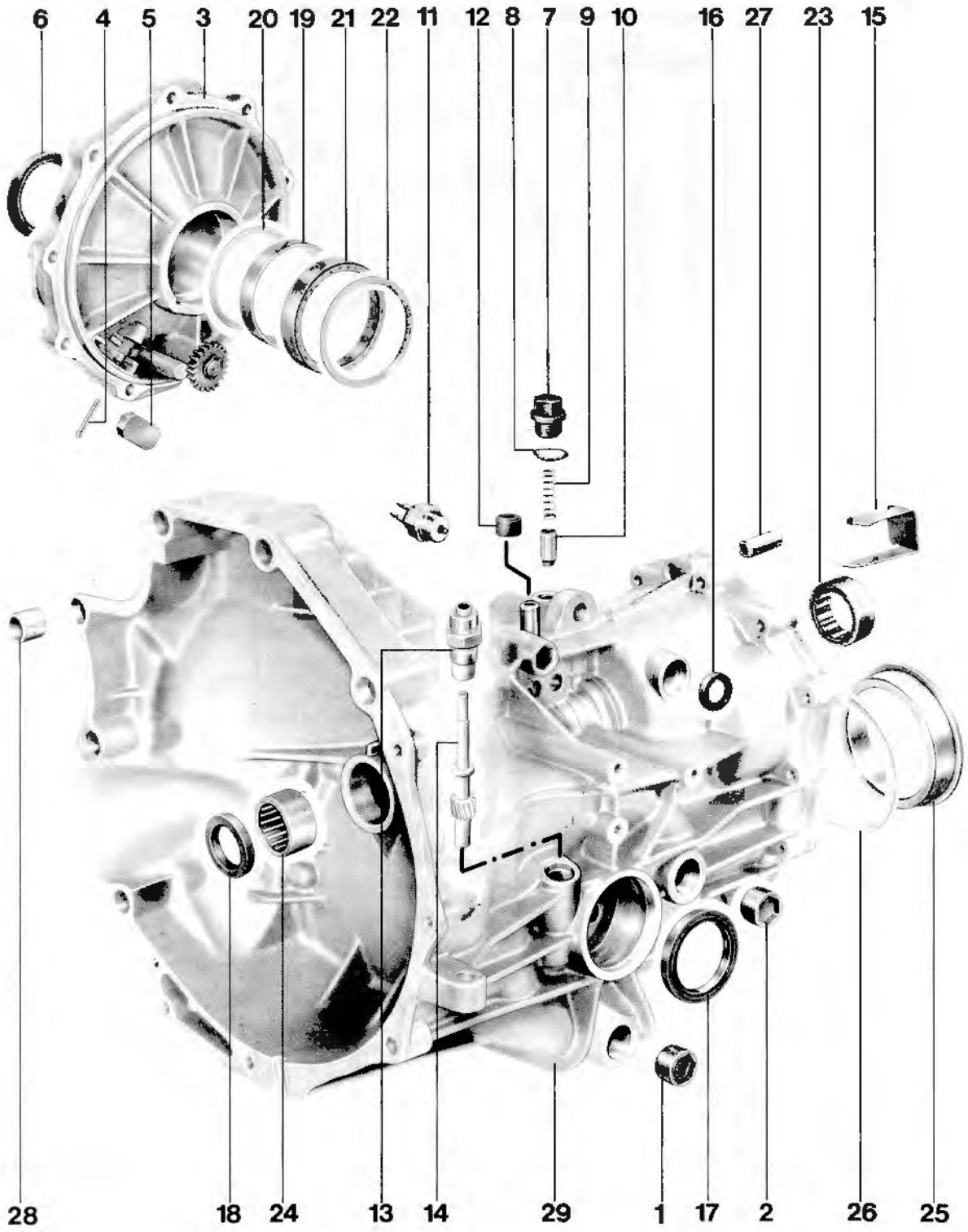
DISASSEMBLING AND ASSEMBLING TRANSMISSION HOUSING



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No.	Description	Qty.	Removing	Note When: Installing
1	Drain plug	1		Tightening torque 24 Nm (17.7 ftlb)
2	Filling bolt	1		Tightening torque 24 Nm (17.7 ftlb)
3	Cover	1		When replacing, adjust gear ring.
4	Clamping sleeve	1		
5	Magnet	1		Clean
6	Seal ring	1		Drive in to stop with VW 2062. Pack space between sealing lips with multi-purpose grease.
7	Threaded sleeve	1		Tightening torque 30 Nm (22 ftlb)
8	Gasket	1		Replace
9	Spring	1		
10	Bushing	1		
11	Backup light switch	1		Tightening torque 42 Nm (30 ftlb)
12	Cap	1	Pull off	
13	Speedometer socket	1		Tightening torque 42 Nm (30 ftlb)
14	Speedometer pinion	1		Oil guide pin

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No.	Description	Qty.	Note When: Removing	Installing
15	Deflector	1	Press down retainer with small screw-driver applied through vent pipe and pull out deflector.	Engage retainer in vent pipe.
16	Seal ring	1	Pull out with VW 681	Replace, packing space between sealing lips with multi-purpose grease.
17	Seal ring	1		Drive in to stop with VW 2062. Pack space between sealing lips with multi-purpose grease.
18	Seal ring	1		Insert only after installing gear set. Oil sealing lip. Drive into housing to a depth of 1.5 mm with Special Tool 9178 and suitable pipe section.
19	Tapered roller bearing outer race	1	Pull out with internal puller	Press in with VW 30-205 and VW 30-505.
20	Shim S2	X	Note thickness for reinstall-ation	Determine new thick-ness if necessary.
21	Tapered roller bearing outer race	1	Pull out with internal puller	Drive in with VW 511 and VW 295.

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No.	Description	Qty.	Note When: Removing	Installing
22	Shim S1	X	Note thickness for re-installation	Determine new thickness if necessary
23	Needle bearing	1	Pull out with internal puller and VW 771	Drive in with Special Tool 9247/1 and P 254
24	Needle bearing	1	Pull out with internal puller and VW 771	Drive in with Special Tool 9247/2 and P 254
25	Tapered roller bearing outer race	1	When replacing, measure installed position (actual distance) of drive pinion prior to removal. Drive out with Special Tool 9247/4 and VW 771.	Heat housing and press in with Special Tool 9247/3 and P 254
26	Shim S3	X	Note thickness for reinstallation	Determine new thickness if necessary.
27	Dowel sleeve	2		
28	Dowel sleeve	2		
29	Housing	1	When replacing, measure installed position (actual distance) of drive pinion before disassembly.	

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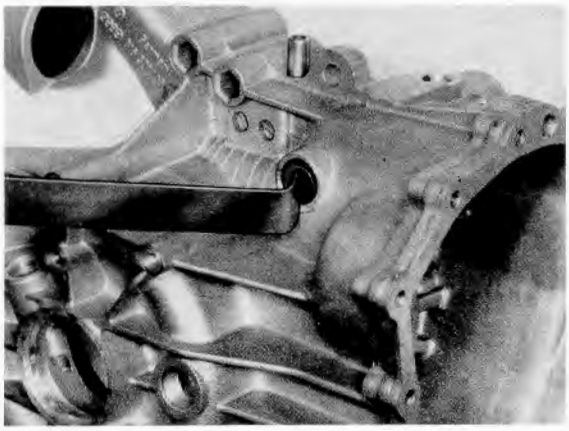
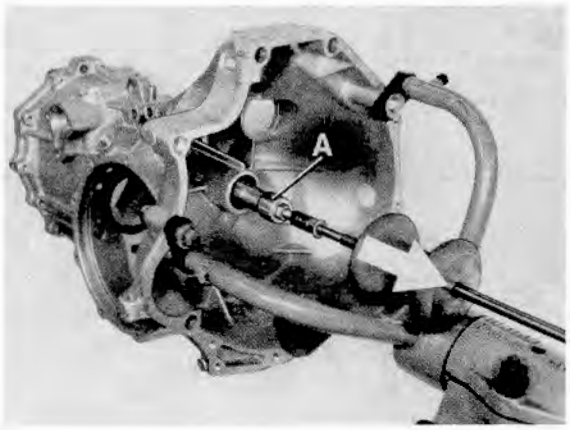
DISASSEMBLY AND ASSEMBLY INSTRUCTIONS

D i s a s s e m b l y

1. Remove seal for flange shaft with puller VW 681.

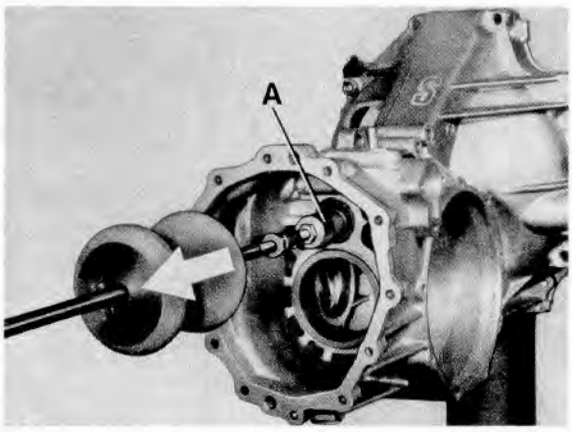


2. Remove front needle bearing for input shaft with an internal puller, for example Kukko 21/5, Special Tool VW 771, and threaded sleeve VW 771/15.

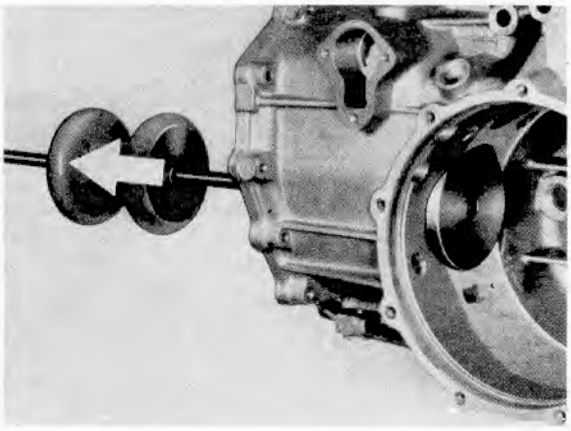


A - Internal puller

3. Remove rear needle bearing for input shaft with an internal claw puller, for example Kukko 21/5, slide hammer VW 771, and threaded sleeve VW 771/15.



4. Knock out tapered roller bearing outer race for drive pinion with Special Tool 9247/4 and slide hammer VW 771.



N o t e

Since the tapered roller bearing outer race has a tight press-fit in the housing, it is a good idea to heat the housing for disassembly as well.

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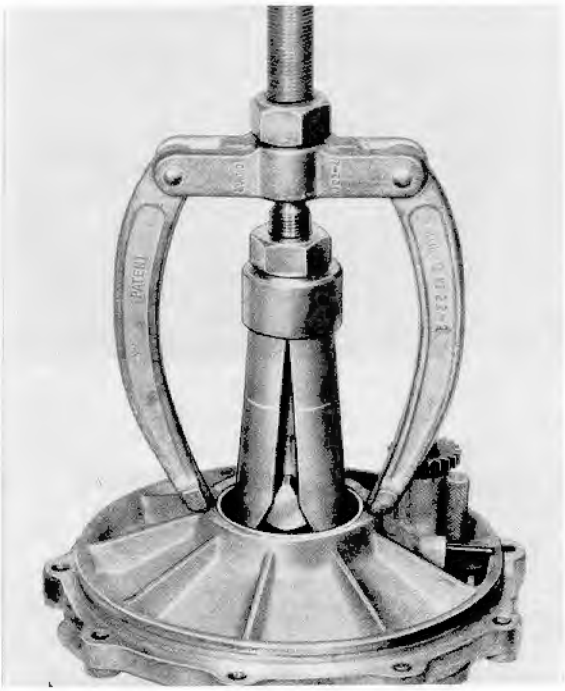
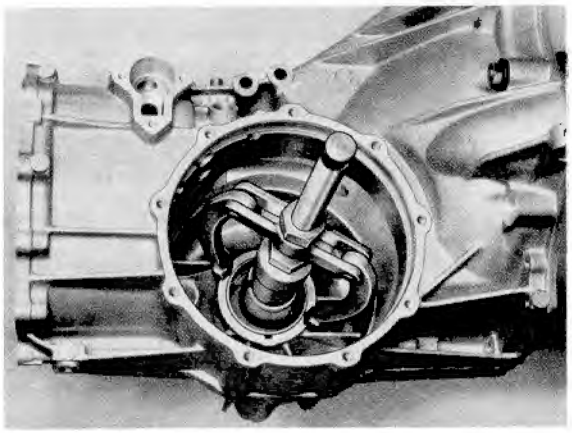
5. Pull out outer race for small tapered roller bearing. Use a 46 to 56 mm internal puller with countersupport for this step.



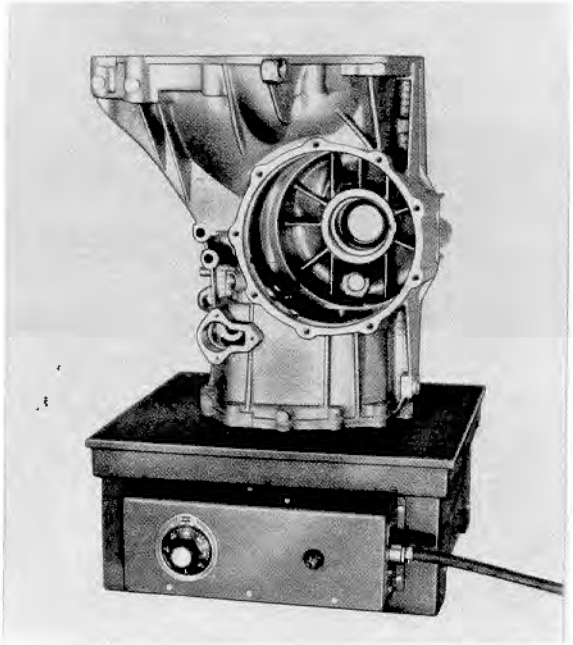
6. Pull out outer race for large tapered roller bearing. Use a 46 to 56 mm internal puller with countersupport for this step.



A s s e m b l y

N o t e

Since the tapered roller bearing outer race for the drive pinion bearing must be installed with a very tight press fit, it is essential to carefully heat the transmission housing before installation. In order to be able to install the outer race without difficulty, housing temperature should be at least 150°C/302°F. Temperatures up to 180°C/356°F will not damage the housing. Heating with hot water or with a washing machine is not sufficient.



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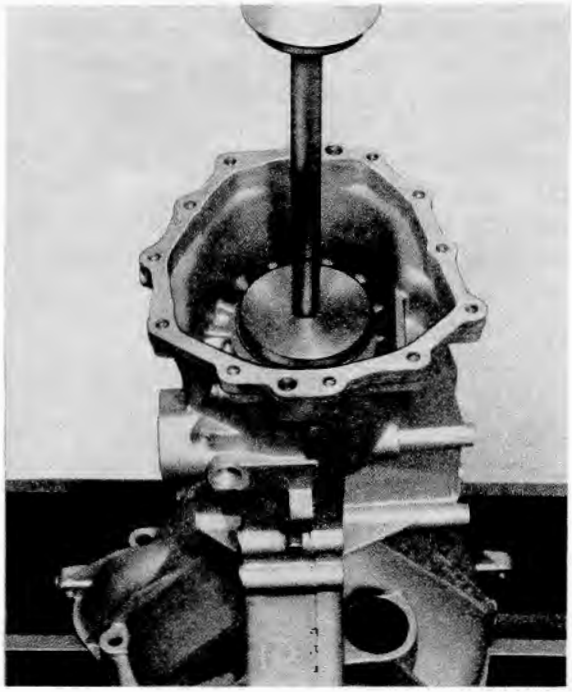
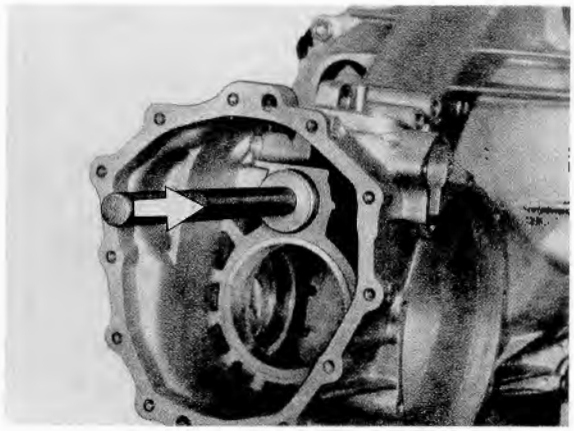
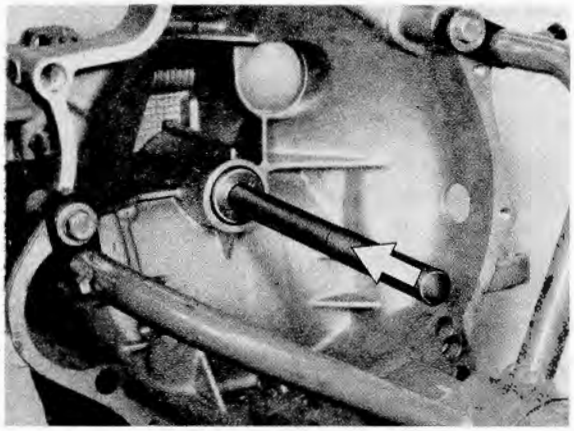
1. Install tapered roller bearing outer race for drive pinion in the heated housing. Always work with a press to avoid canting.
   Use Special Tool 9247/3 and pin P 254. Hold preloading under the press for about 2 more minutes until heat transfer has taken place.



2. Knock in rear needle bearing for input shaft using Special Tool 9247/1.



3. Knock in front needle bearing for input shaft up to stop, using Special Tool 9247/2.



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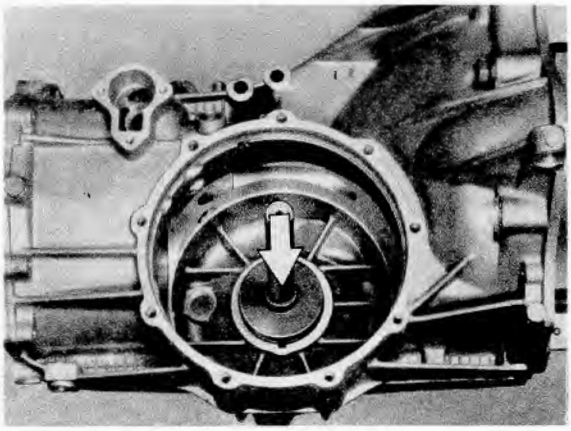
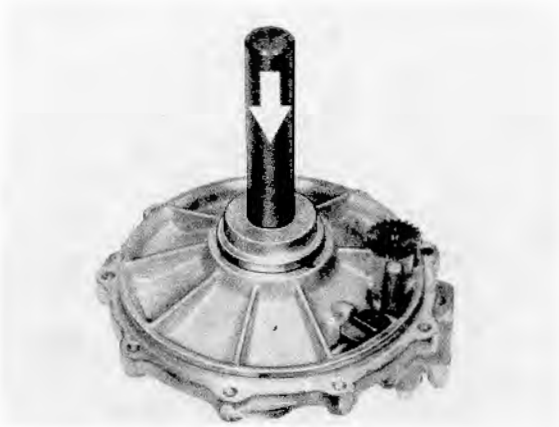
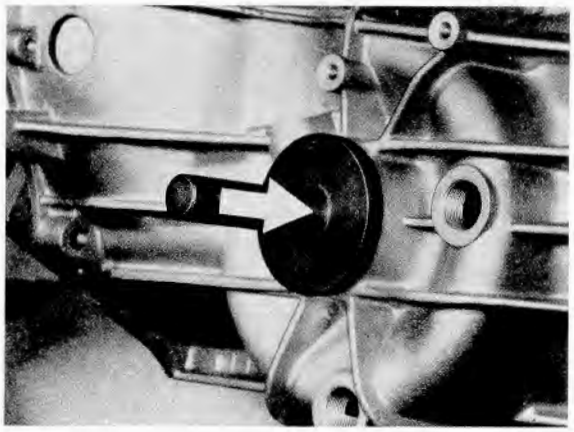
4. Press in outer race for large tapered roller bearing using VW 511 and VW 295.



5. Press in outer race for small tapered roller bearing (inside transmission cover). Heating the cover is recommended. Use thrust pad VW 30-205 and mandrel 30-505.



6. Drive in seal ring for flange shaft up to stop with mandrel VW 2062.



N o t e

It is recommended to install the seals for the flange shafts only after installation of the differential, in order to avoid damage.

7. Drive end seal ring for selector shaft up to stop with a suitable mandrel.

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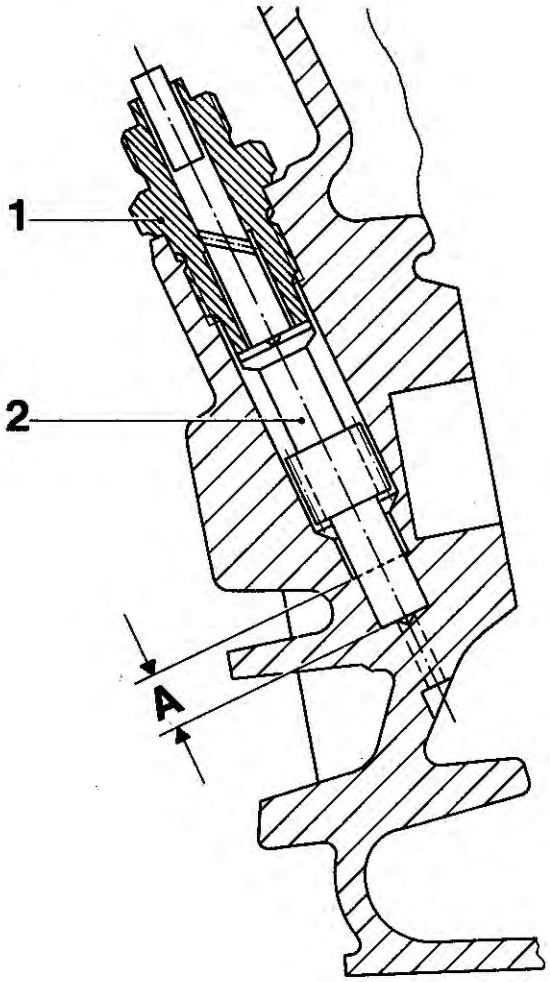
8. Insert speedometer pinion. Prior to assembly, give guide pin a good coat of transmission oil.



1 - Speedometer socket
2 - Speedometer pinion

A - Prior to assembly, lubricate this area well with transmission oil.

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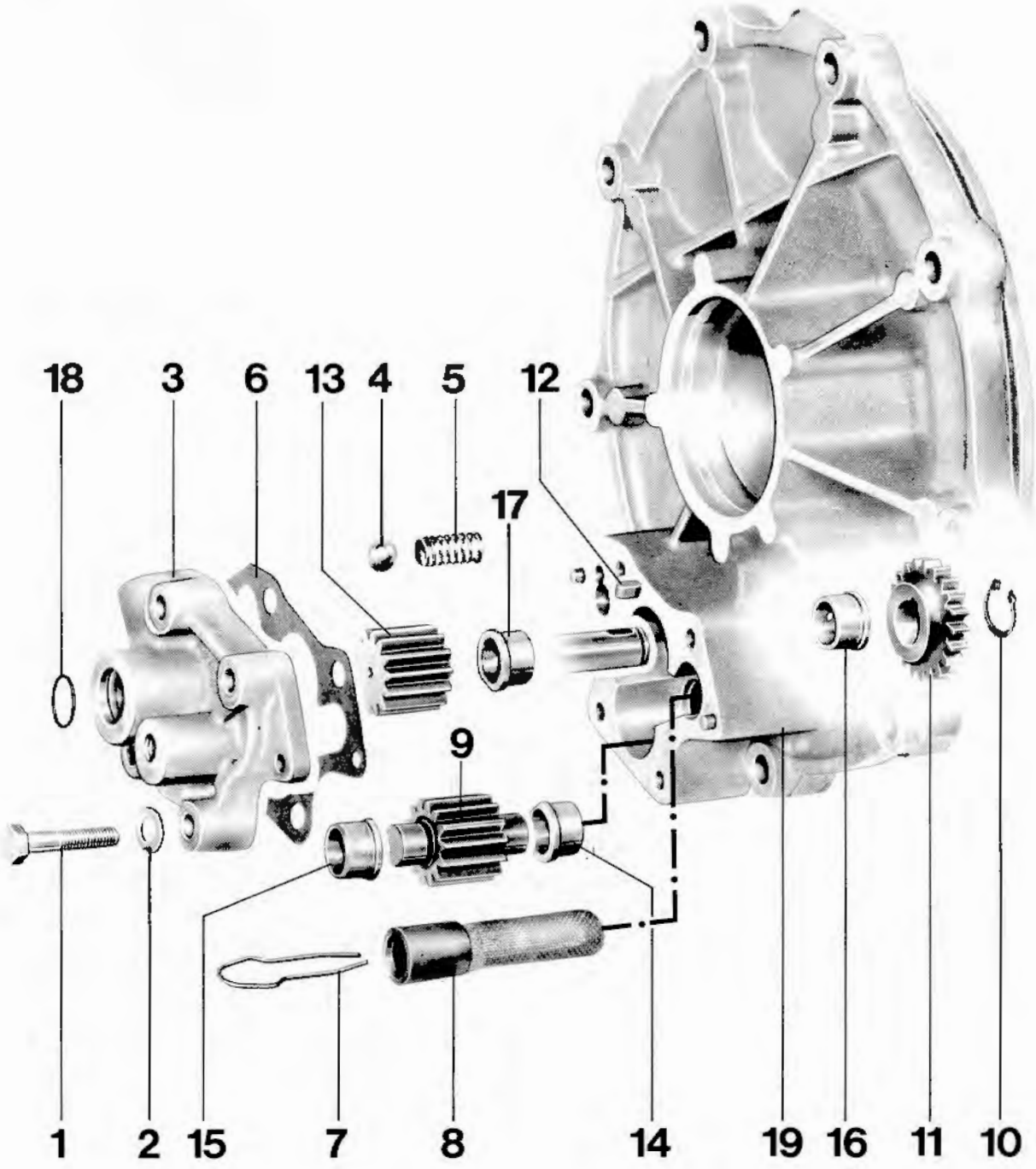
DISASSEMBLING AND ASSEMBLING OIL PUMP



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No.	Description	Qty.	Note When: Removing	Installing
1	Hex bolt	4		Tighten crosswise to torque of 8 Nm (6 ftlb), and check pump for freedom of movement.
2	Washer	4		
3	Cover	1		
4	Ball	1		
5	Spring	1		
6	Gasket	1		Replace, re-determine thickness
7	Holding clip	1		
8	Screen	1		
9	Impeller	1		
10	Circlip	1		
11	Drive gear	1		
12	Woodruff key	1		
13	Impeller	1		
14	Bushing	1	Pull out with suitable internal puller	Drive into correct position with suitable mandrel
15	Bushing	1	Pull out with suitable internal puller	Drive into correct position with suitable mandrel
16	Bushing	1	Pull out with suitable internal puller	Drive into correct position with suitable mandrel
17	Bushing	1	Pull out with suitable internal puller	Drive into correct position with suitable mandrel
18	O-ring	1		Replace, coat with transmission oil
19	Side transmission cover	1		

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DISASSEMBLY AND ASSEMBLY INSTRUCTIONS

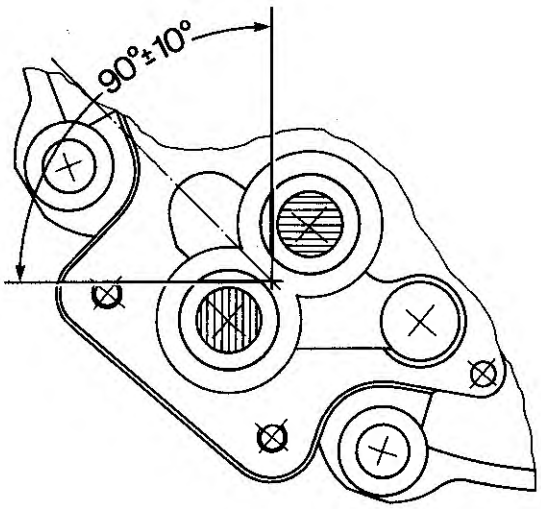
D i s a s s e m b l y

1. Note installation position of bushings for re-installation.

2. Pull out bushings with suitable internal puller.

A s s e m b l y

1. Drive bushing into side transmission cover in correct position until stop with suitable mandrel (see sketch).



NG 300

2. Set end play of pump to 0.05 + 0.1 mm with suitable paper gasket. Gaskets in thicknesses of 0.15 and 0.20 mm are available.

3. Tighten hex bolts for pump cover to a torque of 8 Nm (6 ftlb), and check pump for ease of motion.

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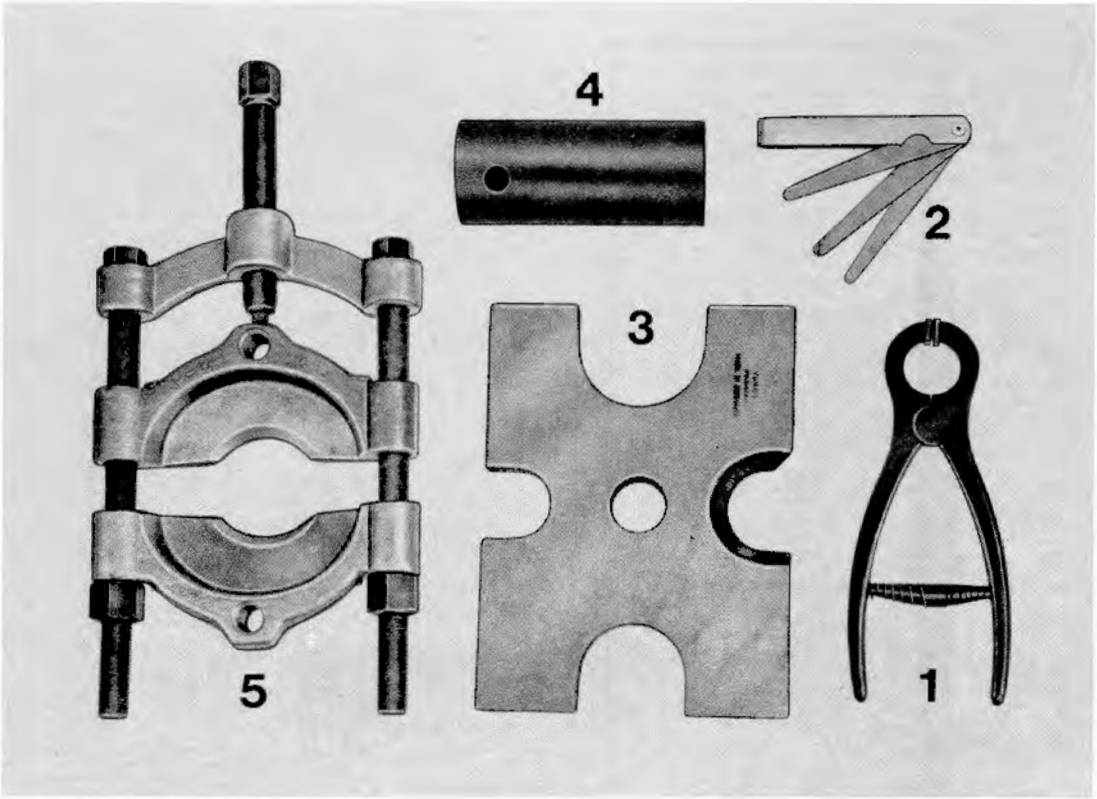
TOOLS



No.	Description	Special Tool	Remarks
1	Circlip pliers	VW 161 a	
2	Feeler blade gage		As commonly used
3	Pressing plate	VW 401	
4	Pipe section	VW 519	
5	Separator		For example, Kukko 15-17 Gr. 1

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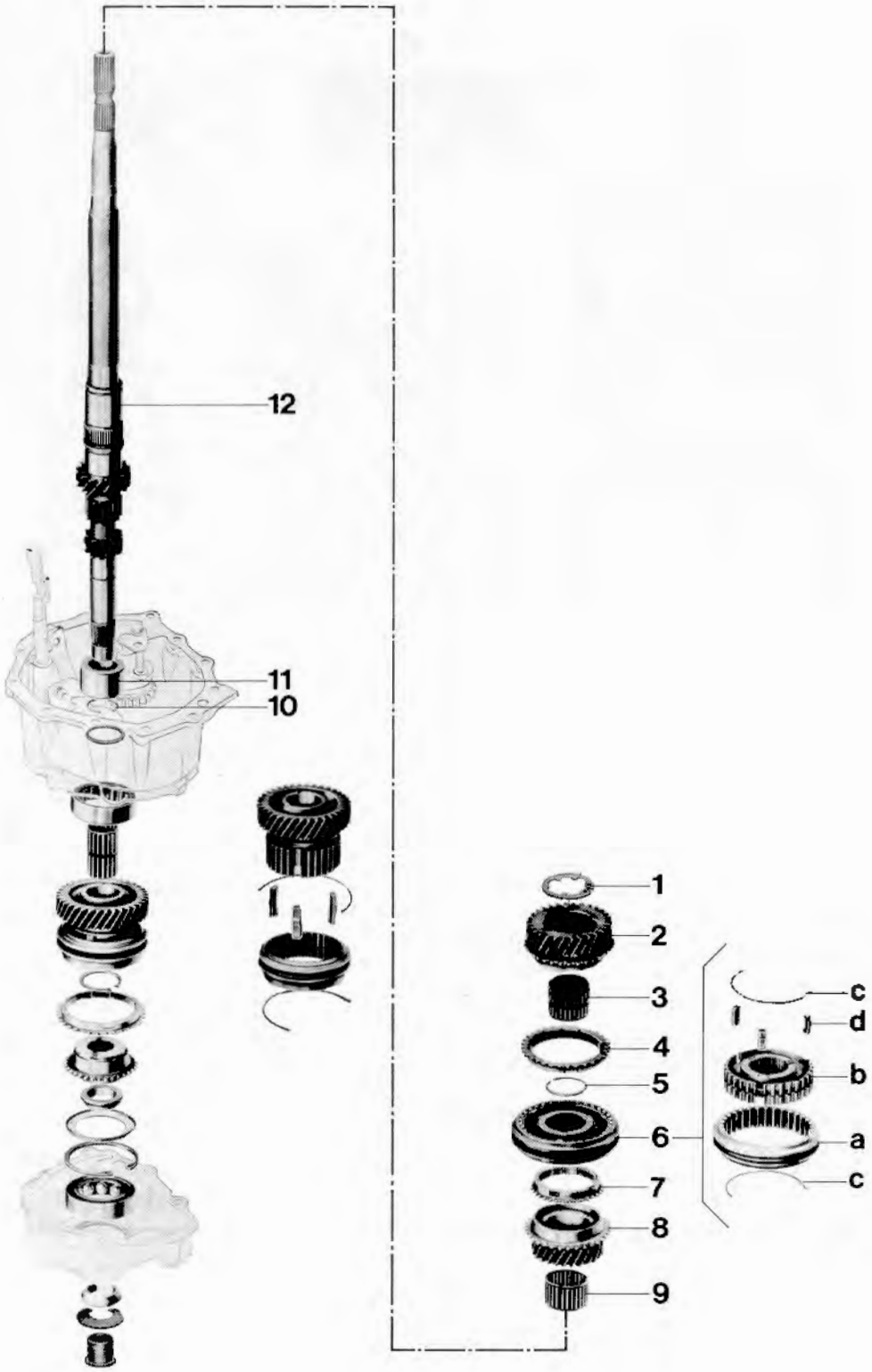
DISASSEMBLING AND ASSEMBLING INPUT SHAFT



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No.	Description	Qty.	Note When: Removing	Installing
1	Circlip	1		
2	Fourth gear	1		End play 0.1 to 0.4 mm
3	Needle bearing	1		Oil with transmission oil
4	Synchromesh ring	1		Check for wear
5	Circlip	1		Re-determine thickness
6	Synchronizer with sliding sleeve for 3rd and 4th gears	1	Press off with 3rd gear wheel	Position correctly, measure end play
a	Sliding sleeve	1		
b	Synchronizer	1		
c	Spring	2		Position correctly.
d	Locking piece	3		
7	Synchromesh ring for 3rd gear	1		Check for wear
8	3rd gear 3. Gang	1		Measure end play between 2nd and 3rd gear wheels. Control value 0.1 to 0.39 mm
9	Needle bearing	1		Oil with transmission oil
10	Circlip ring	1		Install only after installation of input shaft
11	Inner race	1		Install only after installation of input shaft
12	Input shaft	1		

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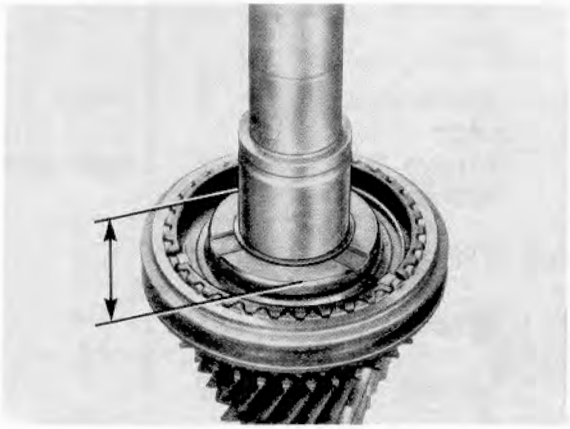
DISASSEMBLY AND ASSEMBLY INSTRUCTIONS

D i s a s s e m b l y

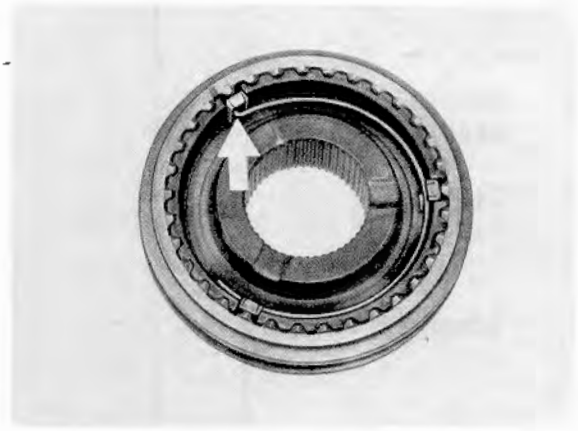
1. Press off sliding sleeve/ synchronizer with 3rd gear wheel.

A s s e m b l y

1. Assemble sliding sleeve and synchronizer for 3rd and 4th gears. It is not necessary to pair in a certain position. However, the wide collar of the hub must face the 4th gear wheel.



2. Mount springs with 120° offset. Angled end of spring must engage in hollow lockpiece.



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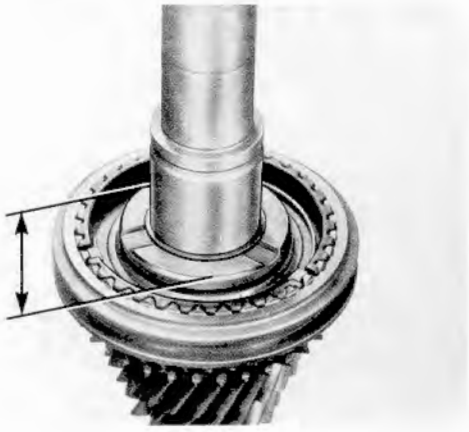
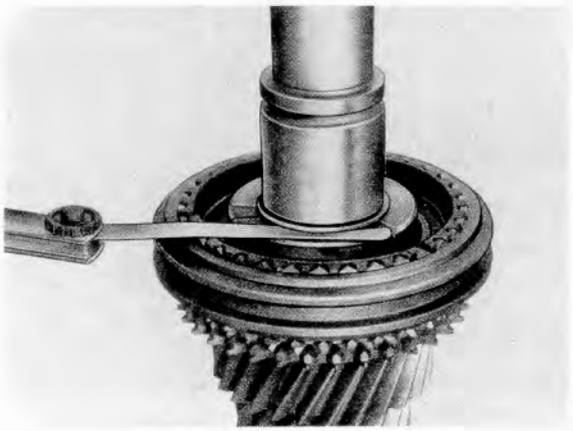
3. Press on sliding sleeve and synchronizer in correct position using VW 519. Turn synchromesh ring so that grooves align with locking pieces.

N o t e

The wide collar of hub must face 4th gear wheel.



4. Measure end play of synchronizer with a feeler gage blade and adjust by selecting the correct circlip. End play should be between 0 and 0.05 mm. The lower value is preferable.



The following circlips are available:

Replacement Part No.	Thickness (mm)
088 311 317	1.50
088 311 317 B	1.56
088 311 317 C	1.62

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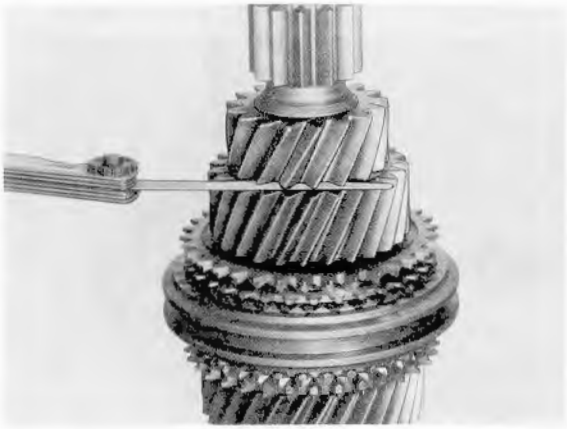
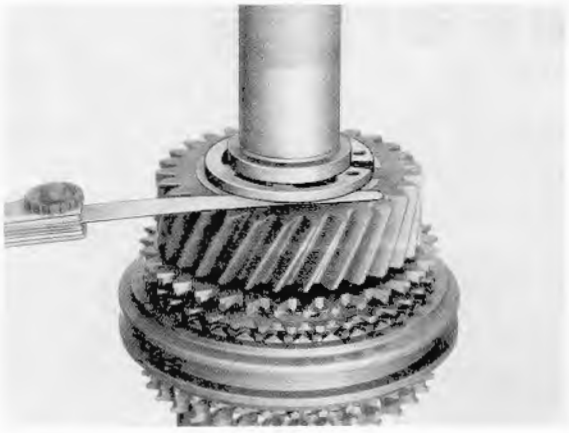
5. Measure play between 2nd and 3rd gears. Nominal value: 0.1 to 0.39 mm. If this tolerance cannot be reached, recheck adjustment of synchronizer.



6. Measure end play on 4th gear. Nominal value: 0.1 to 0.44 mm. If this tolerance can not be reached, recheck adjustment of synchronizer.



Checking Synchromesh Rings

1. Clean synchromesh rings and gears.

2. Press dry synchromesh rings on tapers of gears and measure clearance "a" with a feeler gage blade.

Clearance "a"	New Distance	Wear Limit
3rd and 4th gear	1.0 to 1.7 mm	0.5 mm
5th gear	1.0 to 1.9 mm	0.5 mm

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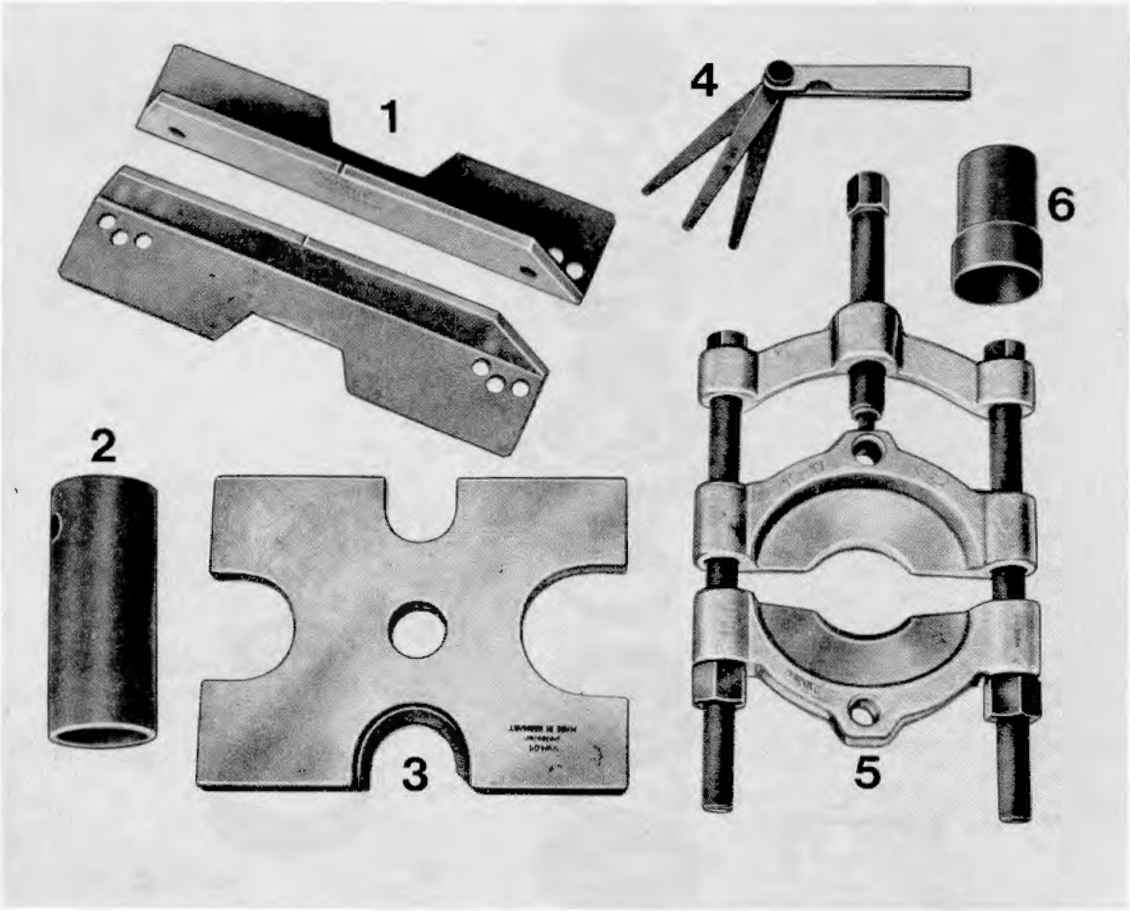
TOOLS



No.	Description	Special Tool	Remarks
1	Support rail	VW 457	
2	Pipe section	VW 519	
3	Pressing plate	VW 401	
4	Feeler blade gage		As commonly used
5	Separator		For example Kukko 15-17 Gr. 1
6	Pressing tool	VW 454	

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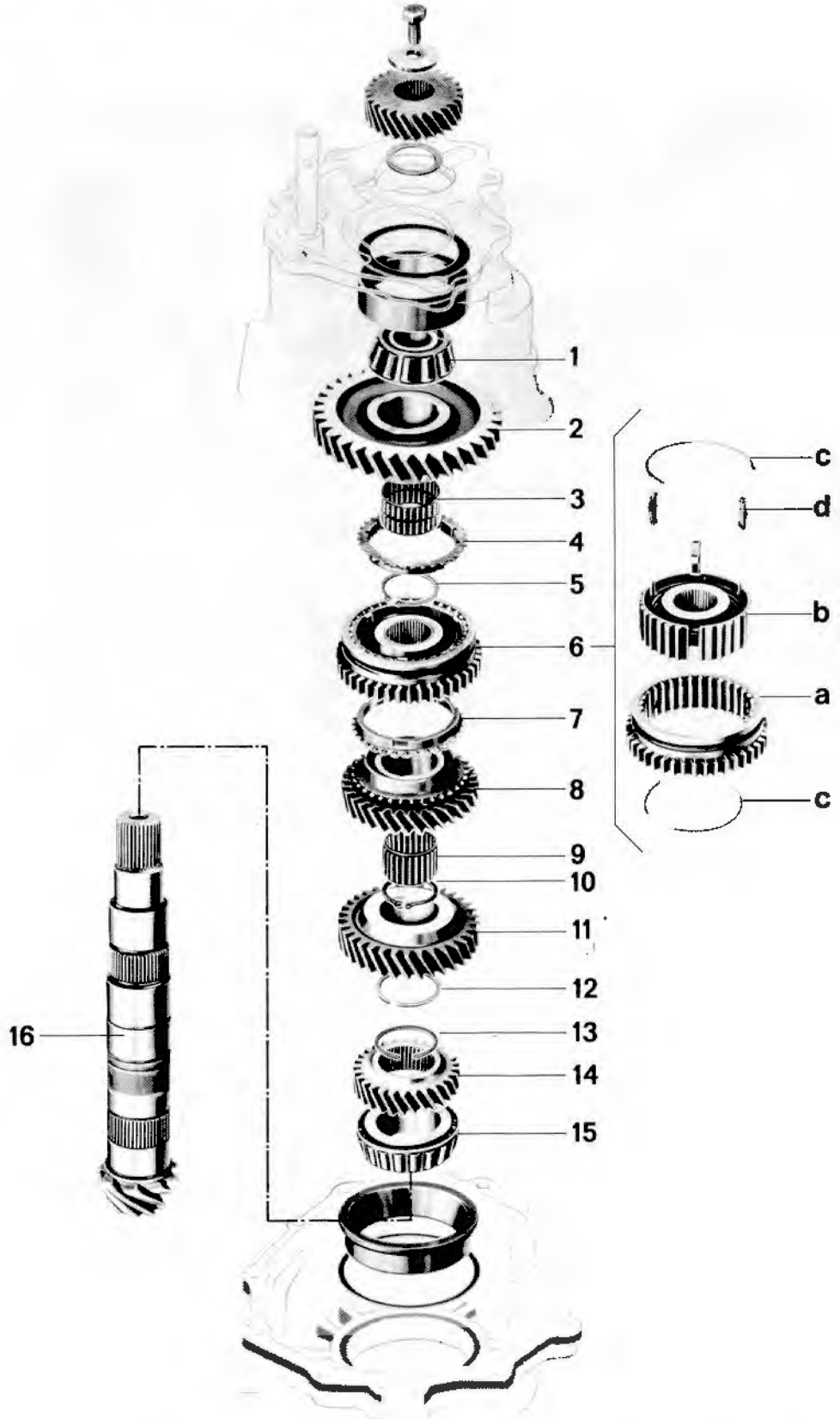
DISASSEMBLING AND ASSEMBLING PINION SHAFT



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No.	Description	Qty.	Note When: Removing	Installing
1	Tapered roller bearing	1	Press off with VW 457	Replace if necessary. Always replace both bearings at same time.
2	1st gear wheel	1		Check end play.
3	Needle bearing	1		Lubricate with gear oil
4	Synchromesh ring for 1st gear	1		Identification: 1 tooth missing every 3. Friction surfaces coated with molybdenum. Spiral groove. Check for wear.
5	Circlip	1		Re-determine thickness
6	Synchronizer with sliding sleeve for 1st and 2nd gears	1		
6a	Sliding sleeve	1		
6b	Synchronizer	1		
6c	Spring	2		Position correctly
6d	Locking piece	3		
7	Synchromesh ring for 2nd gear	1		Friction surface coated with molybdenum spiral groove
8	2nd gear wheel	1		
9	Needle bearing	1		Lubricate with gear oil
10	Circlip	1		Re-determine thickness

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No.	Description	Qty.	Note When: Removing	Installing
11	3rd gear wheel	1		Check for wear. Install warm and press on. Large collar faces 2nd gear wheel. Adjust end play.
12	Circlip	1		Thickness always 2.4 mm
13	Circlip	1		Re-determine thickness
14	4th gear wheel	1		Check for wear. Install warm and press on. Large collar faces 3rd gear wheel. Adjust end play.
15	Tapered roller bearing	1	Press off with separator	Replace if necessary. Always replace both bearings at same time.
16	Pinion shaft	1		Check for wear. Paired with ring gear (pinion set). When replacing pinion set, adjust pinion shaft and ring gear.

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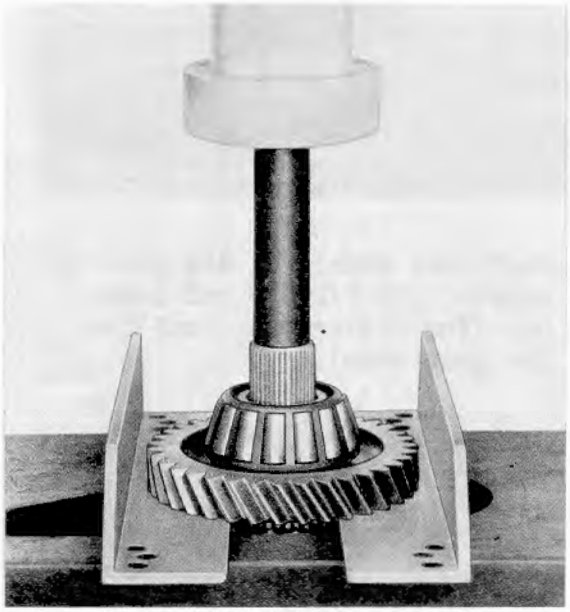
DISASSEMBLY AND ASSEMBLY INSTRUCTIONS

N o t e

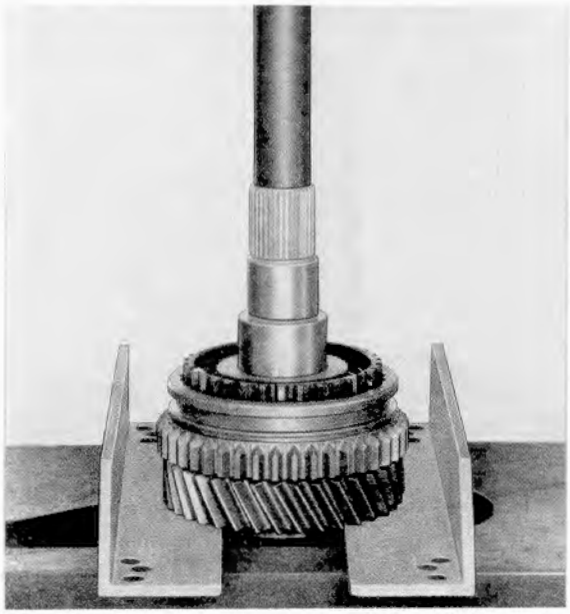
When replacing tapered roller bearings, determine installed position of pinion shaft (actual location) before removing gearbox.

D i s a s s e m b l y

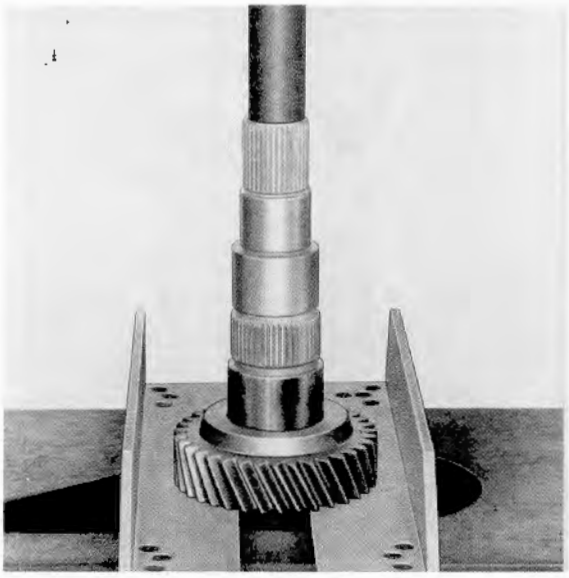
1. Press off inner race of tapered roller bearing with 1st gear. Use support rails VW 457.



2. Press off sliding sleeve and synchronizer with 2nd gear. Use support rails VW 457.



3. Press off 3rd gear wheel.



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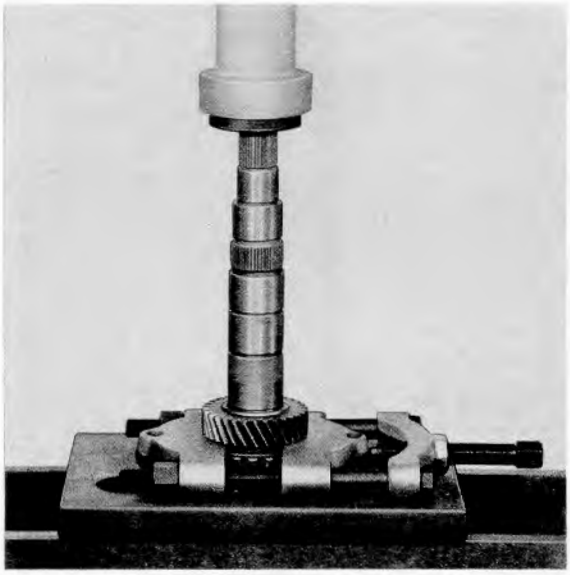
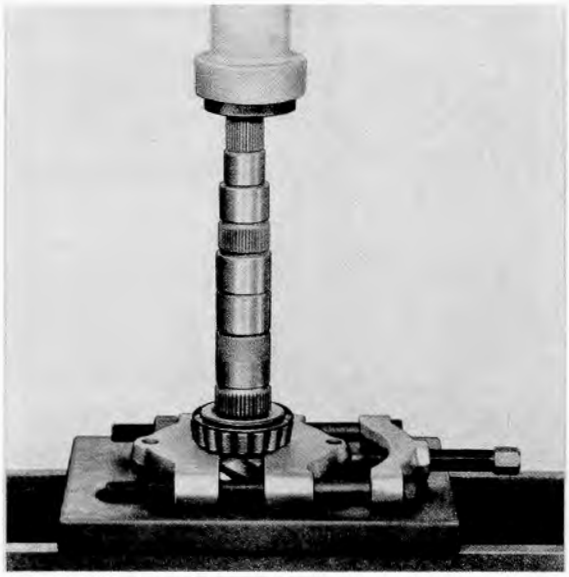
4. Press off 4th gear with a separator, for example Kukko 15-17 Gr. 1.

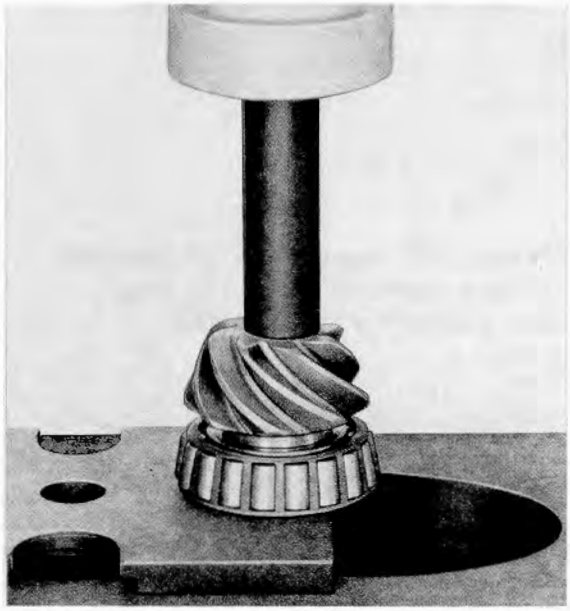


5. Press off inner race for tapered roller bearing with a separator, for example Kukko 15-17 Gr. 1.

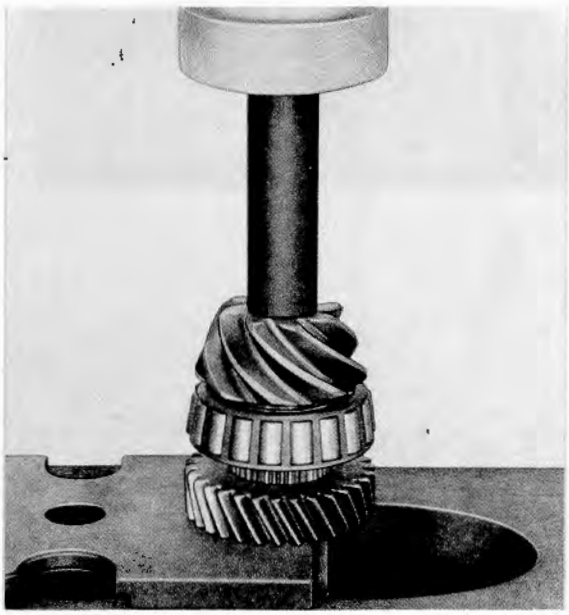


A s s e m b l y

1. Heat inner race for tapered roller bearing to approx. 120°C/ 248°F and press it on.



2. Heat gear wheel for 4th gear to approx. 120°C/248°F and press on. The collar must face the 3rd gear wheel.



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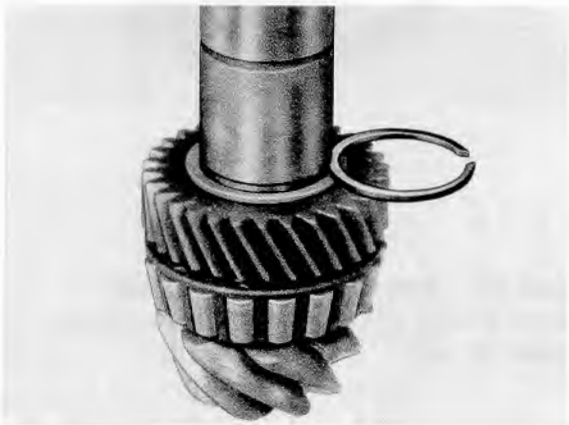
3. Adjust end play on 4th gear wheel (gear must have cooled off and be pressed against stop).
   Measure and install the thickest possible circlip. The end play must not exceed max. 0.03 mm.



N o t e

Perform this adjusting procedure very carefully, as otherwise the service life of the tapered roller bearings will be impaired.

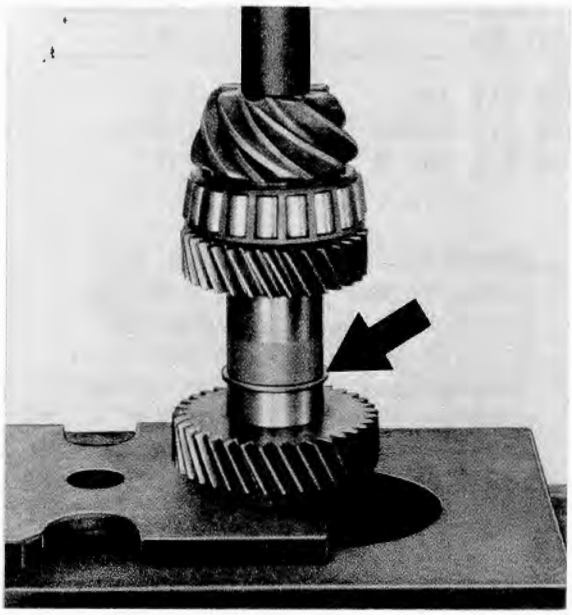
The following circlips are available:

Replacement Part No.	Thickness (mm)
016 311 363 AA	2.24
016 311 363 AB	2.26
016 311 363 AC	2.28
016 311 363 AD	2.30
016 311 363 AE	2.32
016 311 363 AF	2.34
016 311 363 AG	2.36
016 311 363 AH	2.38
016 311 363 AJ	2.40

4. Press on 3rd gear wheel with collar facing 2nd gear wheel, after installing circlip (arrow) 016 311 363 AJ, 2.4 mm thick.

N o t e

Clean gear and shaft, removing all oil and grease, with a clean gasoline. Heat gear on a hotplate to approx. 120° C/248°F.



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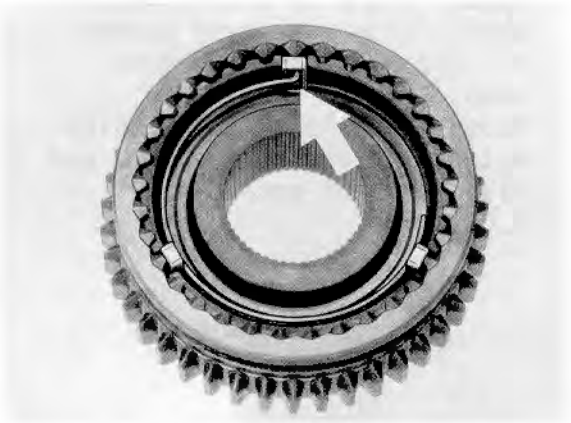
5. Measure end play on 3rd gear wheel with a feeler gage blade and adjust by using the appropriate circlip. Play should be between 0 and 0.04 mm, with the lower value being preferable.

The following circlips are available:

Replacement Part No.	Thickness (mm)
016 311 287	1.65
016 311 287 A	1.70
016 311 287 B	1.75

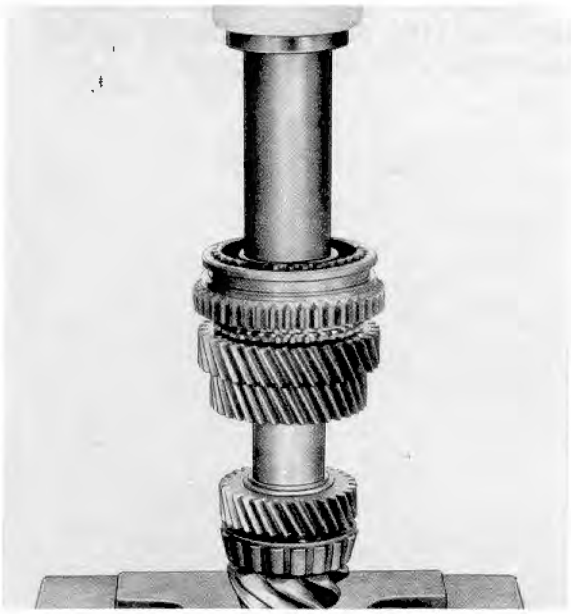
6. Assemble sliding sleeve and synchronizer for 1st and 2nd gears. It is not necessary to pair in a certain position. Insert lock pieces and install springs with a 120° offset. Angled end of spring must engage in hollow lock piece.



N o t e

Coat molybdenum-coated synchromesh rings with an approved transmission oil.

7. Press on sliding sleeve and synchronizer. Turn synchromesh ring so that grooves are aligned with lock pieces.



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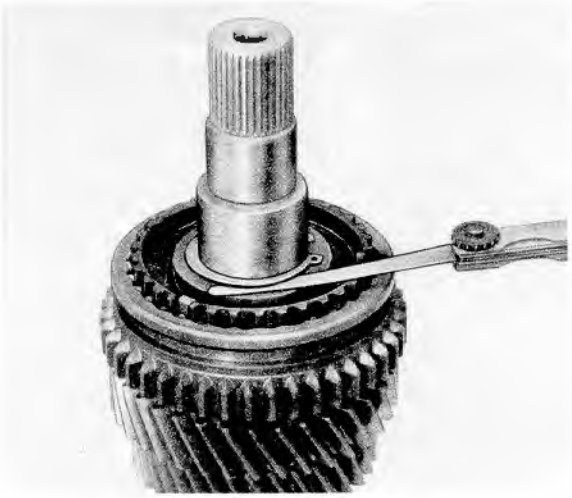
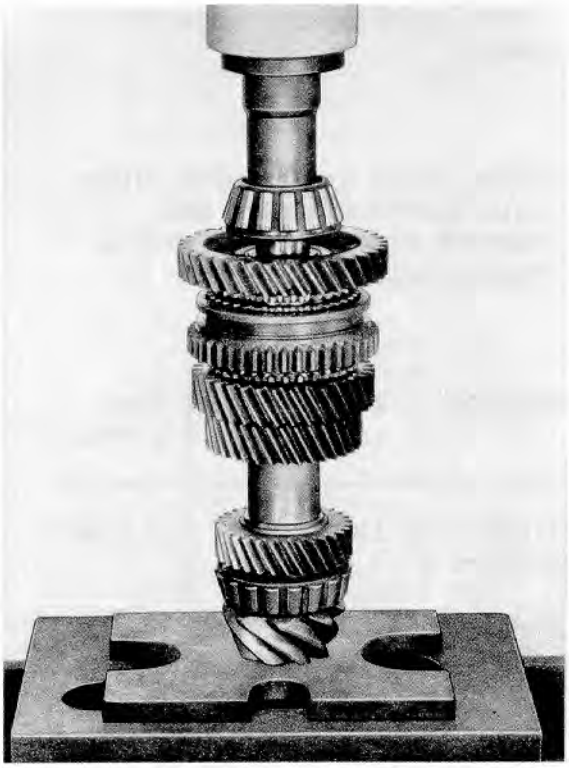
8. Adjust end play on synchronizer. Measure end play with a feeler gage blade and adjust by selecting the appropriate circlip. Play should be between 0 and 0.04 mm, with the lower value being preferable.



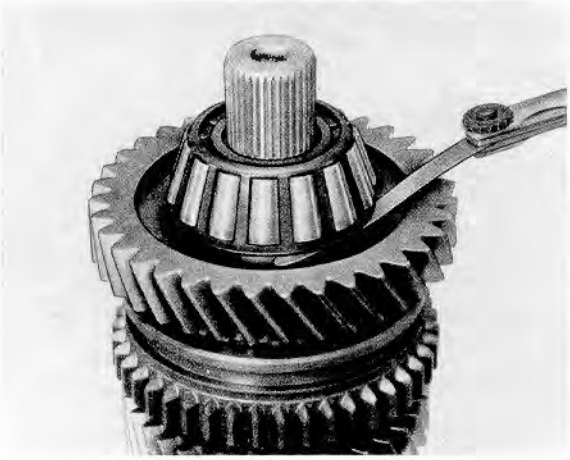
The following circlips are available:

Replacement Part No.	Thickness (mm)
016 311 327	1.50
016 311 327 A	1.55
016 311 327 B	1.60

9. Heat inner race for tapered roller bearing to approx. 120°C/ 248°F and press on with VW 454.



10. Measure play on 1st gear wheel. Play should lie between 0.10 and 0.40 mm. If necessary, check adjustment of synchronizer. Parts must be pressed on up to stop!



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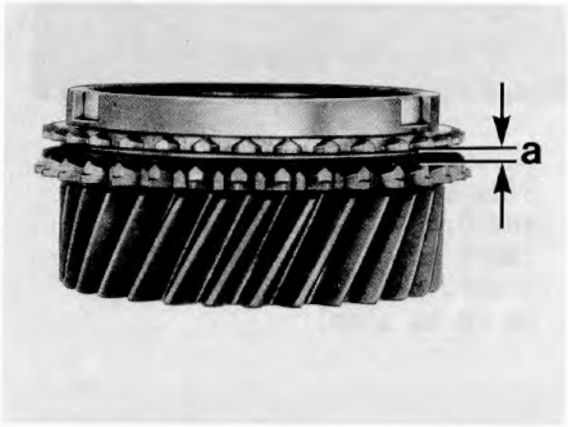
Checking Synchromesh Rings

1. Clean synchromesh rings and gears.

2. Press dried synchromesh rings onto tapers of gears and measure clearance "a" with a feeler gage blade.

Clearance "a"	New Distance	Wear Limit
1st and 2nd gears	1.0 to 1.7 mm	0.5 mm



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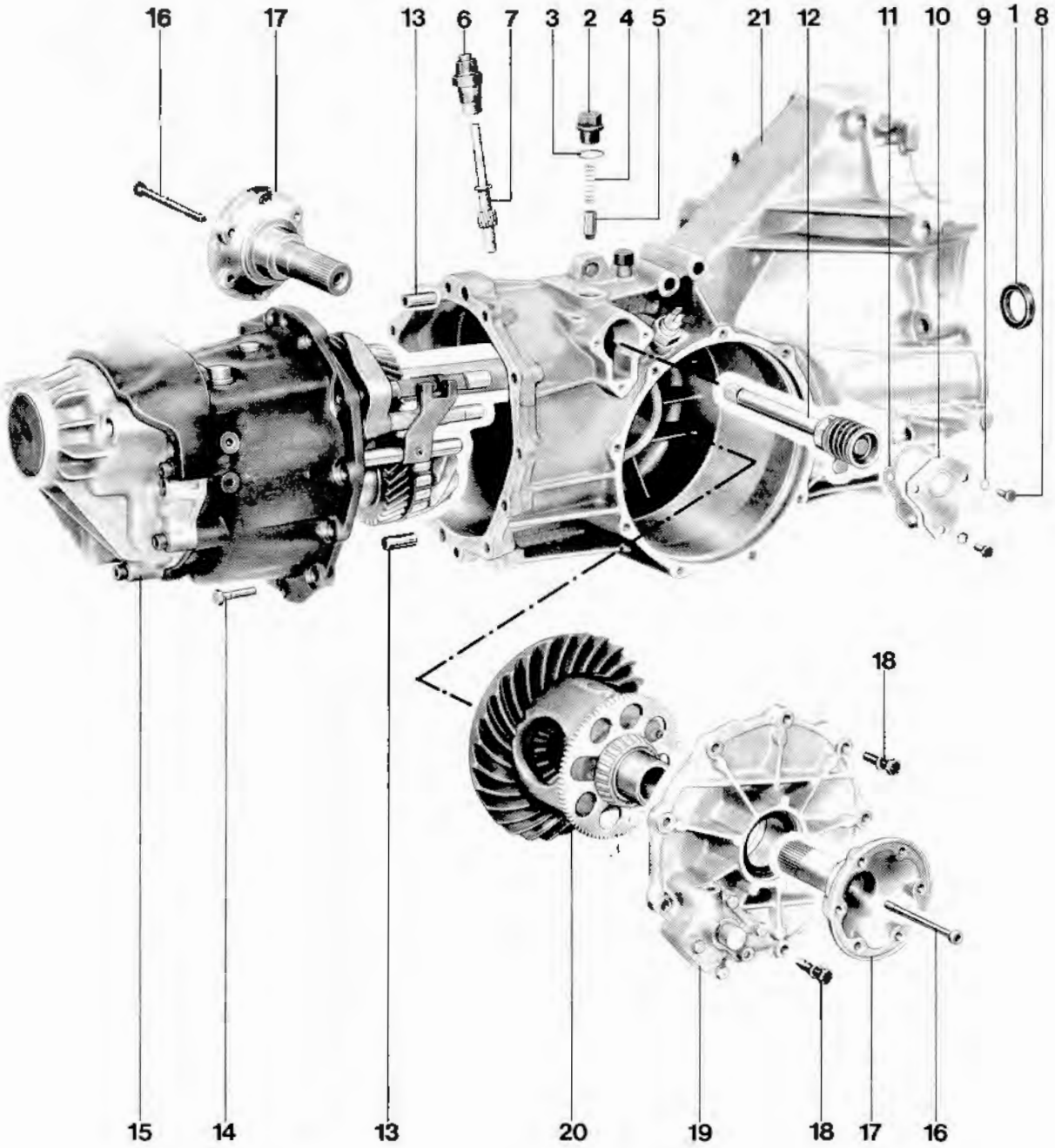
REMOVING AND INSTALLING DIFFERENTIAL



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No.	Description	Qty.	Note When: Removing	Note When: Installing
1	Seal ring	1	Pull out with VW 681	Install only after installing gear set. Oil sealing lip. Drive 1.5 mm into housing with Special Tool 9178 and suitable pipe section.
2	Threaded sleeve	1		Tightening torque 30 Nm (22 ftlb)
3	Gasket	1		Replace
4	Spring	1		
5	Bushing	1		
6	Speedometer socket	1		Tightening torque 42 Nm (30 ftlb)
7	Speedometer pinion	1		Oil guide pin
8	Hex bolt	3		Tightening torque 8 Nm (6 ftlb)
9	Lock washer	3		
10	Cover	1		Position correctly (manufacturer's mark outwards)
11	Gasket	1		Replace
12	Selector shaft (complete)	1		
13	Dowel sleeve	2		
14	Hex bolt	12		Tightening torque 24 Nm (17.7 ftlb)

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No.	Description	Qty.	Note When: Removing	Installing
15	End plate	1		Coat sealing surface with Curil KIH
16	Allen head bolt	2		Tightening torque 24 Nm (17.7 ftlb)
17	Flange shaft	2		Lubricate shaft
18	Hex bolt with washer	9		Tightening torque 24 Nm (17.7 ftlb)
19	Cover	1		Evenly coat sealing surface with Loctite 573 or 574
20	Differential	1	Remove gear-box before removing differential	Light coat of oil for tapered roller bear-ings and conical gear teeth
21	Transmission housing	1	If the trans-mission housing requires replace-ment and deviation "r" is not given on ring gear, check position of pinion shaft prior to removing gearbox (actual distance).	

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ASSEMBLY AND DISASSEMBLY INSTRUCTIONS

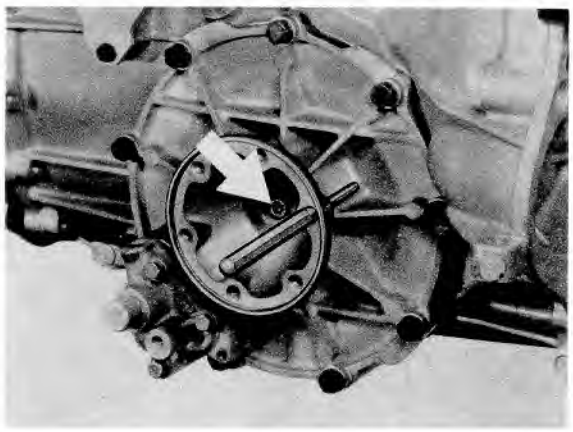
D i s a s s e m b l y

N o t e

Before removing the differential, the gearbox must be removed.

1. Remove cooling coil.

2. Unscrew mounting bolt for flange shaft and take off flange shaft, counterholding with a mandrel.



2. Unscrew final drive cover mounting bolts and pry off cover with two tire irons.

A s s e m b l y

1. Tighten mounting bolts for side transmission cover to a torque of 24 Nm (17.7 ftlb).

2. Tighten mounting bolts for flange shaft to a torque of 24 Nm (17.7 ftlb)

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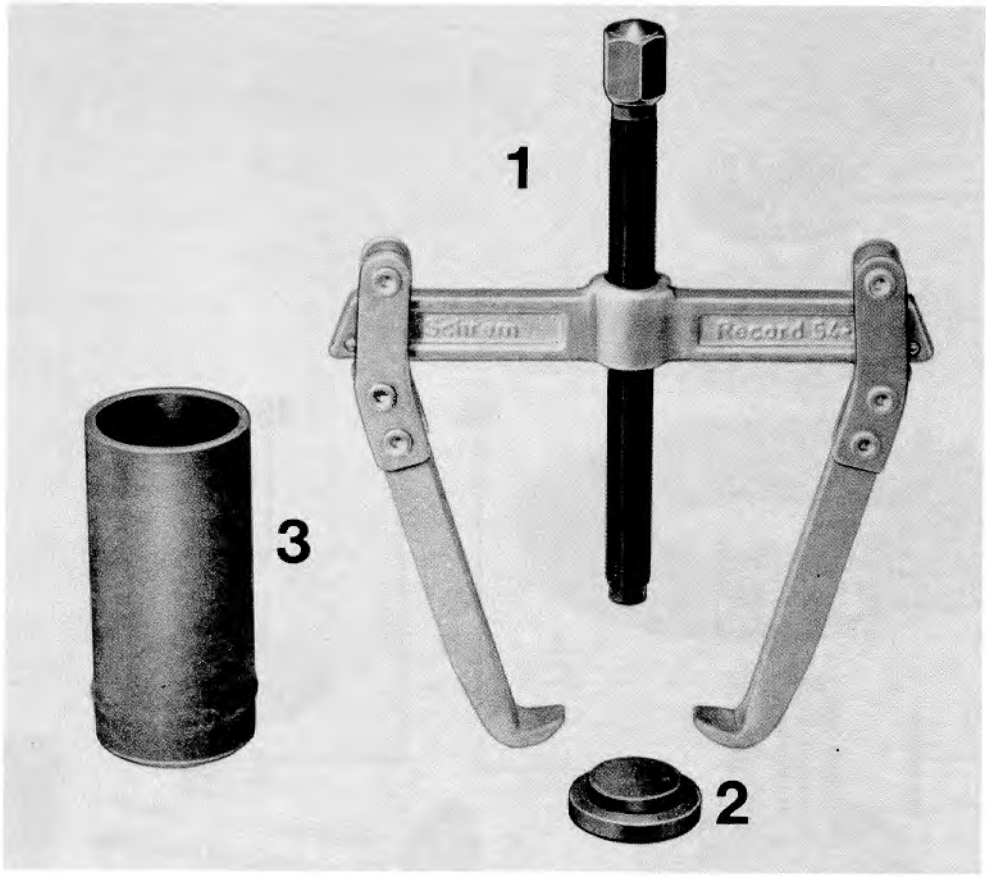
TOOLS



No.	Description	Special Tool	Remarks
1	Two-arm extractor		As commonly used for example Kukko 44/2
2	Pressing tool	VW 40-105	
3	Pipe section	VW 40-21	

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DISASSEMBLING AND ASSEMBLING DIFFERENTIAL

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No.	Description	Qty.	Note When: Removing	Installing
1	Drive gear	1		
2	Inner race for large tapered roller bearing	1	Remove with suitable two-arm puller and Special Tool VW 40-105	Heat to approx. 100°C /212°F and press on with Special Tool VW 40-21.
3	Inner race for small tapered roller bearing	1	Remove with suitable two-arm puller and Special Tool g VW 40-105	Heat to approx. 100°C /212°F and press on with Special Tool VW 40-21.
4	Drive gear	1		Install so that position of recess corresponds to position of recess in housing
5	Hex bolt	10		Loosen, then tighten crosswise to torque of 90 Nm (65 ftlb)
6	Ring gear	1		Heat to approx. 120°C /248°F
7	Dowel sleeve	1		Knock in flush
8	Pin	1		Knock in carefully, to avoid damage to thrust washers. Lock with dowel sleeve.
9	Small differential gear	2		
10	Thrust washer	2		Check for wear
11	Large differential gear	2		Adjust
12	Nut	2		

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No.	Description	Qty.	Note When: Removing	Installing
13	Shim	2		Determine new thickness
14	Locking pin	1		
15	Housing	1		When replacing adjust ring gear

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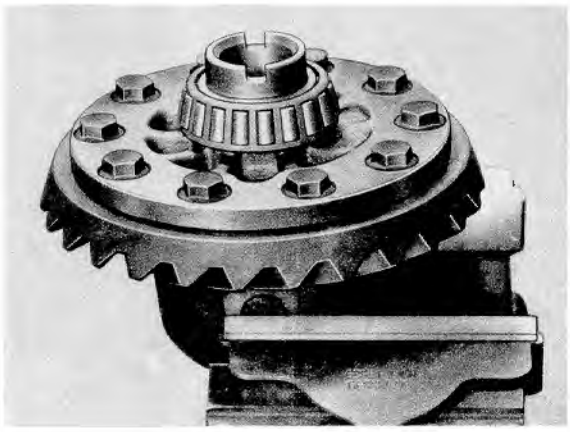
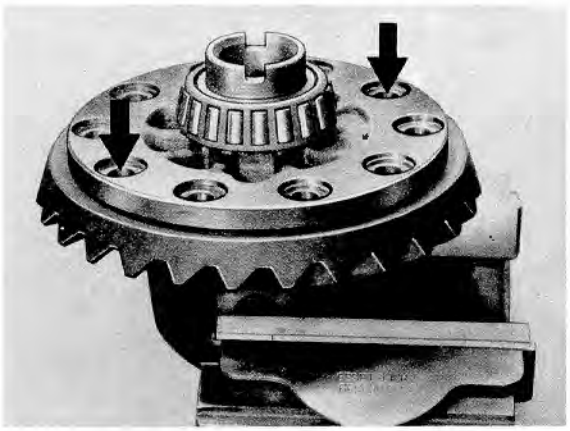
DISASSEMBLY AND ASSEMBLY INSTRUCTIONS

D i s a s s e m b l y

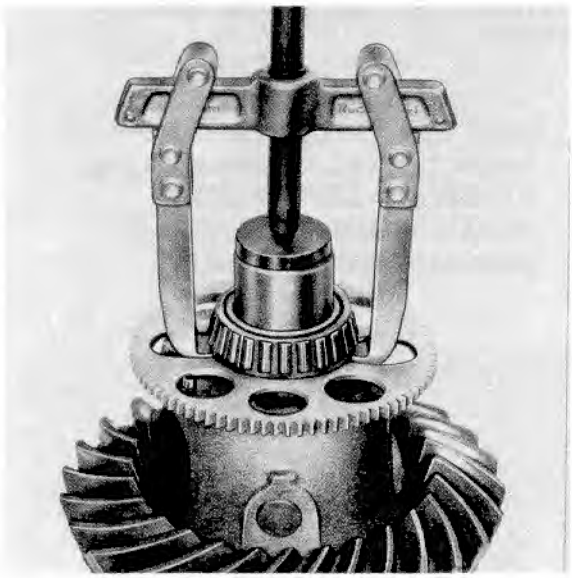
1. Clamp differential in a vice and unscrew ring gear bolts. Fit vice with soft jaws.



2. Take ring gear off of housing.



3. Pull off inner races for large and small tapered roller bearings. Use a suitable two-arm extractor and pressing tool VW 40-105.



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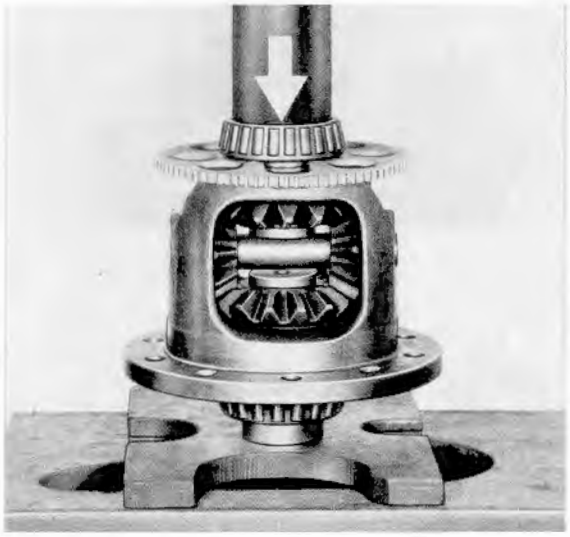
Assembly

Note

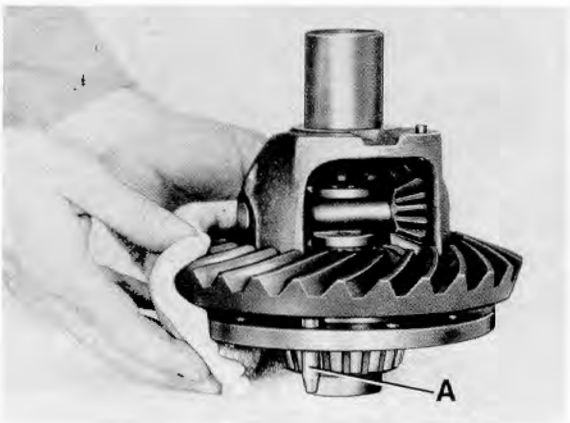
During assembly, lubricate the following parts with transmission oil: running surfaces of the housing as well as large and small differential gears, and thrust washers.

1. Heat inner races for small and large tapered roller bearings to approx. 100°C/212°F, position, and press on with pipe sections VW 40-21.



2. Install differential gears. Install large differential gears with correct shims. Install small differential gears with 180° offset (hold thrust washers in place with a small amount of grease) and swing in. Align thrust washers with shaft bore, knock in shaft carefully, and lock with a dowel sleeve.

3. Heat ring gear to approx. 120°C/248°F and install. Align bolt holes with each other using centering pins.



A - Centering pins

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ADJUSTING DIFFERENTIAL GEARS

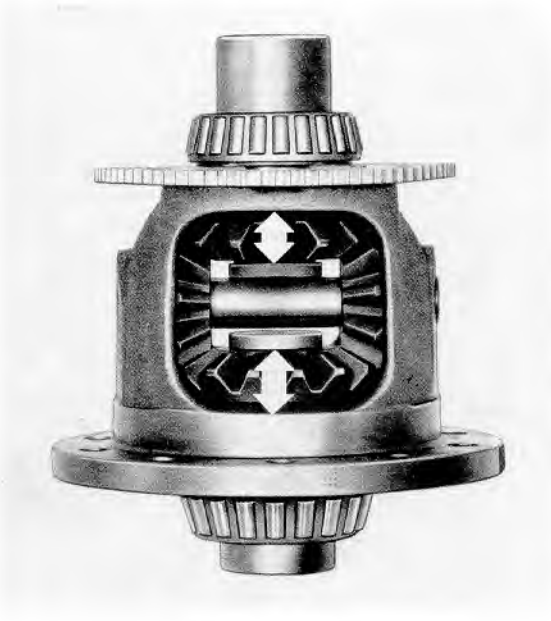
1. Install large differential gears with thinnest shims (0.5 mm).

2. Install small differential gears with thrust washers and press in shaft.

N o t e

From this point on be careful not to mix up differential gears and thrust washers.

3. Press small differential gears outwards and check play of large differential gears by hand (arrows).



4. Adjust play to maximum of 0.10 mm by inserting a shim of the correct thickness.

N o t e

Adjustment is also correct when no play can be felt but the differential gears still turn easily and without catching.

The following shims are available:

Replacement Part No.	Thickness (mm)
011 519 215	0.5
088 409 249	0.6
088 409 249 A	0.7
088 409 249 B	0.8

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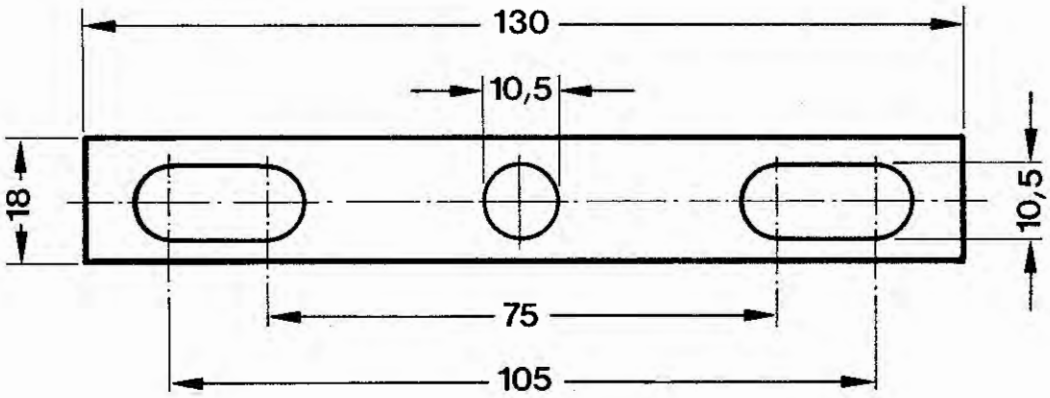
Limited-slip differential, dismantling and assembling (locking ratio 40 %)

Tools



No.	Description	Special tool	Remarks
	Connector	---	Own construction. The knuckle flange connector can be manufactured from 6 x 18 bar steel.

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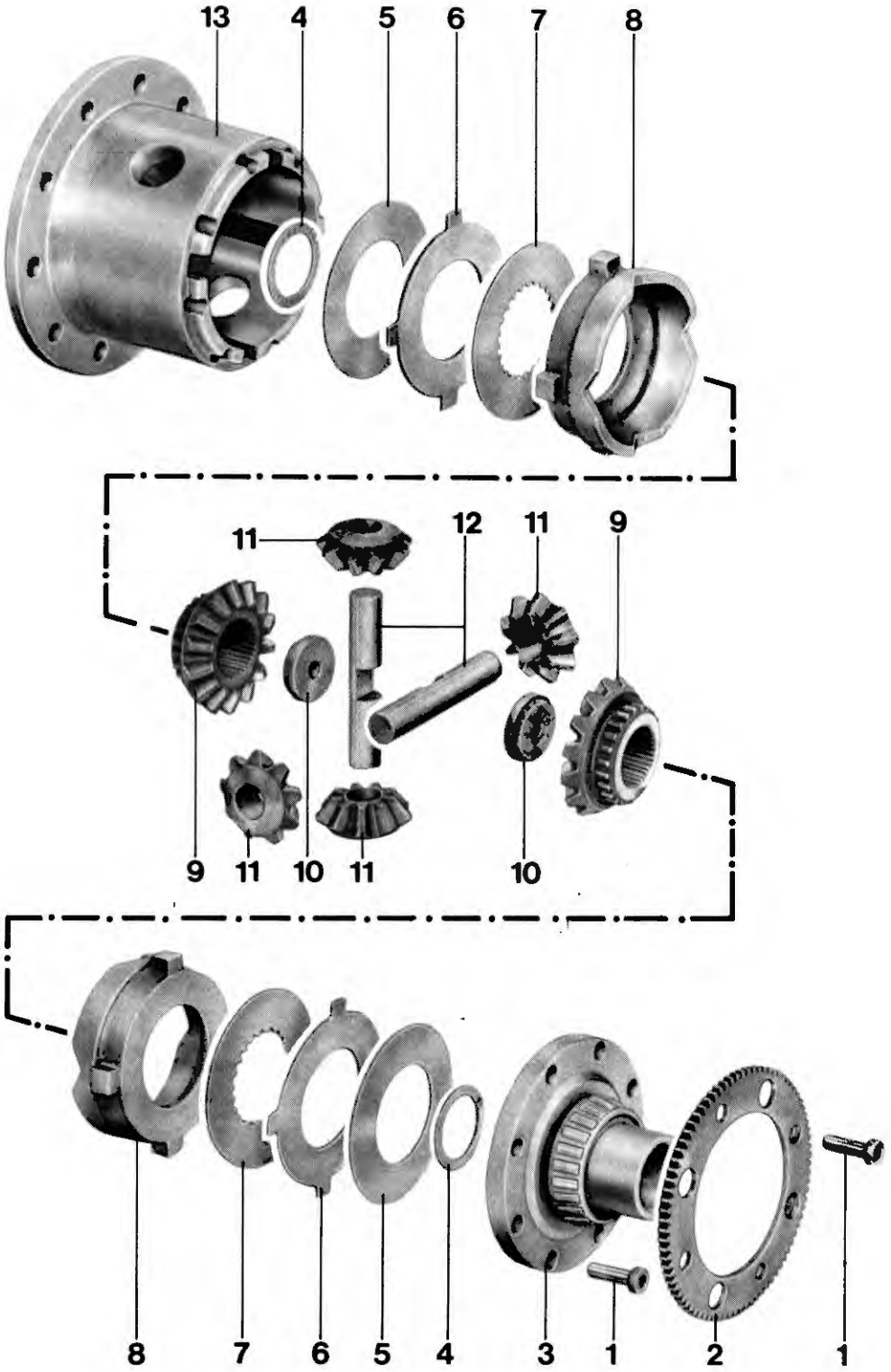
Limited-slip differential, dismantling and assembling (locking ratio 40 %)



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No.	Description	Qty.	Note: Removing	Installing
1	Cheese head screw	8		Apply a film of Loctite 262 and tighten with 38 Nm
2	Driving wheel	1		Install in the correct position
3	Housing cover	1		
4	Friction washer	2		Insert in the correct position
5	Diaphragm spring	2	Observe installation position	Insert in the correct position
6	Outer plate	2		
7	Inner plate* (molybdenum-coated)	2		
8	Thrust ring*	2		
9	Shaft bevel gear	2		
10	Threaded disk	2	Press out of the shaft bevel gear	Press in in the correct position
11	Bevel pinion	4		
12	Differential shaft*	2		
13	Differential housing	1		

*** Note**

The limited-slip differential for the 944 turbo S has reinforced 2.5 mm thick inner plates (944 turbo only 2.0 mm thick). The two thrust rings are each remachined by 0.5 mm in order to provide the same plate package thickness (dimension B).
Apart from this, the 944 turbo S differential shafts are molybdenum-coated.

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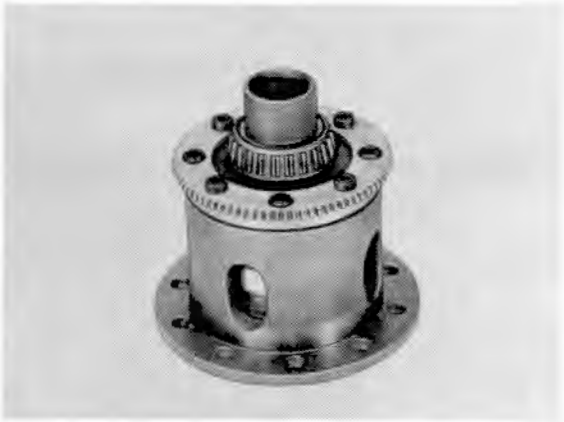
Limited-slip differential, dismantling and assembling (40 % locking ratio)

Dismantling

1. Undo the Allen screw on the housing cover, remove driving wheel (only for transmissions with an oil pump) and cover.



87-1032

2. Remove all inner parts, observing the installation position of the diaphragm springs.

Assembling

1. Check all components for wear or damage and replace if necessary.

a) Differential housing: check the guide grooves for the outer plates and thrust rings for wear.

b) Thrust rings: The guide lugs and thrust surfaces must not be too worn down or scratched. It must also be easy to move them in the differential housing.

c) Shaft bevel gears: The thrust surfaces for the thrust washers must not be worn down and it must be easy to move the inner plates on the teeth of the bevel gears.

d) Plates: Check inner and outer plates for wear. Neither the outer plates' guide lugs nor the gear teeth of the inner plates may be worn down.

2. Before assembly, lubricate all slide faces of plates, thrust rings and differential shafts with Hypoid transmission oil SAE 80.

3. Insert the thrust washers so that the retaining lug latches into the hole in the housing or cover. To make assembly easier, use a little grease to stick the washers in place.

4. Install other components as shown in the exploded illustration.

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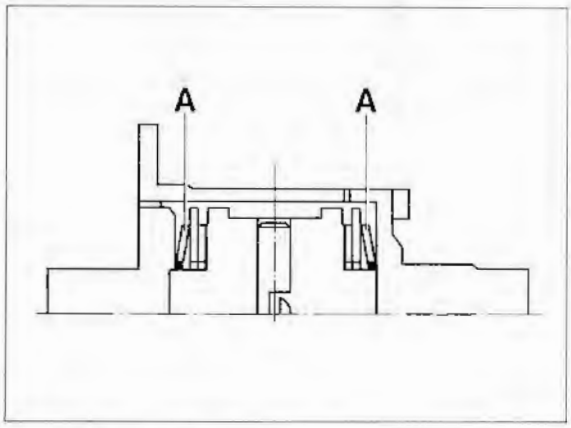
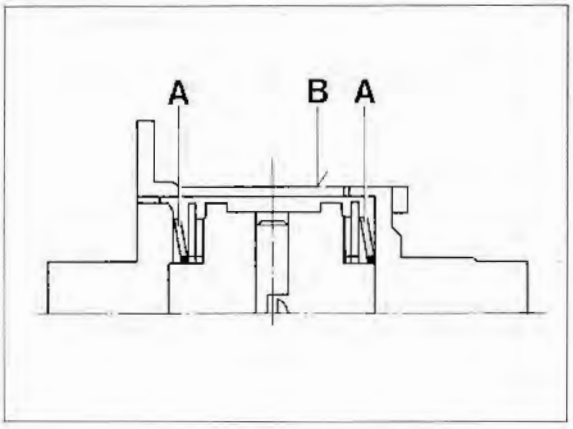
5. Under normal conditions, install the diaphragm springs with the raised section pointing outwards towards the knuckle flange.



A = Diaphragm spring 43 - 39

Note

If there is noise, the manufacturer turns the diaphragm spring on the housing side. These limited-slip differentials are identified by a yellow dot on the differential housing.

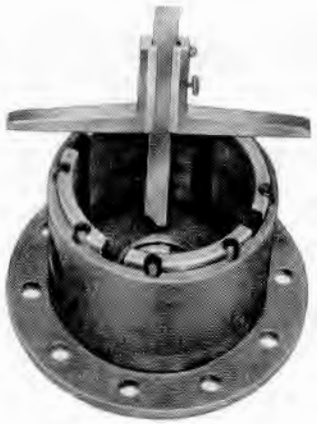


A = Diaphragm spring
B = Yellow dot 42 - 39

Re-specifying the thickness of the plate package:

The thickness of the plate package must be re-specified when new components are used.

1. Measure housing depth dimension "a" with a depth gauge. Example: a = 77.50 mm



85 - 105

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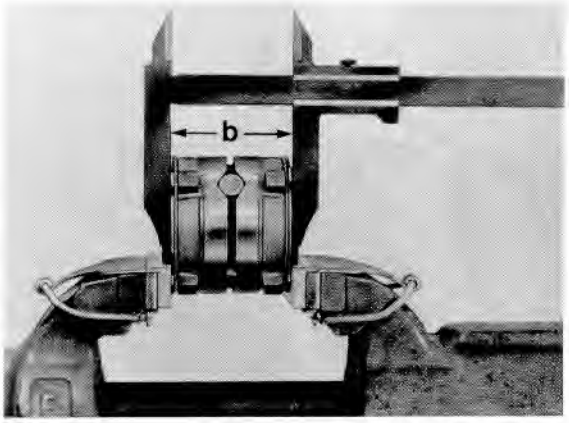
2. Measure the thickness of the plate package - dimension "b" (with 2.0 mm thick inner and outer plates, but without diaphragm springs). To do this, clamp the plate package in the vise slightly, and measure dimension "b" with a caliper gauge. Example: b = 73.20 mm.



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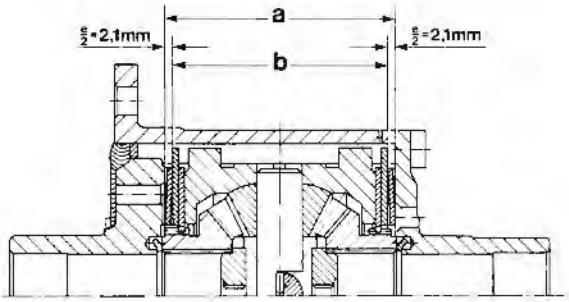
3. Measure dimension "e" (must be 4.2 mm).
   e = a - b

Example

a = 77.50 mm
b = 73.30 mm
e = 4.20 mm



45 - 39

e2 + e2 = e = 4.2 mm

Note

Install thicker or thinner outer plates if dimension "e" is too great or too small.

"e" less than 4.2 mm - install thinner plates

"e" greater than 4.2 mm - install thicker plates

Outer plates are available in thicknesses of 1.9 mm, 2.0 mm and 2.1 mm.

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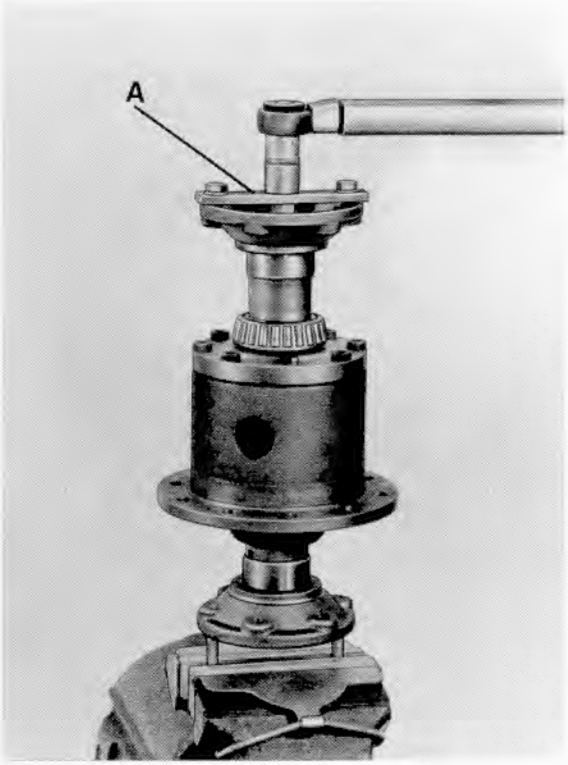
4. After assembly, measure the breakaway torque with one shaft bevel gear blocked and one driven. To do this, clamp a flange with two screws in the vise and put the differential onto this. Mount a second flange with own-construction connector, and crank the differential with a torque wrench. A torque of 10...35 Nm must be achieved.



A = Connector (own construction) 85 - 109

Note

If it is not possible to achieve the prescribed torque with the thickest outer plate, all plates are worn and must be replaced.

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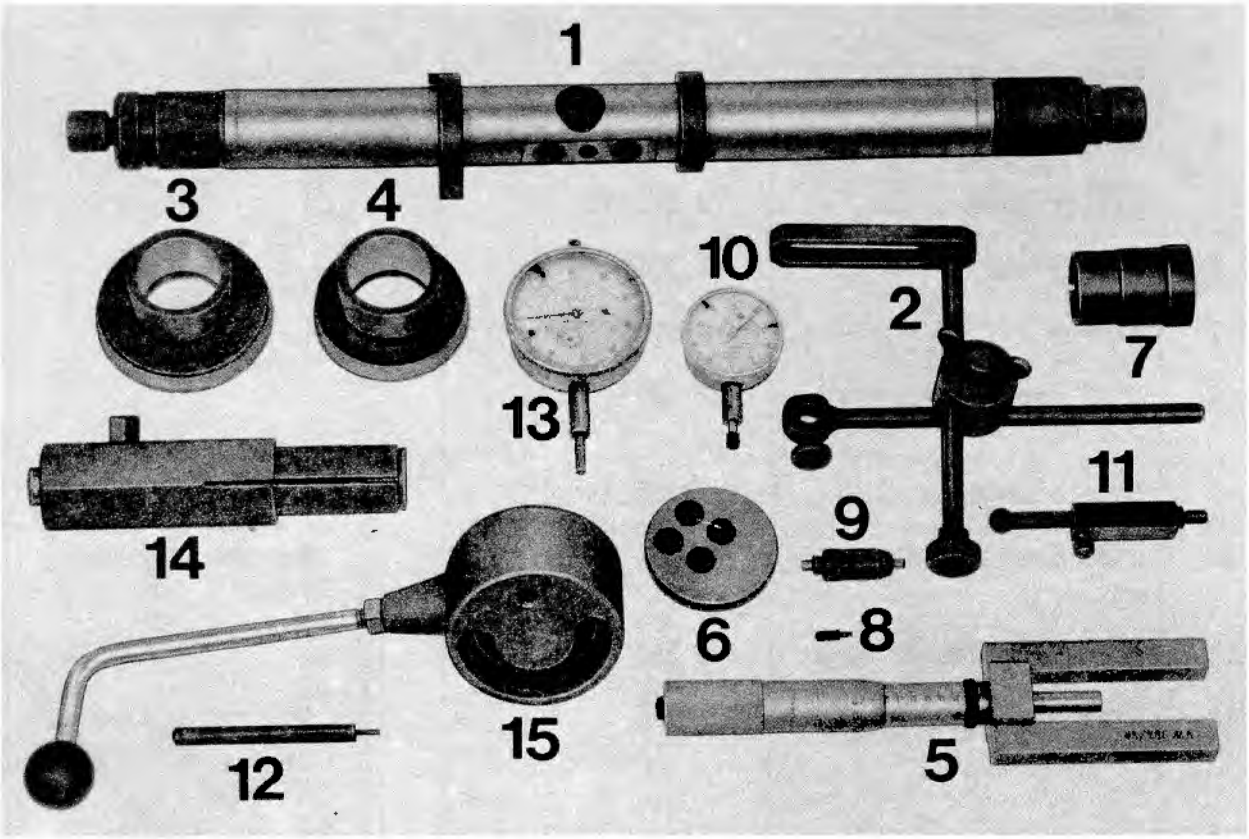
TOOL



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No.	Description	Special Tool	Remarks
1	Universal gage	VW 385/1	
2	Universal dial gage holder	VW 387	
3	Centering disk	VW 385/2	
4	Centering disk	VW 385/3	
5	Master gage	VW 385/30	
6	Gage plate	VW 385/17	
7	Sleeve	VW 521/8	
8	Dial gage extension 9.3 mm	VW 385/15	
9	Gage plunger	VW 385/14	
10	Dial gage		As commonly used, range 3 mm
11	Adjustable lever gage	VW 388	
12	Dial gage extension		As commonly used, length approx. 30 mm
13	Dial gage		As commonly used, range 5 mm
14	Adjusting device	VW 521/4	
15	Torque meter		As commonly used, 0 to 600 Ncm (0 to 4,4 ftlb)

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ADJUSTING PINION AND RING GEAR

N o t e

Careful adjustment of the drive pinion and ring gear is essential for the long service life and quiet running of the final drive. For this reason, drive pinions and ring gears are paired during production and checked on special testing machines for good surface appearance and low noise levels in both directions of rotation. The position of quietest running is determined by moving the drive pinion in an axial direction, while keeping the ring gear far enough out of the play-free gearing to keep backlash within the specified tolerance.

The deviation "r" in relation to master gage "Ro" is measured and inscribed on the outside periphery of the ring gear belonging to a pinion/ring gear set supplied as a spare part. Each gear set (drive pinion and ring gear) must only be replaced together.

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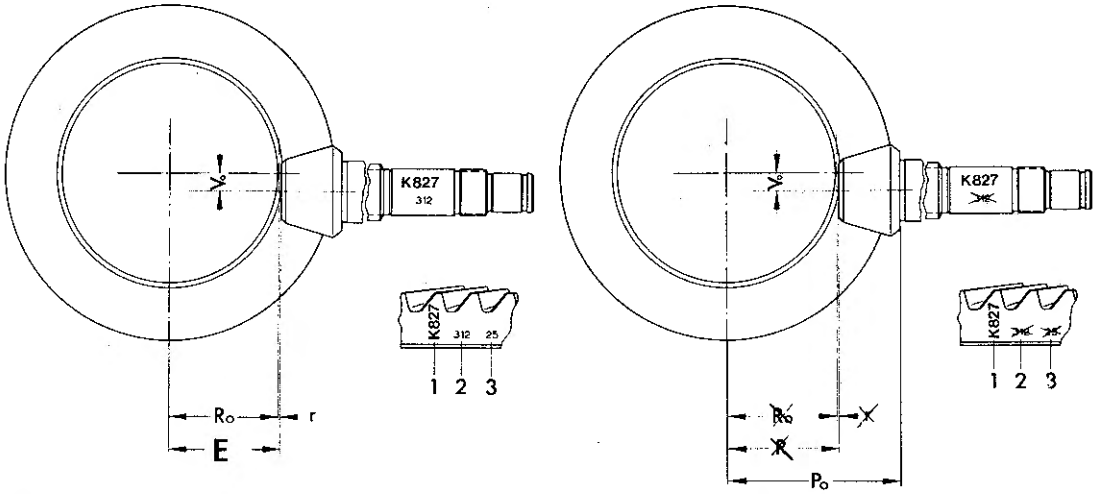
Adjustment and identification of pinion/ring gear sets



Service Sets

1. Code "K" 827 indicates a pinion/ring gear set with Klingelnberg teeth and a ratio of 8:27. The number always has 3 digits.

2. Pair code 312 of pinion/ring gear set. Number always has 3 digits.

3. Deviation "r" in reference to master gage of special testing machines used in production. Deviation "r" is always given in 1/100 mm and always has 2 digits. For example, "25" means "r" = 0.25 mm. Other letters or digits concern manufacturing and material batches.

Ro - Length of master gage used in special testing machine.

"Ro" = 59,65 mm (type 016 R/S and 083 F transmission)

"Ro" = 58,15 mm (type 083 D transmission)

Sets supplied with vehicles

Note

In series production, the location of the drive pinion ist determined as distance "Po" (center of ring gear to back of pinion head). Deviation "r" on the ring gear and the pair code are omitted. Because deviation "r" is not given, an as-is measurement must be taken prior to removal of the drive pinion when replacing parts which will have direct influence on the installed position of the drive pinion.

X - This data not required in production.

E - Actual distance between ring gear shaft and face of pinion at point of quietest running for this particular set.

Vo - Hypoid displacement = 12 mm

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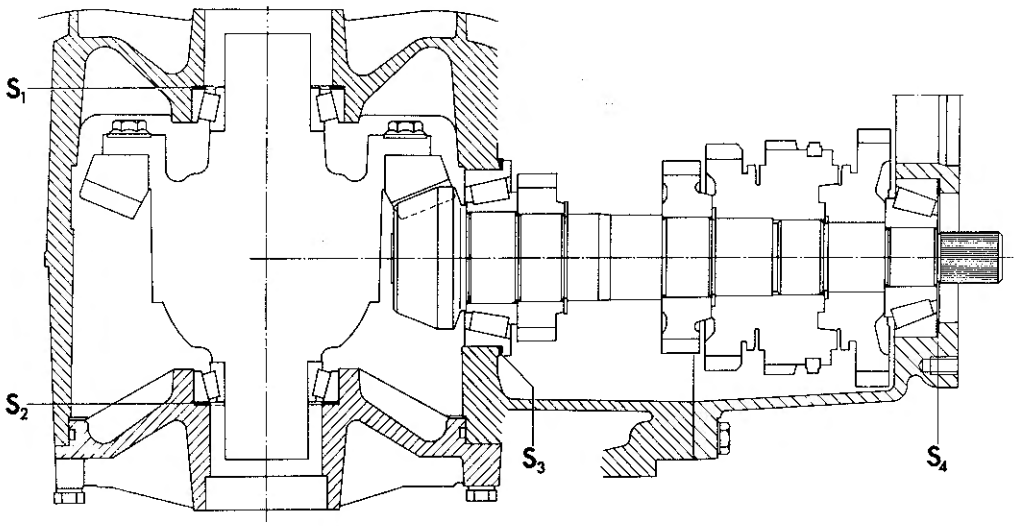
Recommended Sequence for adjusting pinion/ring gear sets



S1 = Shim for ring gear

S2 = Shim for ring gear

S3 = Shim for pinion

S4 = Shim for pinion

When it is necessary to adjust the pinion ring gear, ist is in the interests of efficiency to adhere to the following sequence of procedures:

1. Determine total shim thickness "Stot" (S1 plus S2) for the specified preloading of tapered roller bearing/differential.

2. Determine total shim thickness "Stot" (S3 plus S4) for specified preloading of tapered roller bearing/drive pinion.

3. Divide total shim thickness "Stot" in S3 and S4 in such a way that the distance from the center of the ring gear to the pinion face corresponds to the installed distance "E" determined during production.

4. Divide total shim thickness "Stot" in S1 and S2 in such a manner that the specified amount of backlash is present between ring gear and pinion.

The goal of these adjustment is to reatta in position of quietest running as was determined in the special testing machine during production.

The greatest possible care and cleanliness during all assembly and measuring operatons are absolute requirements for good results.

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Adjustment Overview

The pinion and ring gear have to be adjusted only when work on the final drive requires the replacement of parts having direct influence on the adjustment of the final drive. Refer to the following table to avoid unnecessary adjustment work!

	Ring Gear (S1 + S2)	Pinion, Deviation "r"	Pinion, "as-is" Distance	Pinion shim "S4"
Transmission housing	X		X	
End plate				X
Differential housing	X			
Tapered roller bearing for pinion			X	
Tapered roller bearing for differential	X			
Pinion/ring gear set	X	X		
Final drive cover	X			

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Determining Installed Position of Drive Pinion (As-is Distance)

This operation is only necessary when deviation "r" is not given on the ring gear and parts have to be replaced which have direct influence on the drive pinion position. This would include both tapered roller bearings for drive pinion and transmission housing.

Removing Differential

Complete universal gage as shown in tool list, insert in transmission housing, and measure distance from "Ro" (max. deflection/point of reversal). Measured value will equal deviation "r". Note this value.

After replacing parts, adjust drive pinion as described. Use deviation "r" determined for finding shim thickness S3.

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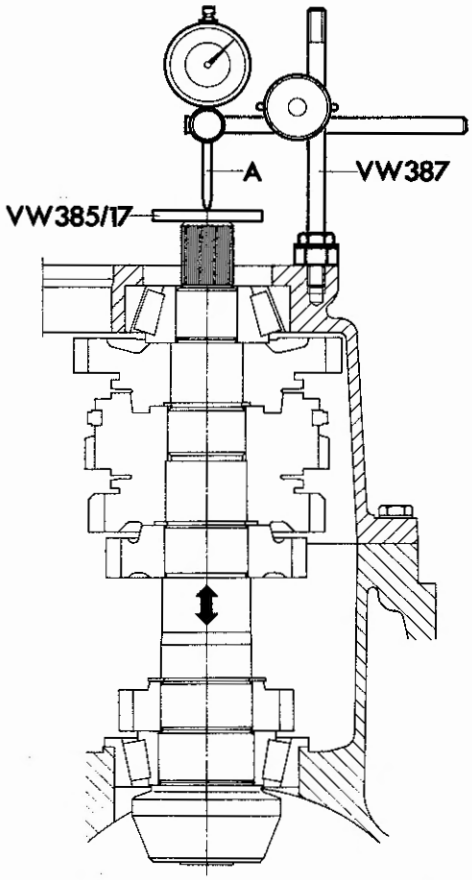
Adjusting Drive Pinion

Re-adjustment of the pinion/ring gear set according to the following instructions will only be necessary when replacing this set. If other parts which likewise influence the drive pinion are being replaced, adjust using the previously determined installed position (as-is distance).

Determining Total Shim Thickness Stot (S3 plug S4)

(Preloading of tapered roller bearing/pinion shaft adjustment)



1. Install tapered roller bearing outer race without shims into transmission housing or end plate.

2. Install completely assembled drive pinion. Mount end plate and tighten bolts to a torque of 24 Nm (17.7 ftlb).

3. Turn drive pinion about 20 full revolutions by hand so that both tapered roller bearings are pre-loaded, while lifting and lowering drive pinion.

4. Mount gages. Set dial gage (3 mm range) to 0 with 1 mm preloading. Dial gage extension length approx. 30 mm.

5. Move drive pinion up and down. Read play on dial gage and note this value. Do not turn drive pinion during this step to avoid false readings.
   Example: 1.30 mm.

6. Remove end plate again.

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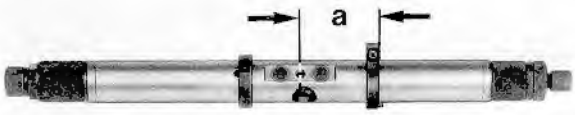
Determining total shim thickness "stot" (S3 plus S4)

Stot	=	Measuring value + loading
Loading	=	0,30 mm (constant value)
Measuredvalue	=	1,30 mm (example)
Stot		1,60 mm

Determining Deviation "e"

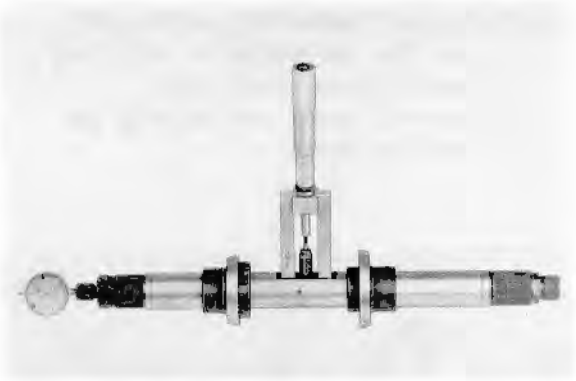
1. Install shim of determined total thickness (in this example, 1.60 mm) behind tapered roller bearing outer race in den plate (S4 side). Reinstall end plate, bolt, and turn drive pinion about 20 revolutions in each direction.

2. Adjust set ring of gage VW 385/1 to distance "a".



A = approx. 50 mm

3. Complete universal gage as shown.



4. Use dial gage extension VW 385/15, with length of 9.3 mm.

5. Set universal master gage to dimension Ro = 59.65 mm (type 016 R/S and 083 F transmission)
Ro = 58.15 mm (type 083 D transmission) and place on universal gage. Set dial gage (3 mm range) to 0 with 1 mm preloading.

6. Set adjustable set ring back against stop.

7. Place gage plate VW 385/17 (with magnet) on pinion head.

8. Take off master gage and insert universal gage in housing (installed position). Centering disk VW 385/2 toward final drive cover.

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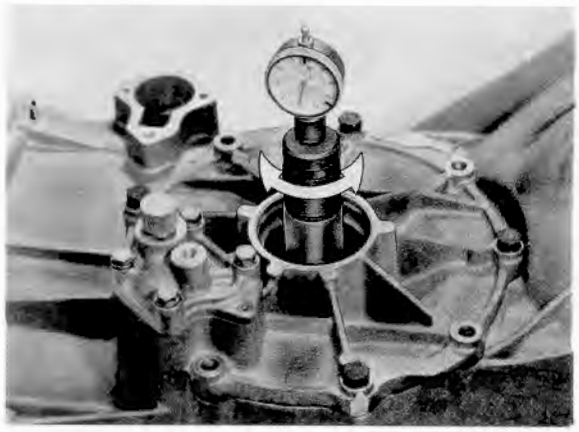
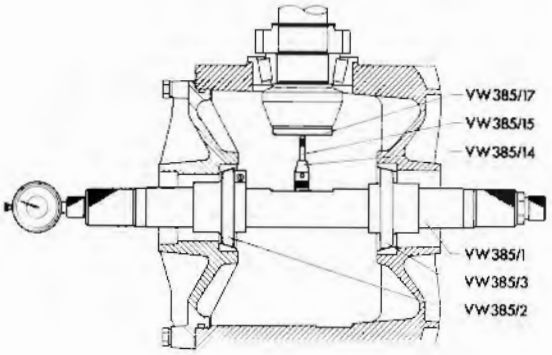
9. Mount final drive cover carefully (do not knock, danger of gage plate slipping). Fasten with 4 bolts.

10. Pull 2nd centering disk out using the adjustable set ring far enough so that the universal gage can barely be turned by hand.





11. Turn universal gage until dial gage tip runs on gage plate on pinion head and displays maximum deflection (point of reversal). The measured value is dimension "e".
For example: 0.46 mm.

Determining Thickness of Shim "S3"

$$S3 = e + r$$

e = Determined value (max. dial gage deflection)
r = Deviation (given on ring gear in 1/100 mm or determined by measuring actual distance)

Example:

Dial gage reading "e"	0.46 mm
Deviation "r" given on ring gear	+ 0.18 mm
Shim thickness "S3"	0.64 mm

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Available Shims S3 :

Thickness (mm)

0,20
0,25
0,30
0,35
0,40
0,65
0,90
1,15

Dicke der Einstellscheiben "S4" bestimmen

S4 = Stot - "S3"

Example:

Total shim thickness	1,60 mm
Shim thickness S3	0,64 mm
Shim thickness S4	0,96 mm

Note

Due to the tolerances of the shims, it is possible to measure any thickness for "S3". Measure shim thickness at many different points with a micrometer. In addition, check shims for burrs and damage.

Install only shims in perfect condition!

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Available shims S4:

Thickness (mm)

0,24
0,27
0,30
0,33
0,36
0,39
0,42
0,45
0,69
0,93
1,17
1,41

Measure thickness of shims at several points with a micrometer. In addition, check shims for burrs and damage.

Install only shims in perfect condition.

Checking Dimension "E"

1. Install drive pinion with measured shims S3 and S4. Bolt end plate and rotate drive pinion in both directions about 20 full revolutions by hand, so that both tapered roller bearings will be preloaded by the rotation and can settle.

2. Apply universal gage and check distance.

3. If shims have been selected correctly, the dial gage (read counterclockwise) should display the value of deviation "r" inscribed on the ring gear to a tolerance of ± 0,04 mm.

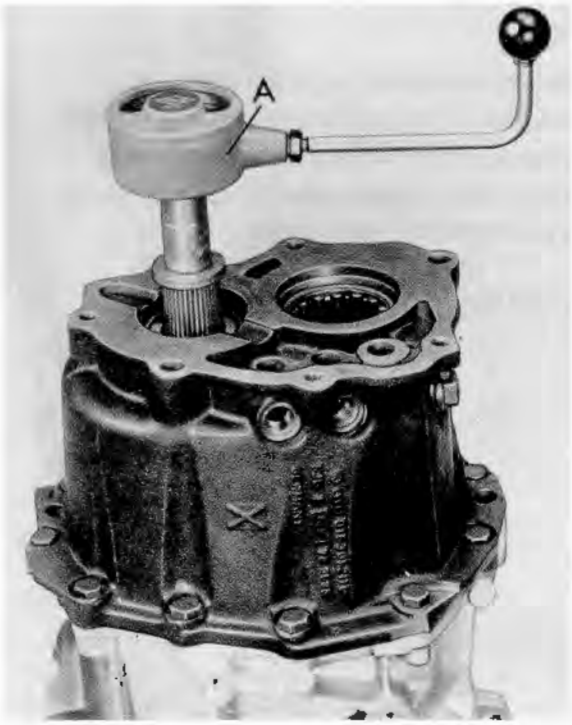
Checking preloading of tapered roller bearings on drive pinion

Screw in hex bolt in drive pinion. Apply torque meter and read friction torque.

For new bearings it should be 200 to 400 Ncm (1.5 to 3.0 ftlb) and 30 to 60 Ncm (0.22 to 0.44 ftlb) for used bearings.

Note

Lubricate bearings with hypoid gear oil.



A-Standard torque meter, 0 to 600 Ncm (0 to 0.44 ftlb).

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Adjusting Ring Gear

Note

The ring gear must be adjusted if

Transmission housing,
Final drive cover,
Tapered roller bearings for differential,
Pinion/ring gear set

are replaced (see also "Necessary Adjustments").

Determining Total Shim Thickness "Stot" (S1 plus S2)

(For determining preloading of tapered roller bearings on differential)

1. Remove drive pinion.

2. Remove seals for shaft flanges.

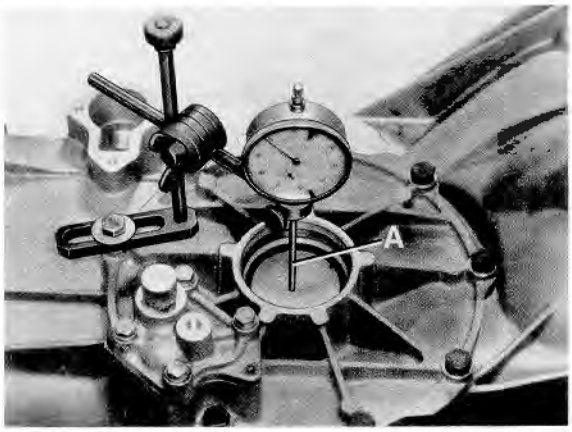
3. Remove outer rings of tapered roller bearings for differential. Remove shims.

4. Drive in tapered roller bearing outer races without shims against stop.

5. Place differential in housing. Installation position: ring gear leading into housing.

6. Mount cover and tighten bolts crosswise to a torque of 24 Nm (17.7 ftlb).

7. Clamp transmission in assembly stand with cover facing up.



A - Dial gage extension approx. 30 mm

8. Place end gage plate VW 385/17 on collar of differential.

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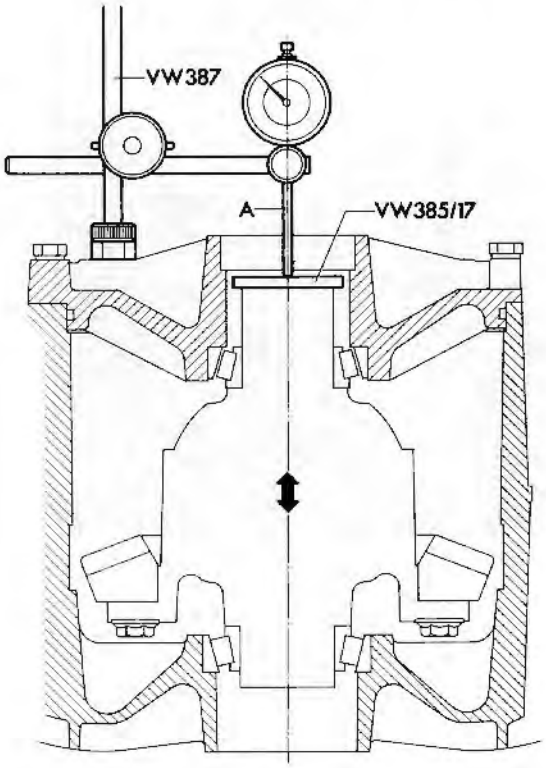
9. Mount universal dial gage holder VW 387 with dial gage and extension on housing and set dial gage to 0 with 1 mm pre-loading.

10. Move differential up and down, read and note play on dial gage (e.g. 1.42 mm).



A - Dial gage extension approx. 30 mm

N o t e

Do not turn differential while measuring play, as this will falsify results.

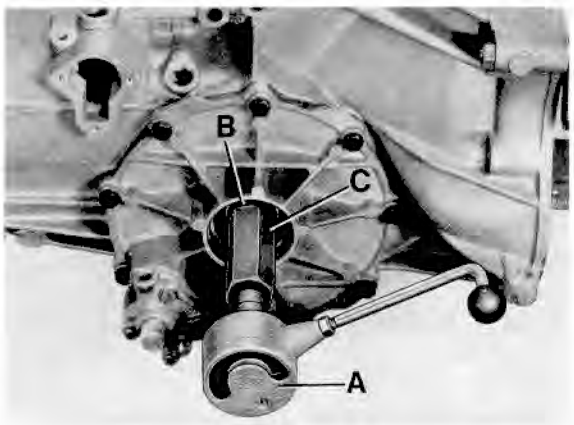
"Stot" = Measured value + loading

Measured value (example)	1.42 mm
Loading (constant value)	+0.50 mm
Stot	1.92 mm

11. Install shims with total shim thickness "Stot" determined (in this example 1.92 mm) behind tapered roller bearing outer race end cover (S2 side). Lubricate both tapered roller bearings with hypoid oil.

12. Remount cover.

13. Guide adjusting device VW 521/4 together with sleeve VW 521/8 into neck of differential, and clamp.



A - Standard torque meter, 0 to 600 Ncm (0 to 4,4 ftlb)

B - Sleeve VW 521/8

C - Adjusting device 521/4

14. Place 0 to 600 Ncm (0 to 4,4 ftlb) torque meter on adjusting device and turn slowly and evenly. The friction torque of new tapered roller bearings should be at least 250 Ncm (1,8 ftlb).

It is not necessary to measure friction torque of used tapered roller bearings.

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N o t e

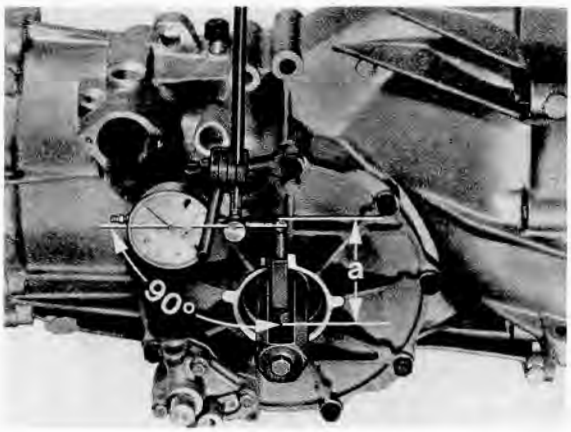
When adjusting the pinion/ring gear set, adjust and check drive pinion at same time.

A d j u s t i n g B a c k-
l a s h

Prerequisite: drive pinion adjusted and installed with S3 and S4.
Turn differential several times to preload and settle tapered roller bearings.

1. Place adjustable lever VW 388 on adjusting device VW 521/4. Lever length via large hexagon surface is 79 mm to upper edge of ball.

2. Apply universal dial gage holder with dial gage and extension so that there is a right angle between the dial gage axis and the lever.



a = approx. 79 mm

3. Carefully turn differential counterclockwise with adjusting device VW 521/4 until ring gear rests on drive pinion.

4. At this point, set dial gage to 0 with 2 mm preloading.

5. Turn differential clockwise until ring gear comes to rest against the opposite flank of the next drive pinion tooth. Read off and note backlash.

6. Repeat measurement procedure three times, turning ring gear 90° further each time.

7. Add up the four measured values and calculate mean backlash.

D e t e r m i n i n g M e a n
B a c k l a s h

Example:

1st measurement	0.84 mm
2nd measurement	0.85 mm
3rd measurement	0.84 mm
4th measurement	0.83 mm
Sum	3.36 mm

Mean backlash = 3.36 : 4 = 0.84 mm

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N o t e

If measured values deviate from each other by more than 0.06, the installation of the ring gear or the pinion/ring gear set is not correct. Check installation, replacing pinion/ring gear set if necessary.

D e t e r m i n i n g S h i m T h i c k n e s s S2 (opposite ring gear)

S2 = Stot

+ Lift (axial displacement of ring gear from play-free gear mesh to attain backlash)

- Measured mean backlash

Stot = Total shim thickness Balance S1 + S2

Lift = 0.15 mm (constant value)

Example:

Stot	1.92 mm
+ Lift	0.15 mm
- Mean backlash	0.84 mm
S2	1.23 mm

The following shims are available:

Replacement Part No.	Thickness (mm)
113 517 201 A	0.15
113 517 202 A	0.20
113 517 203 A	0.30
113 517 204 A	0.40
113 517 205 A	0.50
113 517 206 A	0.60
113 517 207 A	0.70
113 517 208 A	0.80
113 517 209 A	0.90
113 517 210 A	1.00
113 517 211 A	1.20

It is possible to measure exact shim thicknesses due to differing tolerances.

D e t e r m i n i n g S h i m T h i c k n e s s S1 (Ring Gear Side)

S1 = Stot - S2

Example:

Stot	1.92 mm
S2	-1.23 mm
S1	0.69 mm

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The following shims are available:

Replacement Part No.	Thickness (mm)
018 409 381	0.15
018 409 383	0.20
018 409 385	0.25
018 409 387	0.50
018 409 389	0.80
018 409 391	1.00
018 409 393	1.50

It is possible to measure exact shim thicknesses due to the differing tolerances.

Measure thickness of shims at several different points with a micrometer. In addition, check shims for burrs and damage.

Install only shims in perfect condition!

Install shims S1 and S2 as determined.

Check Measurement

Measure backlash on periphery four times. It should be:

0.12 to 0.22 mm

N o t e

The individual measurement results must not deviate from each other by more than 0.05 mm.

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Technical Data

Front axle

Suspension		independent wheel suspension with light-alloy control arms and spring struts (McPherson type) inboard scrub radius up to end of MY 86, outboard scrub radius as of MY '87
Springs		one coil spring per wheel, mounted coaxially to damper strut
Shock absorbers		double-acting hydraulic damper struts of twin-tube gas shock type
		Manufacturer, identification
	up to end MY '88	standard: Fichtel und Sachs black optional: Koni yellow and/or yellow/height-adjustable for sports-type running gear M030* of MY '87/88
	MY '89	Koni yellow/height-adjustable optional: ———
	as of MY '90	Fichtel und Sachs black with white nameplate and red lettering (part no.) on nameplate optional: Koni yellow/ height-adjustable
Stabilizers	up to end of MY '86	Solid stabilizer Ø 22.5 mm or Tubular stabilizer Ø 24 x 3.7 mm
	MY '87/88	(introduced during MY '87) Tubular stabilizer Ø 25.5 x 4 mm or Tubular stabilizer Ø 26.8 x 4 mm for sports-type running gear M030*
	as of MY 89	Tubular stabilizer Ø 26.8 x 4 mm

* standard equipment for 944 turbo special model "S" (M758)

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TIGHTENING TORQUES FOR FRONT AXLE

Location	Description	Thread	Material	Torque in Nm (ftlb)
Control arm to cross member	Self-locking Hex nut	M12x1.5	8	65 (48)
Control arm to body	Hex bolt	M 10	8.8	46 (34)
Control arm mounting to control arm (caster eccentric)	Self-locking Hex nut	M12x1.5	8	85 (62)
Control arm to steering knuckle	Self-locking Hex nut	M 10	12	50 (37)
Cross member to body	Hex bolt	M 12	8.8	85 (62)
Guard plate for hydr. mounting to cross member	Hex bolt	M 6	8.8	10 (7)
Tie rod to steering knuckle	Castle nut	M12x1.5		30+20 (22+14)
	Lock nut	M12x1,5		50
Stabilizer mounting body	Hex bolt	M 8	8.8	23 (17)
Stabilizer clamp to mounting	Locknut	M 8	8	23 (17)
Stabilizer mounting to control arm	Self-locking hex nut	M 10	8	25 (18)

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Location	Description	Thread	Material	Torque in Nm (ftlb)
Spring strut mount to shock strut	Self-locking hex nut	M14x1.5	8	77 (56.7)
Pan head bolt to clamping nut	Allen bolt	M 7	10.9	13 (9+2.2)
Guard plate to steering knuckle	Hex bolt	M 7	8.8	10 (7)
Fixed caliper to steering knuckle	Hex bolt Pan head	M12x1.5	8.8	85 (62)
Spring strut to steering knuckle	Self-locking hex nut	M12x1.5	10	100 (73.7)
Spring strut to body	Hex nut	M 8	8	25 (18)
Spoiler to spring strut	Hex bolt	M 6		10 (7)
Brake disk to wheel hub	Hex nut Countersunk head bolt	M 8 M 6	8 8.8	23 (17) 10 (7)
Light alloy wheel to brake disk	Light alloy wheel nut	M14x1.5	AlZnMgCu 1.5 F 53	130 (96)

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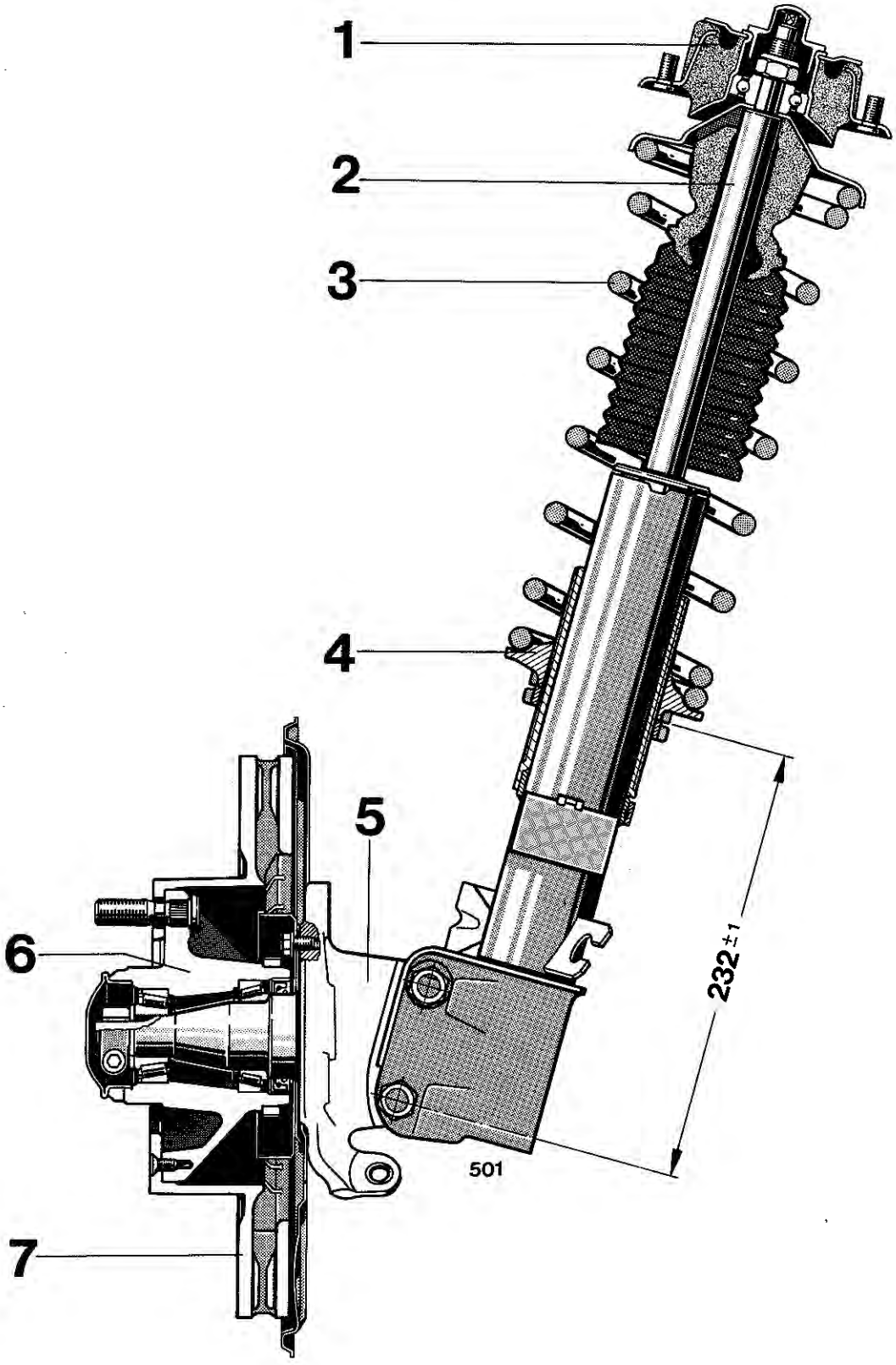
The front axle modifications for 944 turbo special model "S" (M 758)



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The front axle modifications for 944 turbo special model "S" (M 758)

No./Designation	The most major modifications*	Notes
1 Strut bearing	Harder rubber compound	Green identification
2 Vibration shock absorbers	Rebound travel adjustable from the outside (harder rebound than sports shock absorber M 474 even at the basic setting)	Adjusting rebound travel Page 40-9 / 40-10
3 Coil spring	With harder spring rate	Page 40-6 / 40-7
4 Adjustable spring seats	Vehicle height adjustable, thus enabling compensation for differences in wheel load, left to right	See repair group 44 for height adjustment
5 Steering knuckle	Fastening points for brake caliper	Four-piston fixed caliper similar to 928 S 4 (difference: brake line connector)
6 Wheel hub	2.85 mm longer (to accommodate the 928 S 4 brake disk)	
7 Brake disk	32 mm thick (series 28 mm) up to end of MY 88	From 928 S 4

* standard for 944 turbo model year '89
partially standard for 944 turbo model year '90

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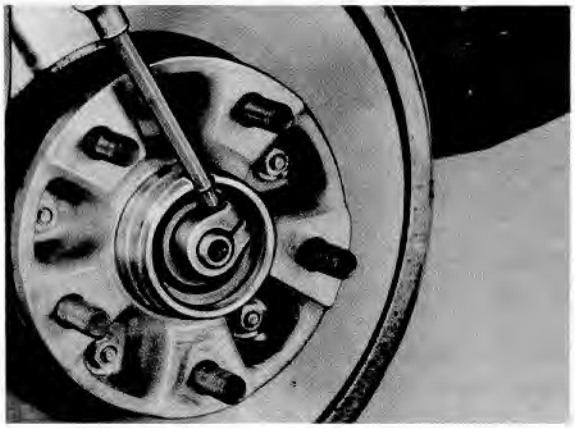
ADJUSTING FRONT WHEEL BEARINGS

Wheel bearing play is adjusted correctly as long as pressure plate can be moved by finger pressure applied to a screwdriver (never by turning or with leverage).



1. Remove wheel. Pry off hubcap with two tire irons.

2. Unscrew pan head bolt of clamping nut. Tighten clamping nut slightly, turning hub at same time.

3. Unscrew clamping nut until pressure plate can barely be moved by finger pressure applied to a screwdriver.
   Do not support screwdriver on hub when testing this.

4. Tighten panhead bolt of clamping nut to a torque of 13 + 3 Nm, without turning clamping nut.

5. Recheck adjustment by moving pressure plate, correcting if necessary.

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CHECKING CAPS ON JOINTS OF CONTROL ARMS AND TIE RODS

The rubber caps on the joints of the front axle can be damaged from external influences, for example flying stones or repair work. If a rubber cap is damaged so that it leaks, the control arm or the applicable joint of a tie rod must be replaced, since the entry of dirt or moisture will destroy the joint. For this reason, the following points are included in the service schedule:
Check tightness of all connections on steering gear, tie rods, and control arms, as well as checking protective caps and joints for function and leakage.
We recommend that a visual check for leakage be carried out on joint caps every time work is performed on the front axle.

Checking Rubber Caps on Joints of Control Arms

1. Lift car on lifting platform. Disengage steering lock.

2. Turn front wheels against lock.

3. Visually inspect left and right visible surfaces after cleaning. Rubber caps should be pressed with fingers so as to be able to recognize hidden cracks.

4. After turning front wheels against stop on other side, inspect other half of rubber caps.

Thers is a small surface in the area of the brake guards where visual inspection is not possible. Inspect this area by feel.

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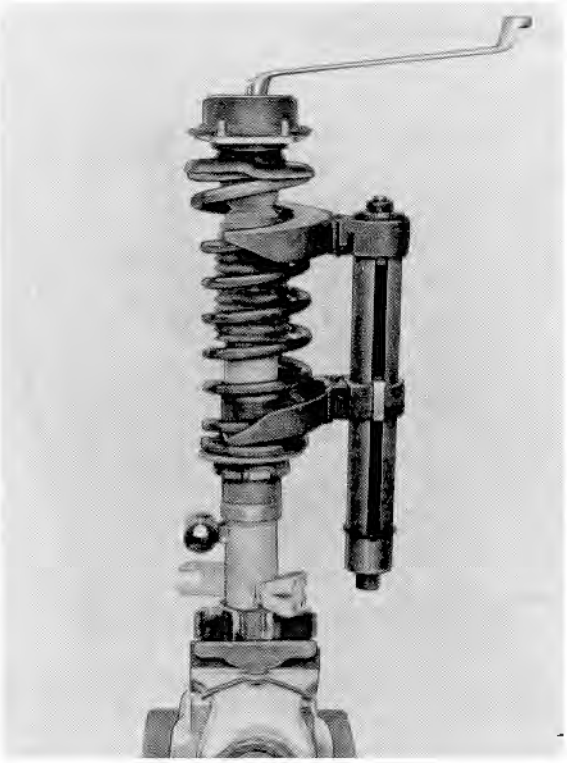
Height-adjustable strut, dismantling and assembling

Dismantling

1. Tension the coil spring with a spring-tensioning device, e.g. from Klann (see workshop manual). Remove the dust cap from the piston rod and undo the lock nut.

Note

Make sure that the height-adjustment thread is not damaged.



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2. Remove all components from the piston rod.

Check vibration shock absorbers

It is only possible to check vibration shock absorbers correctly with a test machine. A visual and/or functional test will, however, show whether shock absorbers are completely defect, or still capable of performance.

Expand and contract vibration shock absorbers manually in the installed position. It must be possible to move the shock absorber across its entire stroke without jerking. The stages of pull and push absorption must be clearly felt up to the stop. Because of the gas pressure, it becomes more difficult to move the piston rod as it travels further into the shock absorber. If shock absorbers have been installed for a long time, pump a few times in installed position if necessary.

Replace heavily leaking vibration shock absorbers.

If the gas pressure has dropped inside the shock absorber (shock absorber does not automatically return to the stop of the pull stage), but there is no evidence of oily vapor (oil mist), the shock absorber may still be used as long as it fulfills all other requirements. Shock absorbers which show evidence of both factors - oily vapor (oil mist) and lack of gas pressure - must be replaced.

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Assembling

Notes

Observe the tolerance groups when replacing coil springs, i.e. always install springs with identical color codings (page 40 - 7).

Strut bearings for sport chassis M 030* as from model 87 (refer to spare parts catalog) have a harder rubber compound. Identified by a green strip on the underside A, also occasionally on the upper side.

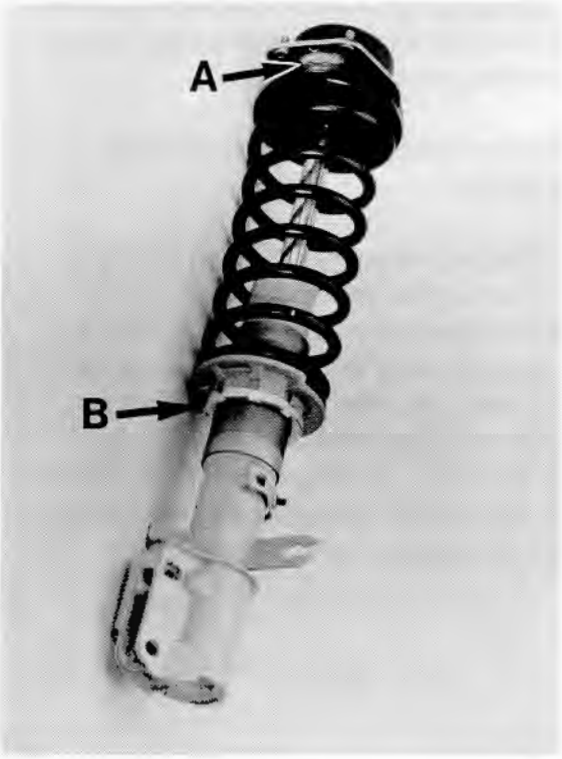
Lubricate the threaded ring, adjustable spring seat B and counternut with Optimoly TA

1. Mount the larger spring diameter to the upper spring seat.

2. If parts are replaced which influence the height adjustment (coil spring/threaded ring/lower spring seat), adjust the spring seat to the same position as before or carry out a basic adjustment.

When new springs are used, follow up by making height corrections or fine adjustments (after the strut is installed) (Page 44 - 7).

Basic setting dimension 232 ±1 mm (bottom edge of the spring seat to the middle of the lower fastening screw)



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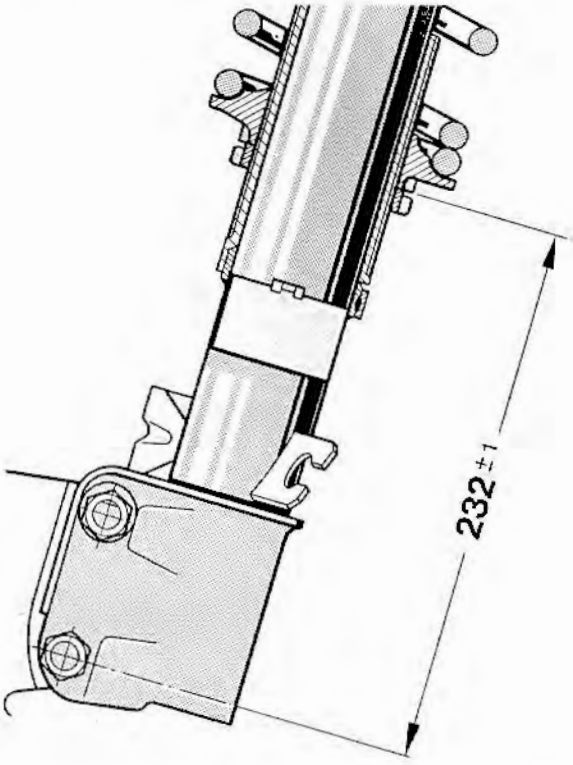

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* fitted as standard in 944 Turbo-Special model "S" (M758)

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Note to 2.

Strut installation:

There is a hole on the outer side of the strut bearing and a bolt on the wheel well to ensure the correct installation position.

The following must be observed when adjusting height:

One-sided height adjustment produces an alteration in wheel load at the same time. If the wheel load is altered for one wheel this alters the wheel loads on the other wheels.

For this reason, the two adjustable front-axle spring seats must be adjusted from the basic setting to the same extent to ensure that the difference in wheel load between right and left does not assume unacceptable proportions. (The exception being a combination of springs, one in use for a long time and one new one).

If wheel-load scales are used, the difference in wheel load (less than 20 kg at front and rear axles wherever possible) is adjusted by altering the height of the vehicle within the height tolerance. Priority is given to the lowest possible difference in wheel load between right and left.

3. Check wheel settings and correct if necessary.

Make sure that the rebound settings for left and right vibration shock absorbers are not adjusted differently (Page 40 - 9 / 40-10).

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Tolerance groups of coil springs

General Information

The coil spring versions differ from each other by their length and spring stiffness (spring rate). They are identified by yellow, grey or white/yellow color marks, respectively.

Spring rate 21.8 N/mm (constant wire - Ø = 12.0 mm) : spring A (Ident. yellow)

Spring rate 28.0 N/mm (non-constant wire - Ø = 11.7 - 12.2 mm) : spring B (Ident. white/yellow)

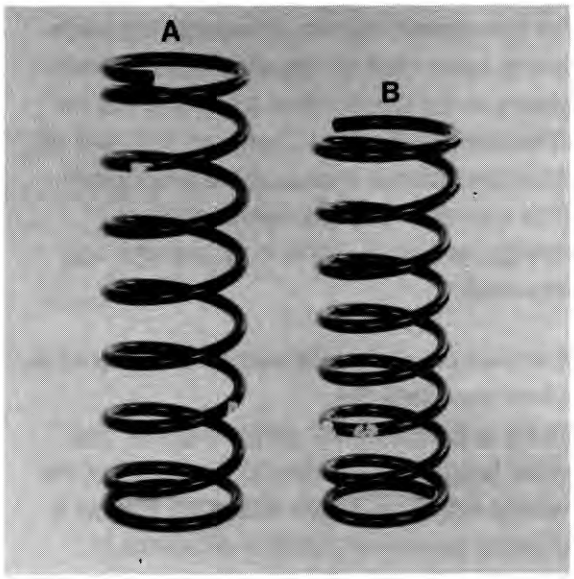
Spring rate 28.0 N/mm (constant wire - Ø = 11.6 mm) : spring - (Ident. grey)

In addition, each spring version (yellow, grey and white/yellow identification) is also classified into two or three tolerance groups, respectively (tolerance of spring rate).

A = 944 Turbo with standard and with sport-type shocks up to end of MY '88

B = 944 Turbo with sport-type running gear M 030* as of MY '87 and standard for MY '89

– = 944 Turbo with standard shocks as of MY '90



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Assembly notes

For repairs, always fit springs with identical color marks. Since the vehicle is subject to settling of the suspension with increasing mileage, this may result in uneven vehicle height if only one spring is replaced. We therefore recommend the springs to be exchanged in pairs. In certain cases, springs are only available in pairs. Replacing springs in pairs is not required in the case of vehicles with height adjustment facility (spring type B).

* standard equipment for 944 turbo special model "S" (M 758).

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Overview

Coil spring, part no. 951 343 531 01 (Type A)
Application: 944 turbo with standard and sport-type shock absorbers up to end of MY '88

Group	Length, removed	Spring force F at length L1 = 251 mm	Color dot	Order index
1	approx. 396 mm	3034 - 3118 N	1 yellow	101
2	approx. 396 mm	3118 - 3202 N	2 yellow	102
3	approx. 396 mm	3202 - 3286 N	3 yellow	103

Coil spring, part no. 944 343 531 01 (Type B).
Application: 944 turbo with sport-type running gear M 030* as of MY '87 and standard for MY '89

Group	Length, removed	Spring force F at Length L1 = 220 mm	Color dot	Order index
1	approx. 329 mm	3050 - 3150 N	1 white - 1 yellow	101
2	approx. 329 mm	3150 - 3250 N	2 white - 1 yellow	102

Coil spring, part no. 951 343 531 03 (Type –).
Application: 944 turbo with standard shock absorbers as of MY '90

Group	Length, removed	Spring force F at Length L1 = 241 mm	Color dot	Order index**
1	approx. 356 mm	3082 - 3168 N	1 grey	
2	approx. 356 mm	3168 - 3253 N	2 grey	
3	approx. 356 mm	3253 - 3330 N	3 grey	

* standard equipment for 944 turbo special model "S" (M 758)

** Springs are only available in pairs. Selection of a specific tolerance group is not possible.

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Koni vibration shock absorbers without rebound travel adjustment from outside

There are no shock absorber inserts for the Koni shock-absorber strut of the 944 turbo, because it cannot be taken apart.

The rebound travel can be adjusted for Koni shock-absorber struts. *Replacement shock-absorber struts are adjusted.*

Shock-absorber strut System/Identification	Setting*	Application/installation
Twin tube, gas shock absorber painted yellow	Basic setting adjusted approx. 1/2 turn	944 turbo up to end of MY 88

Spare parts: refer to the spare parts catalog for the appropriate part numbers.

Modifications as from Model 87

Brake-hose retainer position and retainer for combination connector and earthing bolt. *The damping power has not altered.*

* These specifications are approximate values. Precise adjustments are made in the factury with a shock absorber testing machine.

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Koni vibration shock absorber with outside rebound travel adjustment

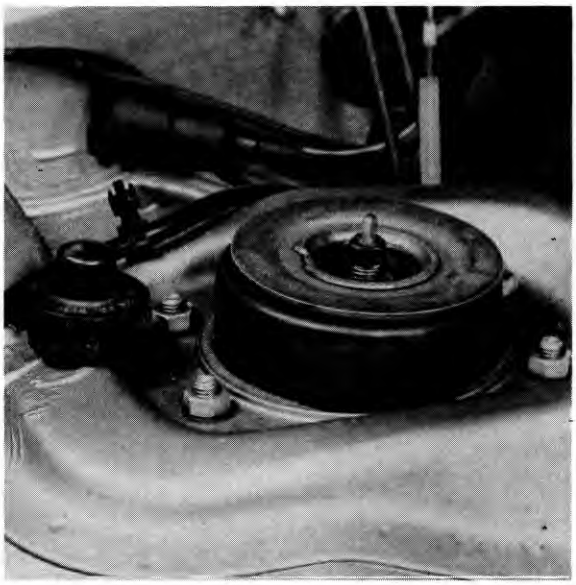
The Koni shock absorbers, adjustable from outside (with adjustable front-axle height), are used in the sports chassis M 030* as from Model 87. As is the case for shock absorber struts not adjustable from outside, there are no replacement shock absorber inserts

Shock-absorber strut System/Identification	Settings	Application/installation
Twin tubes, pressurized Painted yellow Adjustable height SP No.embossed (above the height-adjustment thread on the shock-absorber tube)	Adjusted approx. 3/4 turn from the basic setting (right-hand stop/softest rebound)	944 turbo special model "S" (M 758) and 944 turbo with sports chassis M 030 as from Model 87 standard for MY 89

Adjusting rebound travel

1. Remove the dust cap from the piston rod.

2. Plug the adjusting wheel onto the setting screw.



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* fitted as standard in 944 Turbo-special model "S" (M 758) and for MY 89

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3. The damping power can be adapted to specific driving conditions by turning the setting screw steplessly with the adjusting wheel.

   When doing this, always start at the zero position (right-hand stop/softest rebound). Always adjust the shock absorbers axle-by-axle with the same number of turns.

Harder rebound

Turn to the left (counter-clockwise)

Softer rebound

Turn to the right (clockwise)

Note

When setting, always use the original adjusting wheel and not pliers.

4. Remove the adjusting wheel and replace the dust cap. (Always remove the adjusting wheel after each setting to avoid damaging the hood).

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Technical Data

Rear axle

Suspension		independent suspension on light-alloy semi-trailing arms
Suspension		one round transverse torsion bar per wheel
Torsion bar	up to end of MY '88	Ø 23.5 mm (Ø 25.5 mm for M 030* of MY '87/88)
	as of MY '89	Ø 25.5 mm
Shock absorbers		double-acting hydraulic shock absorbers of twin-tube gas shock design
		Manufacturer/ Identification
		standard: Fichtel und Sachs **grey-green dot** or stripe on lower mounting eye; optional: Koni yellow or yellow with 2 white color dots offset by 180° for sports-type running gear M 030* of MY '87/88
	MY '89	Koni yellow with 2 white colordots offset by 180°
	as of MY '90	Fichtel und Sachs grey with **blue stripes** on lower mounting lug; optional: Koni yellow with 2 white color dots offset by 180°
Stabilizers		18 mm 16 mm as of MY '89 (introduced during MY '89)
Adjustment of spring braces (inclination of spring brace)		page 44 - 3

* standard equipment for 944 turbo special model "S" (M 758)

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TIGHTENING TORQUES FOR REAR AXLE

Location	Description	Thread	Material	Torque in Nm (ftlb)
Bearing flange to cross tube	Hex bolt	M 10	8.8	46 (34)
Bearing flange to body	Locknut	M12x1.5	8	70 (51)
Thrust bearing to bearing flange	Locknut	M 10	8	46 (34)
Thrust bearing to body	Hex bolt	M 10	8.8	46 (34)
Mount to body	Hex bolt	M 10	8.8	46 (34)
Mount to strut	Locknut	M 8	8	23 (17)
Trailing arm to rear axle strut	Locknut, camber eccentric	M12x1.5	10	90 (66)
Trailing arm to rear axle strut	Locknut	M12x1.5	10	103 (76)
Trailing arm to cross tube	Locknut	M12x1.5	8	61 (45)
Shock absorber to body	Hex nut	M12x1.5	8	61 (45)
Shock absorber to trailing arm	Hex bolt	M14x1.5	8.8	123 (90.7)
Adjusting lever to spring strut	Locknut, eccentric and hex bolt	M16x1.5	10	245 (180.7)

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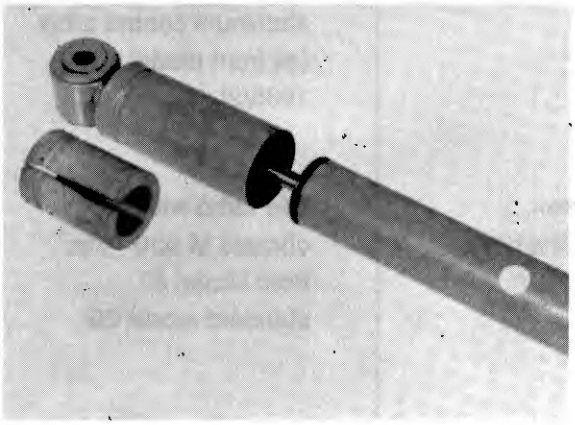
Setting procedure for rebound travel

1. Remove the additional rubber spring (bump stop) from the protective tube. There are holes below the mounting ring for this. Push a wire through the hole and slide the additional rubber spring downwards out of the protective tube, then remove it from the shock absorber.

Note:

Do not damage the piston rod when doing this.



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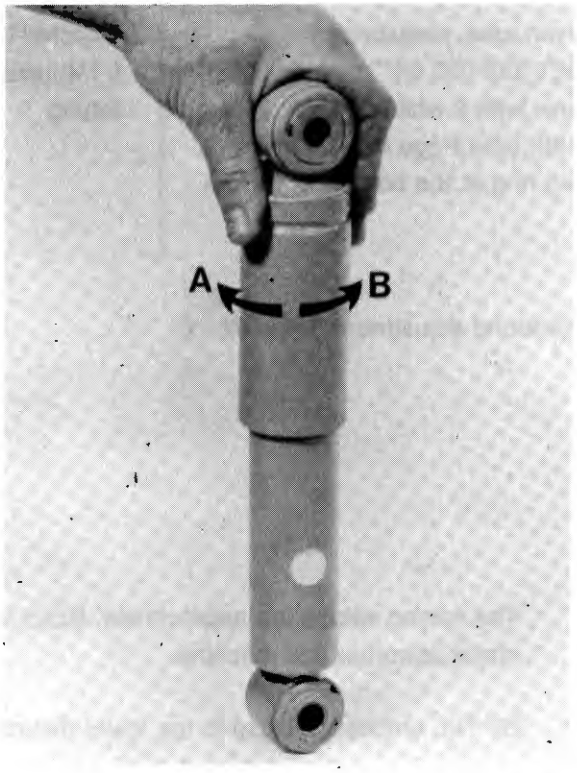
1. Press the protective tube with the piston rod right down to the bottom. Turn the protective tube (without using force) until the adjustment device latches in. Mark the latching position on the protective and shock absorber tubes with chalk.

2. Turn the protective tube/piston rod to achieve the required damping power:

To the left B (counter-clockwise)	Protective tube/piston rod pointing upwards (installed position)
	↓
	Softer rebound

To the right A (counter-clockwise)	Protective tube/piston rod pointing upwards (installed position)
	↓
	Harder rebound



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3. After adjusting, pull the protective tube/piston rod upwards again to disengage the adjustment device. Replace additional rubber spring.

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Wheels and tires

Tire condition / tire pressure

Tires are safety-relevant items that are only capable of meeting the requirements aplicable if they are run at the correct tire pressure and with sufficient tread depth.

The tire pressures indicated are minimum pressures. The tires must never be run at lower pressures since this influences roadholding in a negative manner and may lead to severe tire damage.

Valve caps protect the valve against dust and dirt and therefore help prevent leaks. Always screw on caps tightly and replace missing caps.

For safety reasons, do not limit tire checks to checking the tire pressure but also check for sufficient tread depth, ingress of foreign matter, pinholes, cuts, tears and bulges in the sidewalls (cord break)!

Tire pressure for cold tires (summer and winter tires)

Up to end of MY '89

front	2.5 bar excess pressure
rear	2.5 bar excess pressure

As of MY '90

front	2.5 bar excess pressure
rear	3.0 bar excess pressure

Folding spare tire

front and rear	2.5 bar excess pressure	for tires 8 PR 89 P
	2.2 bar excess pressure	for tires 4 PR 83 P

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Tire and wheel survey / tire specification identification mark

The tire and wheel survey for summer and winter tires is to be found in the corresponding Technical Information (TI) Group 4.

When replacing summer tires, check for the correct tire specification number. The specification character N 1 or N 0, respectively, helps to distinguish summer tires approved by Porsche from other versions of identical tire type and the same tire size. The tires approved by Porsche are also identified in the corresponding TI.

Important note

From MY '87, the rim offset of the wheels has been changed. Wheels designated for cars as of MY '87 must not be mounted on older vehicles. At the same time, wheels for cars made before MY '87 must not be fitted to vehicles produced from MY '87.

For 15-inch light-alloy disc wheels, fit counterweights to a max. weight of 40 g on the inside (space limitations). If required (if out-of-balance is more severe), use 2 weights.
15-inch disc wheels are only admissible for winter tires on vehicles up to end of MY '86.

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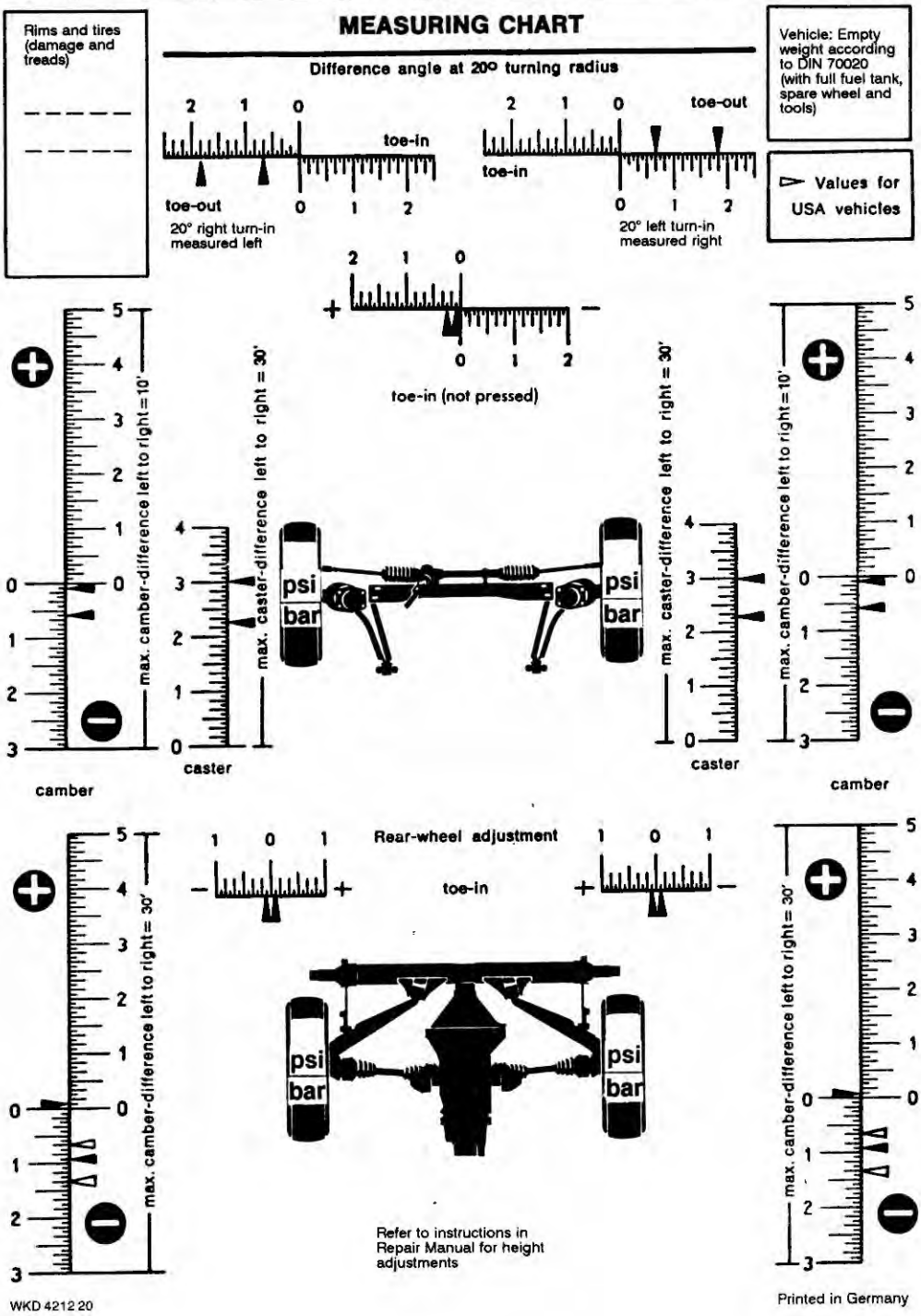
Sample measuring chart up to end of MY '89

Name: Vehicle: All Porsche types 924/944 until end of model year 89

Vehicle Ident. No.: License plate No: miles/km:

Date: measured by:



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Sample measuring chart as of MY '90

Name: Vehicle: All Porsche types 944 90 models onward

Vehicle Ident. No.: License plate No: miles/km:

Date: measured by:

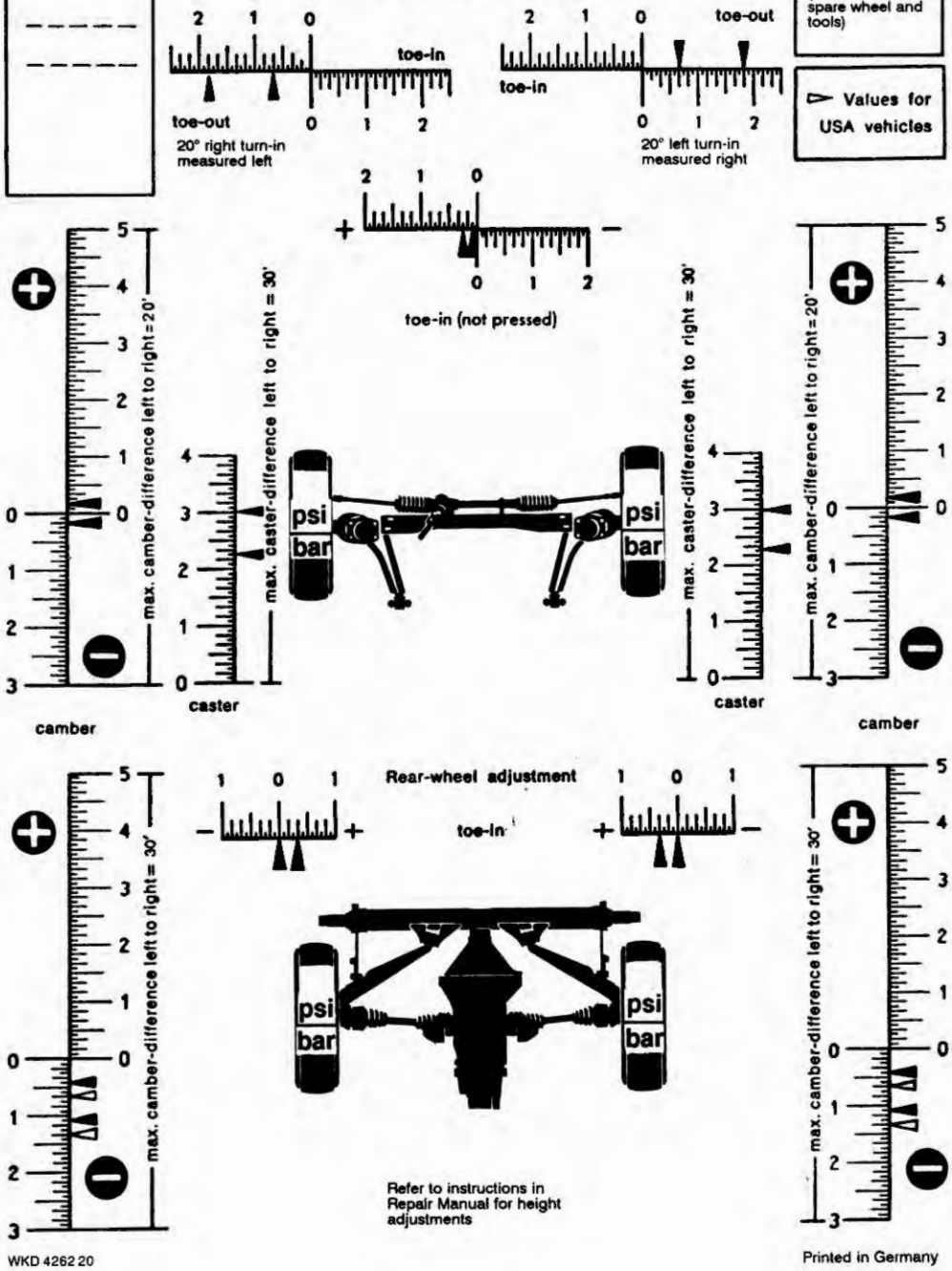
Rims and tires (damage and treads)

MEASURING CHART

Vehicle: Empty weight according to DIN 70020 (with full fuel tank, spare wheel and tools)

Values for USA vehicles

Difference angle at 20° turning radius



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Adjustment values for wheel alignment

The following values are valid for the vehicle curb weight to DIN 70020 (vehicle tank full, with spare wheel and tools).
Adjustment values for U.S. and Canadian models are given in brackets.

Wheel alignment values

	Adjustment value and tolerance		max. difference
	up to end of MY '89	as of MY '90	left to right
Front axle			
Toe - unpressed	+ 10' ± 5'	+ 10' ± 5'	
Toe difference angle at 20° steering lock	- 40' to - 1° 50'	- 40' to - 1° 50'	correction only possible by replacing the steering arms
Camber	- 20' ± 15'	**0° ± 10'**	10' to end of MY '89 20' as of MY '90
Caster	2°30' + 30' - 15'	2°30' + 30' - 15'	30'
Rear axle			
Toe (each wheel)	0° ± 5'	**+ 10' ± 10'**	10'
Camber	- 25' ± 30' (- 1° ± 20')	**- 45' ± 20'** (- 1° ± 20')	30' 30'

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Adjustment values for height and spring brace adjustment

Front axle		Height adjustment* Bolt bottom edge measured from rear steering arm **under** wheel center (p. 44-7)
Sport-type running gear M 030*** (height-adjustable spring struts)		130 ± 10 mm
Rear axle	Spring brace adjustment (inclination of spring brace)**	height adjustment* center of brace bearing (center of torsion bar) **below** wheel center (-value)
up to end of MY '88		
Standard and M 474 (M 474 = Shock absorber with sports tuning) Torsion bar Ø 23.5 mm	25° (26°30' USA, Canada)	- 3.5 ± 10 mm
Sport-type running gear M 030*** Torsion bar Ø 25.5 mm	18°	- 18.5 ± 10 mm
as of MY '89		
Standard and sport-type running gear M 030*** Torsion bar Ø 25.5 mm	18°	- 18.5 ± 10 mm

* max. height difference left to right 10 mm.
For U.S. and Canadian vehicles the bumper height is decisive. The distance from the measuring surface (road / level surface) to the top edge of the bumper must be 522 ± 20 mm at the rear axle. **The distance at the front axle** must be 533 ± 20 mm.

** **max. difference right to left 0.5°**. Changing the inclination of the spring brace by 1° is equivalent to approx. 5 mm change of vehicle height.

*** Standard equipment of 944 turbo special model "S" (M758)

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Vehicle measurements

General

Carry out vehicle measurements with an optical or electronic wheel-alignment analyzer. Refer to the wheel-alignment analyzer's operating instructions for measurement procedures. The following preconditions must be fulfilled before measuring:

- Curb weight of the vehicle in accordance with DIN 70020, i.e. vehicle ready for driving with full fuel tank and spare wheel.

- Adequate play on joint and wheel bearing

- Correct tire inflation pressure, approximately uniform tread depth

If the vehicle is to be measured front and rear, first check the rear-axle wheel alignment and adjust if necessary. Set steering wheel and steering gear to the middle position at toe.

Before adjusting front and rear wheel alignment, it is *advisable* (or necessary *) to check the height adjustment of the rear axle and/or the front axle, for vehicles with adjustable front struts, at DIN curb weight.

If wheel-load scales are available it is possible to reduce the difference in wheel load between right and left to a minimum thanks to the height-adjustment facility. The difference in wheel load is adjusted by altering the height of the vehicle within the height tolerances. Priority is given to a minimum difference in wheel load between right and left.

* Following work which causes an alteration in height or if the height is obviously incorrect.

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Important notes for vehicle measuring procedures

Observe the following when measuring vehicles:

Height adjustment/wheel-load alteration

Altering the height on one side automatically causes a change in wheel load. *An alteration of load on one wheel also affects the loads on the other wheels.*

If the initial compression of a spring is increased on one side (lifting the vehicle) the wheel load becomes greater.

If the initial compression of a spring is reduced on one side (lowering the vehicle) this reduces the wheel load.

An alteration in wheel load is always felt diagonally on the other side of the axle. That means if the load on one wheel is reduced or increased, the same effect is felt at the diagonally opposite wheel.

Example

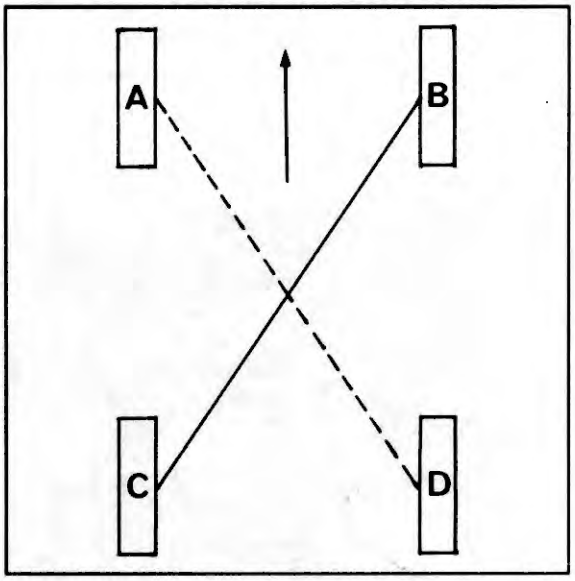
The initial spring compression is increased rear left C.

The wheel load is then:

– greater at rear left C and front right B

———

– less at rear right D and front left A



The difference in wheel load between left and right for front and rear axles should be kept to a minimum (less than 20 kg if possible).

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Checking the height / adjusting the height

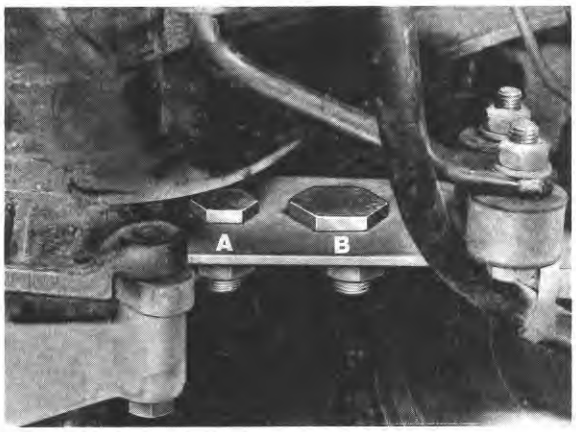
Drive the vehicle on to the test platform and check the height adjustment of the rear axle or (in the case of adjustment facilities at the front) at rear and front axles and correct if necessary.

Rear axle

Measuring points are at the middle of the torsion bar and at the middle of the wheel, both measured from the wheel contact area.

Setting: Page 44 - 3

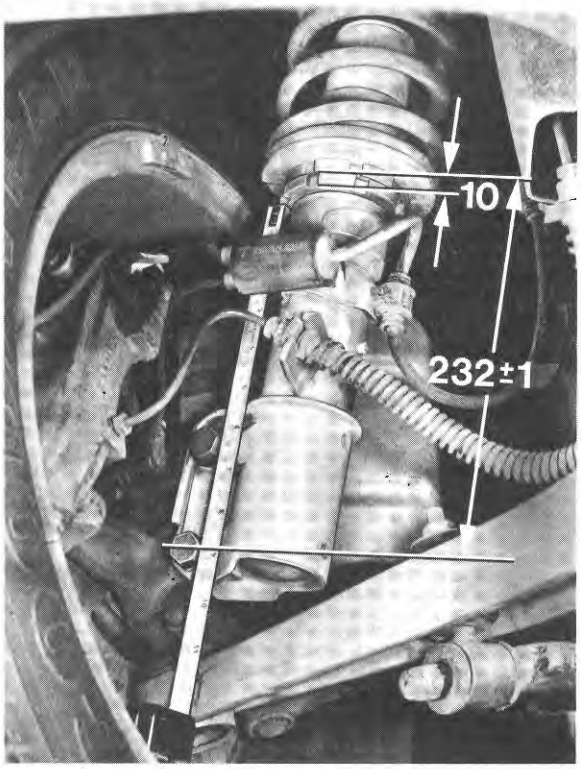
If necessary, correct the rear vehicle height by means of eccentric screw B on the two-part shock absorber, undoing fastening screw A beforehand.



Front axle

(For vehicles with adjustable struts)

1. Setting I (basic setting)
   = 232 ± 1 mm (from the bottom edge of the spring seat).
   To adjust, undo the counternuts and turn the spring seat accordingly
   Always observe the following notes (Page 44-7) when setting.



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Notes on setting I (basic setting)

– A basic setting (specified initial spring compression) is usually adequate. The nominal vehicle height is then within tolerance.

– Starting at the basic setting, a height correction may be necessary and/or it is possible to make fine adjustments.

Fine adjustment:
It is possible to keep differences in wheel loads to a minimum (below 20 kg) with the help of wheel-load scales.
The vehicle height can be exactly adjusted within the tolerances (priority is given to a minimum difference in wheel load between right and left at front and rear axles)

Height correction:
To compensate for differences when installing only one new spring.

2. Height correction or fine adjustment (Only if necessary or desirable). Measuring point is the bottom edge of the suspension link bearing bolt = 130 ±10 mm* below the middle of the wheel. Max. tolerance between right and left 10 mm.

If necessary turn the spring seat accordingly. Refer to the above-mentioned notes for this.

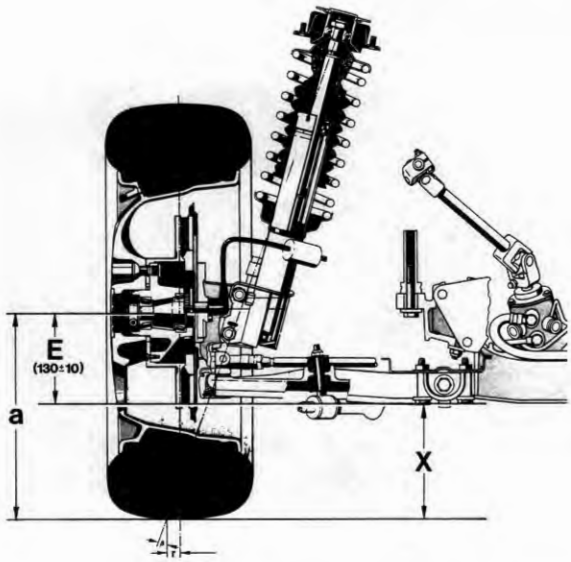
Example*

(Measuring the height at one wheel)

Measure to the middle of the wheel
a = 300 mm

Specified height
E = 130 ±10 mm

Value (from wheel contact surface to measuring point) = 170 ± 10 mm



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* Bumper height is decisive for USA cars. Distance from measuring platform (road/level surface) to upper edge of front covering (upper edge of bumper) must be 533 ± 20 mm.

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Wheel alignment

Front axle

Adjusting the camber

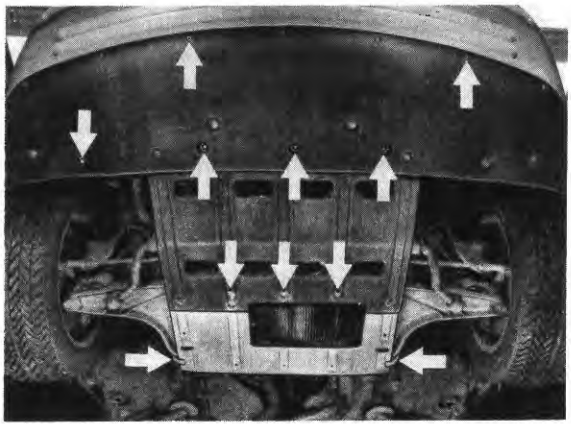
The camber is adjusted by turning the eccentric screw (arrow). Remove the brake-cooling air guide for this if necessary.

Note

For the 944 turbo special model "S" (M 758), avoid damaging the brake line (bending).

Adjusting the caster

Remove sump guard



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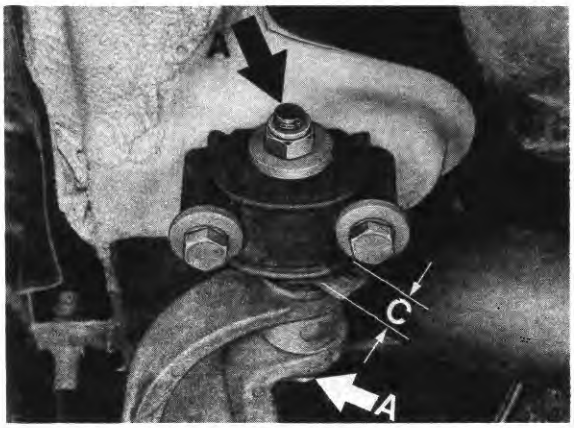
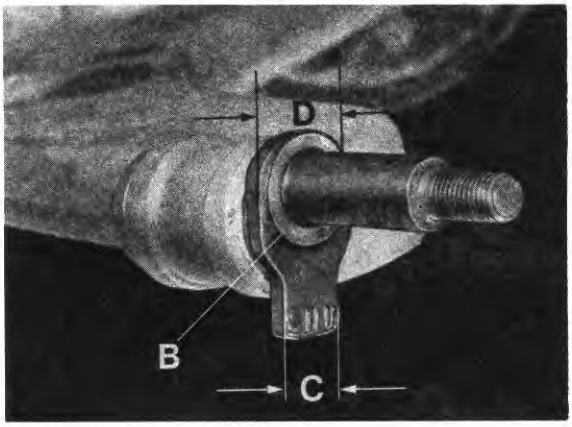
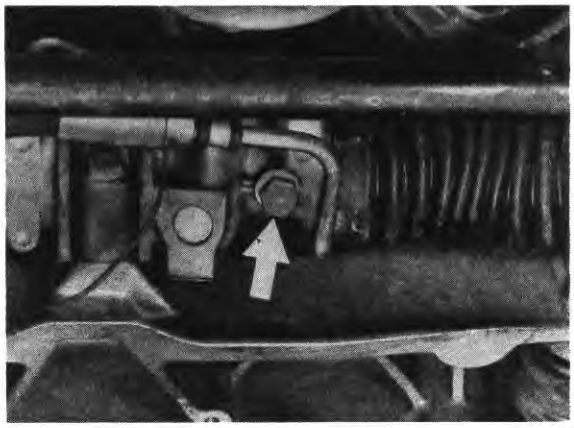
Undo self-locking hexagon nuts A on caster eccentric B. Adjust to the specified value by turning caster eccentric B. Depending on the position of the eccentric, use a 19 mm open-end wrench in area C or a 32 mm open-end wrench in area D. (Tightening torque for hexagon nuts = A 85 Nm).





Adjusting the toe

Preparation: Center steering gear in middle position with special tool 9116. If the steering wheel is offset, try to get the best value when converting.
Remove special tool 9116 afterwards.



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Clamp the steering wheel in the middle position and adjust the toe at the tie rods.

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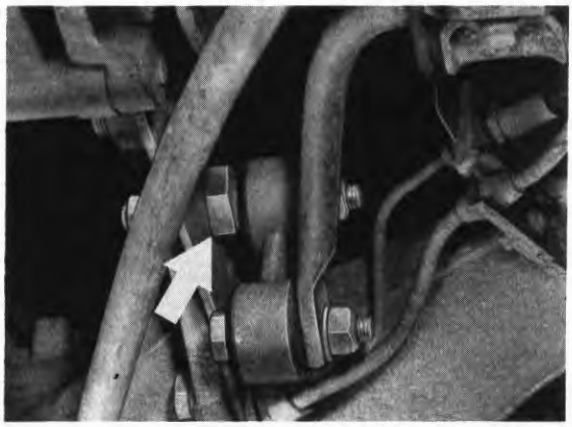
Toe difference angle

The toe difference angle cannot be adjusted (it can only be influenced by replacing the steering arms).

Rear axle

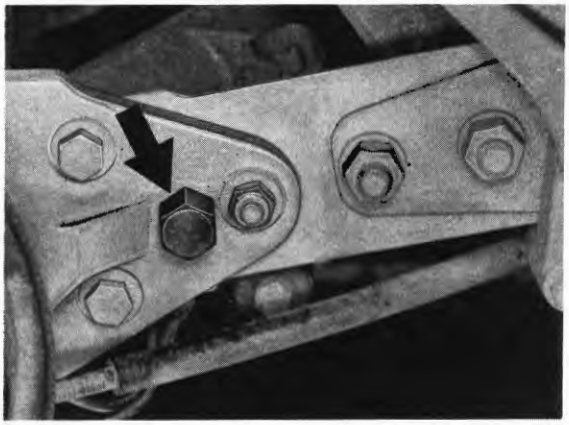
Adjusting the camber

Loosen stabilizer suspension and the screw connection between shock absorber and control arm. Adjust to the specified value by turning the camber eccentric.



Adjusting the toe

Adjust the toe by moving the control arms in the slots on the spring strut. Use special tool 9171 for this.



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Technical Data

Designation	Remarks, dimensions up to end of 88	as of MY 89	Wear limit up to end of MY 88	as of MY 89
Operating brakes (foot brake)	Hydraulic dual-circuit brake system with front/rear axle circuit division (black/white), brake booster, vented brake discs with fixed caliper on front and rear axle. The pushrod brake circuit is allocated to the front wheels. 4 pistons per each fixed caliper. ABS optional as of MY '87 (M593), as of MY '88 included in standard specification of some models.			
Brake booster (light weight built)	Ø 9 inch	Ø 9 inch		
Boost coefficient	3.1 or 3.4**	3.4		
Brake master cylinder*** (aluminum design) Ø in mm	up to end of MY '86 23.81/19.05 MY '87/88 23.81/20.64	23.81/20.64		
Brake power regulator in rear axle circuit switchover pressure/ reduction coefficient	18 bar / 046	18 bar/046		
Brake discs Ø front	298 mm (304 mm)*	304 mm		
rear	299 mm	299 mm		
Effective brake disc dia. front	245 mm (250,8 mm)*	250,8 mm		
rear	246 mm	246 mm		

* 944 turbo special model "S" (M 758)

** as of MY '87, boost coefficient 3.4

*** for vehicles with ABS (optional equipment as of MY '87 / standard as of MY '89) with two central valves

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Designation	Remarks, dimensions up to end of MY 88	as of MY 89	Wear limit up to end of MY 88	as of MY 89
Piston dia. in brake caliper				
front, mm	2 x 36 + 2 x 38 MY 87/88 2 x 36 + 2 x 40 (2 x 36 + 2 x 44)*	2 x 36 + 2 x 44		
rear, mm	2 x 28 + 2 x 30	2 x 28 + 2 x 30		
Brake pad thickness				
front	13 mm	13 mm	2 mm	2 mm
rear	13 mm	13 mm	2 mm	2 mm
Brake pad area				
(each front wheel	86 cm^2 (126 cm^2)*	126 cm^2		
Brake pad area				
(each rear wheel)	86 cm^2	86 cm^2		
Total brake pad area	344 cm^2 (424 cm^2)*	424 cm^2		
Brake pad thickness, new				
front	28 mm (32 mm)*	32 mm		
rear	24 mm	24 mm		
Min. brake disc thickness**				
after refacing				
front	26.6 mm (30.6 mm)*	30.6 mm	26 mm (30 mm)*	30 mm
rear	22.6 mm	22.6 mm	22 mm	22 mm
Tolerance of thickness of				
brake disc max.	0.02 mm	0.02 mm		
Lateral runout of brake disc				
max.	0.05 mm	0,05 mm		
Lateral runout				
of fitted brake	0.1 mm	0.1 mm		
disc max.				
Lateral runout of				
wheel hub max.	0.05 mm	0.05 mm		
Surface roughness of brake				
disc after machining max.	0.006 mm	0.006 mm		

* 944 turbo special model "S" (M 758)

** The brake disc may only be machined symmetrically, i.e. in a uniform manner on both sides

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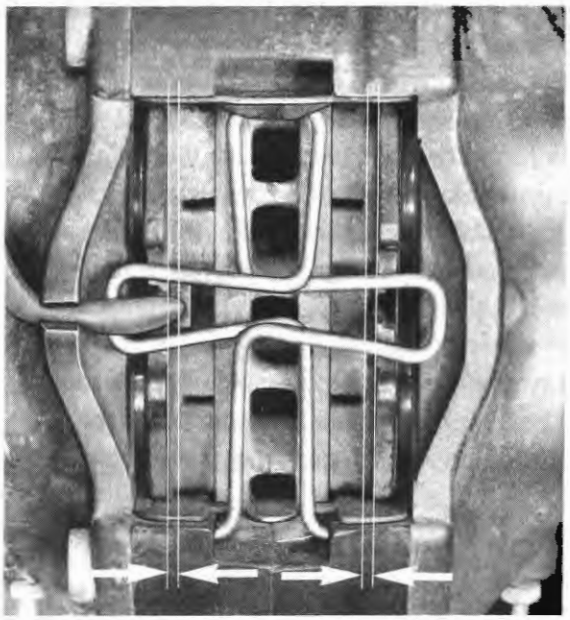
CHECKING THICKNESS OF BRAKE PADS

N o t e

All brake pads on one axle must be replaced when the brake pad wear indicator lamp comes on, and no later than when remaining pad thickness is 2 mm. If brake pad wear is reported by the indicator lamp, the warning contact (sensor including wire and plug) must also be replaced. Warning contact replacement is not necessary if brake pads are replaced no later than with a thickness of 2.5 mm. Warning contacts whose electric lead core is ground (worn) must be replaced. Replacement is not necessary when only the plastic part of the warning contact is worn.

1. Remove wheels to check thickness of brake pads.

2. Visually inspect brake pads for wear.



Wear limit is reached when pad has a remaining thickness of 2 mm.

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Removing and installing brake pads

Removing

Note

If the brake pads are to be reused, mark them for refitting prior to removal. Changing the pads from the outside to the inside and vice-versa as well as from the right-hand to the left-hand wheel is not permissible and may result in uneven braking efficiency.

1. Compress expander spring in the middle and disengage from its support.
   At the same time, or before compressing the expander spring, press spring towards the brake disc in the retainer area (to unload the spring). This helps to avoid damage to the retainer.

2. Pull up warning contact lead at the brake caliper and pull warning contact out of the brake pad plate.

Note

Replace warning contact if the core of the lead is ground through or down to the bare core. The warning contact may be reused if grinding marks are limited to the plastic section of the warning contact.

3. Pull out brake pads using a pad removal tool. For brake calipers fitted with suppressors or vibration dampers with an adhesive coating, respectively, make sure the following points are observed:

Push out brake pads along with suppressors or vibration dampers, respectively. If this is not possible (depending on the degree of wear of the brake pads), separate suppressors / vibration dampers from the brake backing plate using a spatula before removing the pads. In both cases, push brake pads as far back as possible using the piston retraction tool. If required, draw off some brake fluid from the reservoir first.
Warning: Engage the spatula exactly between the brake pad and the suppressor / vibration damper to avoid damaging the brake piston seals.

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Designation	Remarks, dimensions up to end of MY 88	as of MY 89	Wear limit up to end of MY 88	as of MY '89
Play at brake pedal with brakes bled and engine standing still	approx. 10 mm	approx. 10 mm		
Parking brake (hand brake)	Drum brake, with mechanical action on both rear wheels			
Parking brake drum dia.	180 mm	180 mm	181 mm	181 mm
Brake shoe width	25 mm	25 mm		
Brake lining area (each wheel)	85 cm^2	85 cm^2		
Brake lining thickness	4.5 mm	4.5 mm	2 mm	2 mm

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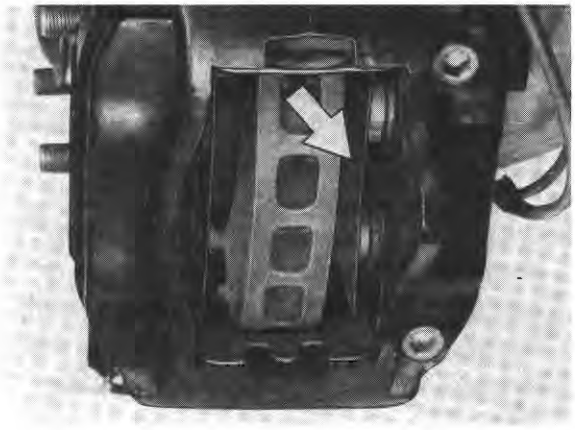
Notes

From MY '89 and, in some cases, from MY '88, fixed callpers used in conjunction with asbestos-free brake pads must be fitted with vibration absorbers or suppressors.
For allocation to the various types of brake calipers, refer to the Technical Informations Gr. 4 as well as the spare parts catalog.

Since the suppressors have an adhesive coating, they must be replaced whenever the brake pads are removed or replaced.

Vibration dampers (suppressor plates with integral absorber weights) must also be coated with an adhesive backing. Always replace the vibration dampers that feature a backing coat whenever the brake pads are removed or replaced.
For fixed calipers with scraper ring piston seals, a version without coating is currently (May, 1991) used. The version without coating should be fitted with special double-sided adhesive tape (arrow).
Vibration dampers are only used for the front axle with large fixed calipers (for radial fitting, refer to page 46 - 7).

For the double-sided special adhesive tape, use **Scotch - 3M tape (No. 9485, width 38 mm).**



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Do not combine asbestos-free and asbestos-type brake pads on one and the same vehicle.

For types of brake calipers and notes on spare part replacement, refer to page 47 - 04.

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Installation

1. If required, push piston back into original position using a retraction tool.

2. Clean brake pad seat and guiding area of brake pads in brake caliper using white spirits and a cylinder brush or special brush to ensure smooth sliding action of the pads in the pad tunnel. Make sure the brake piston seals (dust seals) are not damaged.

3. Check brake calipers for correct mounting position. Small pistons must face the entry side of the brake disc. This is also indicated by the arrow above the PORSCHE logo that indicates the sense of rotation of the brake disc.

Note

In addition, the larger pistons of the front calipers of vehicles made up to the end of MY '86 feature a small recess that points towards the entry side of the brake disc (towards the smaller pistons). The edges of the recess of the piston must be parallel to the guiding area of the brake pad.

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4. If vibration dampers or suppressors, respectively, are used, insert them into brake pistons.
Replace suppressors as a rule, replace vibration dampers or line with double-sided adhesive tape (refer to notes on pages 46 - 3).
Remove protective backing from suppressors or vibration dampers before installation.
Make sure they are allocated to the correct version (Technical Information Gr. 4 and spare parts catalog).

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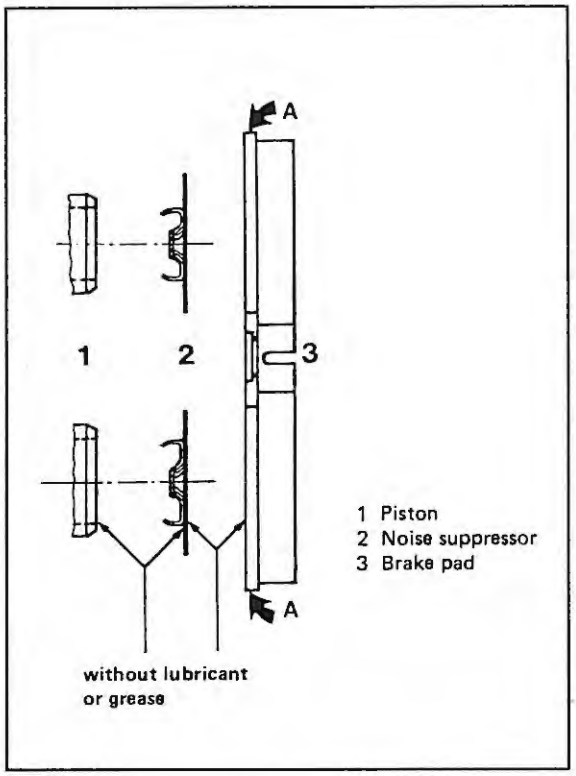
5. Insert brake pads. Check for correct pad quality.

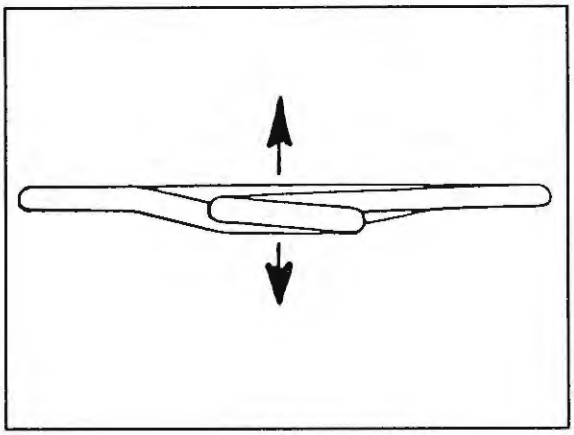
Note

Brake backing plates (rear of brake pads) must not be greased when used in conjunction with vibration dampers or suppressors.
To avoid corrosion of the brake pads inside the brake caliper, however, coat the seating and guiding surfaces (arrow A) with a thin coat of lubricant,
e.g. using Optimoly HT (Cu paste) or Plastilube (supplied by Messrs. Schillings, Postfach 1703, 7080 Aalen).



6. Coat engaging lugs of the expander spring with Optimoly TA or Plastilube. If required, fit new expander spring in such a manner that the flat side points towards the brake disc. If it is installed incorrectly, correct seating of the brake pads cannot be ensured, causing the raised section in the middle of the cross to rub on the brake disc. Compress center section of expander spring and engage spring. **Check for correct engagement of the expander spring (arrow). Do not force expander spring when fitting in place (risk of breaking the retainer).**

Brake disc



Outside

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7. Push warning contact in correct position into pad plate and connect warning contact lead to the brake caliper.

Note

In case of unfavorable tolerances, the expander spring may have to be disengaged again.

8. Depress brake pedal several times firmly to allow the brake pads to settle in the operating position. Check brake fluid reservoir level and refill if necessary.

Running in the brake pads

New brake pads require a running-in period of approx. 200 km. Optimum friction and wear coefficients are only reached after this period. During the initial running-in period, do not brake fully from high speeds except in case of emergency.

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TIGHTENING TORQUES FOR MECHANICAL BRAKE PARTS

Location	Description	Thread	Material	Torque in Nm (ftlb)
Pan head bolt to clamping nut	Allen head bolt	M 7	10.9	13+3 (9+2.2)
Fixed caliper to steering knuckle	Hex bolt	M 12 x 1.5	8.8	85 (62.7)
Brake disk to front wheel hub	Hex nut	M 8	8	23 (17)
Guard plate to steering knuckle	Hex bolt	M 7	8.8	10 (7)
Air guide plate to spring strut	Hex bolt	M 6		10 (7)
Wheel hub to rear wheel shaft	Locknut	M 22 x 1.5	8	500 (370)
Brake line holder to trailing arm	Hex screw	M 6	8.8	10 (7)
Cable holder to trailing arm	Hex screw	M 6	8.8	10 (7)
Guard plate to trailing arm	Hex screw	M 6	8.8	10 (7)
Brake disk to rear wheel hub	Countersunk screw	M 6	8.8	5 (3.6)
Fixed caliper to trailing arm	Hex bolt	M 12 x 1.5	8.8	85 (62.7)
Parking brake lever to body	Hex bolt	M 8	8.8	21 (15.5)
Brake cable to pivot end	Hex screw	M 6	8.8	8.5 (6.3)

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Location	Description	Thread	Material	Torque in Nm (ftlb)
Parking brake cable to clamping lock	Nut	M 6	8	8.5 (6.3)
Brake power assist to connector	Hex nut	M 8	8	21 (15.5)
Connector to firewall	Hex nut	M 8	8	21 (15.5)
Pivot end on brake push rod	Hex nut	M 10	8	35 (25)

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ADJUSTING BRAKE PUSH ROD

N o t e

The brake push requires adjustment only when:

- the brake power assist unit is replaced,
- the pivot end of the brake push rod has been removed, or
- the push rod or pivot end has been turned.

The brake pedal does not have a stop. Its initial position is reached when the brake unit (power assist and brake master cylinder) are in released position. Since with a correctly adjusted brake push rod the brake pedal is without support in the initial position, the set air clearances in the brake power assist unit are guaranteed. Consequently, with the engine stopped and the brakes bled, approx. 10 mm of push rod play will be noticed on the brake pedal plate when operated manually.

A d j u s t i n g

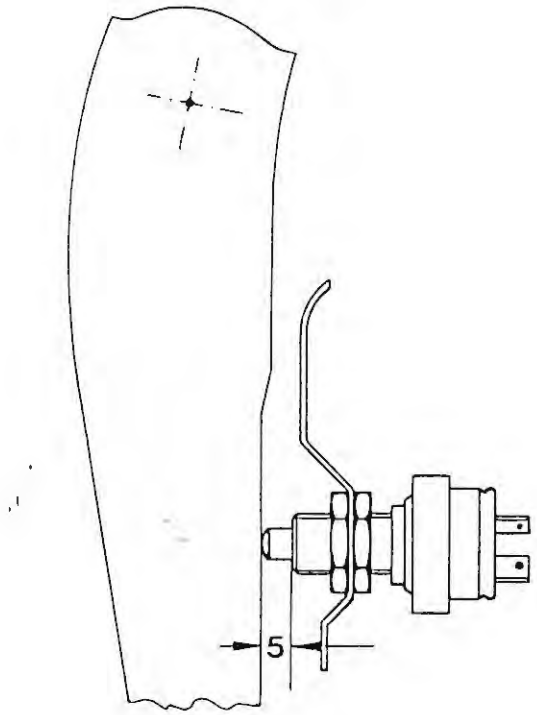
1. Adjust length of brake push rod by turning pivet end.
   Length from contact surface of brake power assist on connector (mounting piece) to the bearing pin center of pivet end should be 186 + 1 mm until end of mod. 86 and/or 206 + 1 mm as from mod. 87

2. Tighten locknut.

3. Check brake light switch adjustment.

CHECKING BRAKE LIGHT SWITCH ADJUSTMENT

The brake light switch is a mechanically operated switch, which is installed on a console above the brake pedal plate. The distance between brake light switch and brake pedal should be 5 mm with brake pedal in initial (neutral) position. If necessary, change position of brake light switch by turning mounting nuts until a distance of 5 mm is reached. Turn mounting nuts against each other (lock).



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Checking and adjusting parking brake

The parking brake must be adjusted if the parking brake lever can be pulled up by more than two teeth by applying average force, without showing any braking effect.

1. Jack up car and remove rear wheels.

2. Release parking brake and press back disk brake pads on rear wheels until brake disk can be turned easiliy.

3. If necessary, loosen adjusting nut on clamp far enough so that cable is under no tension.

4. Using a screwdriver inserted through the hole in the brake disk, turn adjusting device so that the wheel can no longer be turned. Now turn back adjusting device until wheel can be turned freely, then turn back (loosen) by two catches.

5. Pull up parking brake lever two teeth and turn adjusting nut until wheels can only with difficulty be rotated by hand (at 4th tooth the wheels must be firmly stopped).

6. Release parking brake lever and check whether both wheel turn freely.

7. Lock adjusting nut.

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Dismantling and assembling front brakes, as of MY '87

General Information

Starting with Model Year '87, mounting of the brake disc on the 944/944 S and 944 turbo has been modified. Mounting on the 924 S remains the same.

Type/Model Year	Mounting/Notes
944//944 turbo up to end of MY '86 and all 924 S models	Mounted on wheel hub with five M8 bolts. To remove the brake disc, the wheel hub has to be removed.
944/944 S/944 turbo as of MY '87 and all 944 S2 models	Mounted on wheel hub with two M6 countersunk screws. The brake disc may be removed without removing the wheel hub.

Dismantling

1. Remove brake caliper and suspend in a suitable place (do not disconnect brake hose or brake pipe but extend at spring strut).

Mounting with hexagon head screw

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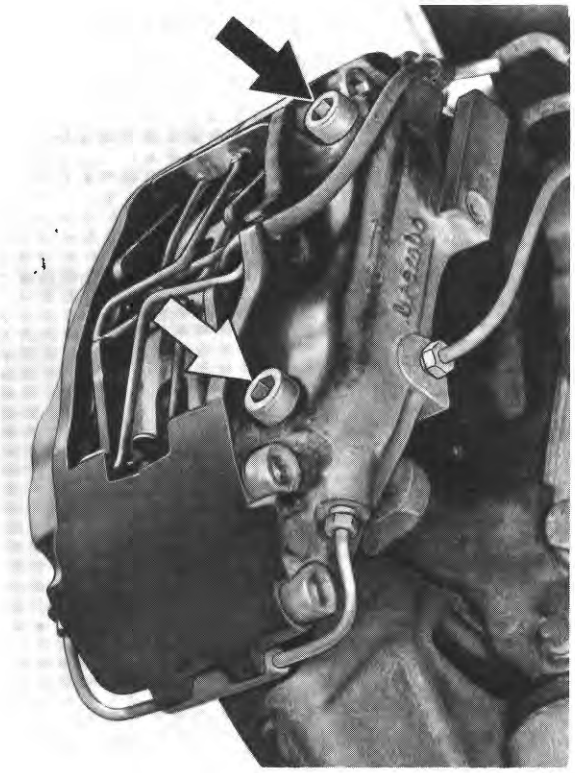
Mounting with cylinder bolts



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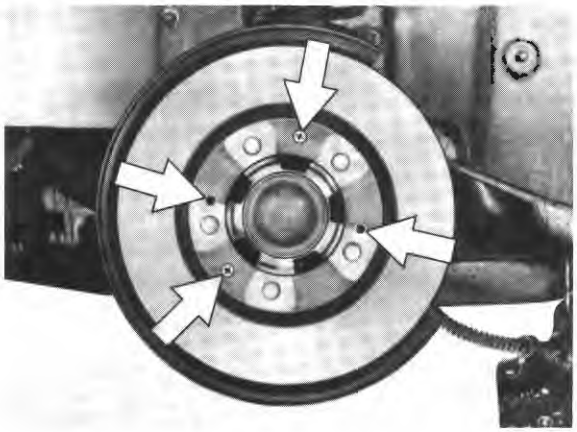
2. Remove brake discs after having removed the cylinder bolt(s). If a brake disc that is stuck cannot be freed even when light blows with a plastic hammer are applied, screw two hexagon head bolts evenly into both 8 mm threads of the brake disc and press disc off.



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Assembly

1. Check all parts for good condition and replace if necessary.

2. Clean centering surface for the brake disc on the wheel hub and coat very lightly with Optimoly TA.

3. Install brake disc and brake caliper. Tighten bolts of the brake caliper with 85 Nm.

Parts replacement note

- For the 944 turbo, four brake disc versions for **the front axle** are available

I (up to end of MY '86)

II Model Year 87 and 88 /
as of MY 87 / modified cup height

III MY '88 / modified in vent duct area.
(Retrofitting - only in pairs - for MY '87 vehicles is possible)

IV as of MY '89 and
944 turbo special model "S" / right- and left-hand discs are different (note difference when assembling)

Difference: shape of involute and spare part no. (marked on brake disc)

Spare part left-hand side -
3rd group no. uneven

Spare part right-hand side -
3rd group no. even

Example:

- Part No. Brake disc LH:
928.351.043.04

- Part No. Brake disc RH:
928.351.044.04

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Rear wheel brake, dismantling and assembling

Refer to the 944 repair manual for dismantling and assembly procedures for the rear wheel brakes.

Differences between the 944 turbo and 944:

- Four-piston fixed caliper with larger brake pads

- Thicker brake disk with larger diameter.

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HYDRAULIC BRAKE PARTS TIGHTENING TORQUES

Location	Description	Thread	Material	Torque in Nm/kpm (ftlb)
Brake pressure pipe to brake master cylinder, brake hose, branch and caliper	Pipe coupling nut	M10 x 1	5.8	12/1.2 (8.8)
Brake power regulator to brake master cylinder		M10 x 1		14/1.4 (10)
Brake hose to fixed caliper	Brake hose	M10 x 1		14/1.4 (10)
Bleeder bolt to fixed caliper	Bleeder bolt	M10		8-12/0.8-1.2(6-8.8)
Brake master cylinder to brake power assist	Hex nut	M8	8	21/2.1 (15.5)
Brake power assist to adapter	Hex nut	M8	8	21/2.1 (15.5)
Adapter to fire-wall	Hex nut	M8	8	21/2.1 (15.5)
Guard plate for brake unit to body	Hex bolt	M6		10/1.0 (7)
	Hex nut	M6		5/0.5 (3.6)
Bracket to rear trailing arm	Hex screw	M6	8.8	10/1.0 (7)
Stop bolt in brake master cylinder	Hex screw	M6		7-10 /0.7-1.0 (5 - 7)

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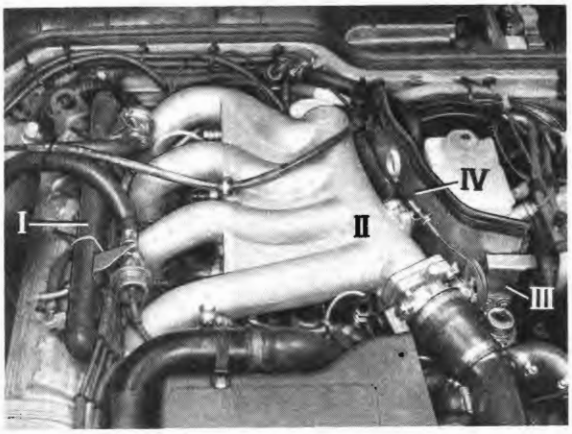
BRAKING SYSTEM

B r a k e U n i t

The removal procedure for the brake power assist (brake booster) can be found in the 944 Workshop Manual. In addition, the following procedures and information must be observed.

a. Remove brake guardplate as follows:
- detach fuel collection pipe complete with injection valves from intake air distributor (intake pipe). Note that fuel collection pipe remains in vehicle.
- remove intake air distributor.
- remove bracket for turbocharger coolant pump and run out brake guard plate after loosening fastening bolts. If necessary, replace guard plate.



I Fuel collecting pipe
II Intake air distributor (intake pipe)
III Bracket for turbocharger coolant pump
IV Brake guard plate

b. When loosening and pulling on the brake line, counterhold on hexagon of braking power regulator. However, when assembling or disassembling regulator do not on hexagon. The two surfaces next to the screw-in thread are provided for this purpose.

c. During repair, due to their differing pedal travel, only main brake cylinders and brake power assists from the ATE company may be installed. This applies only to the 944 turbo.

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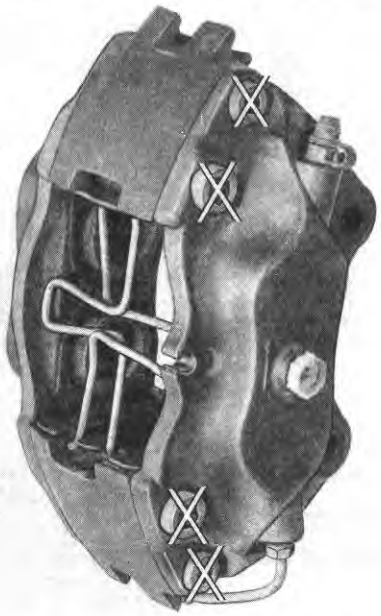
Brake system notes

Four-piston fixed caliper

Do not separate the caliper sections from each other.

Piston seals, dirt scraper rings and spring plates may be replaced with the fixed caliper remaining assembled.
To remove the spring plates, heat the mounting bolts to approx. 150°C using a hot air gun since the bolts have been inserted with locking compound. Use new bolts for reassembly. Coat bolt threads lightly with Loctite 270. When assembling the brake pistons, always use Unisilikon TK 44 N 2 brake cylinder paste.
Unisilikon paste is available from the spare parts department (Part No. 000.043.117.00).



X = Never loosen or tighten those bolts

To allow for checking of the correct mounting position of the brake calipers with the brake pads in place, the fixed calipers are marked with an arrow above the Porsche logo to indicate the sense of rotation of the brake disc.

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For modifications on the front-axle fixed calipers and notes on parts replacement, refer to page 47-04.

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Modifications on the four-piston fixed calipers

Modification I

As of MY '87*, the piston diameters in the front-axle fixed calipers were increased from 36/38 mm to 36/40 mm.
The rear-axle fixed calipers remain unchanged (Ø 30/28 mm).

Note

The recessed surface (milled surface) on the large pistons of the front fixed calipers is no longer present as of MY '87*.

Parts replacement

The front-axle brake calipers with a piston diameter of 40/36 mm may be retrofitted into earlier vehicles - **but only in pairs**.
Combination of Ø 36/38 mm on one side and Ø 36/40 mm on the other side is not permitted.

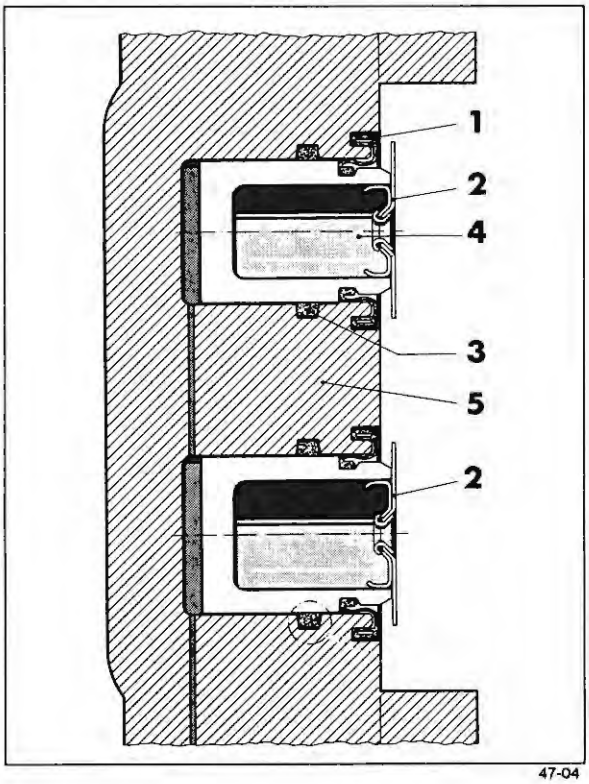
Modification II

As of MY '89 and for the 944 turbo special model "S" (M 758), the piston diameter at the front axle was increased to 44/36 mm.
The modified brake caliper is now mounted radially by means of cylinder bolt was axial, i.e. lateral mounting with hexagonhead bolts (p. 46 - 7).

Modification III

In the course of Model Year 1989, the brake piston seals of the **front and rear axles** were modified. The seal was changed from a scraper ring to a dust cap type.

Modified design



47-04

1 Dust boot
2 Suppressor
3 Rubber seal (rectangular ring)
4 Piston
5 Brake caliper housing

* In some cases (USA spec.) fixed calipers with Ø 38/36 mm pistons continued to be fitted during Model Year 1987.

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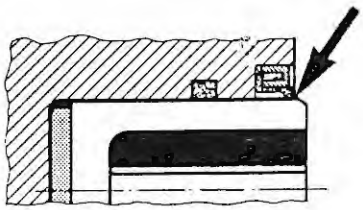
Former version

The scraper ring provided a sliding seal at the piston surface.

Parts replacement



Make sure only brake calipers of identical design are fitted to one and the same axle.

Brake pads up to end of MY '88

944 turbo

Front axle: Jurid 238, asbestos-type
Rear axle: Jurid 238, asbestos-type

or

Front axle: Textar T400, asbestos-free
Rear axle: Textar T400, asbestos-free

Combination of asbestos-free and asbestos-type brake pads is not permitted

944 turbo special model "S"

Front axle: Textar T400 with or without sinter plug asbestos-free

Rear axle: Textar T400 without sinter plug, asbestos-free

Brake pads as of MY '89

Front axle: Textar T 400 asbestos-free
Rear axle: Textar T 400 asbestos-free

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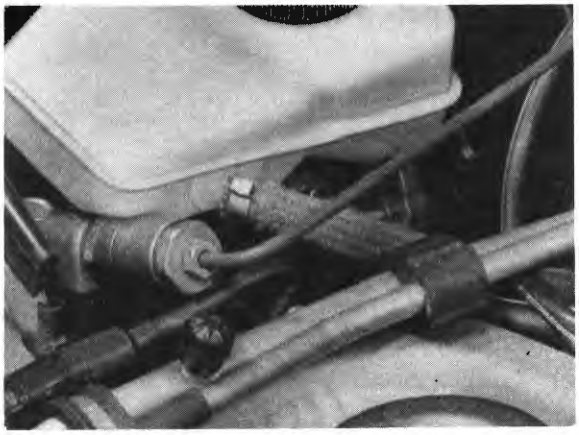
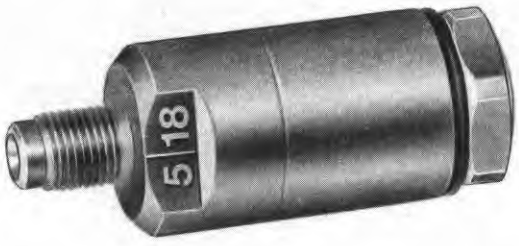
Brake power controller

A brake power controller is provided for the rear brake circuit.
On vehicles without ABS, the brake power controller is screwed into the intermediate piston circuit of the brake master cylinder.
On vehicles with ABS, the brake power controller is screwed into port h of the hydraulics unit.
For notes on removing and installing, refer to page 47 - 02.



Switchover pressure of the brake power controller is 18 bar. Reduction coefficient 0.46 = designator 5 (Designator 3 refers to reduction coefficient 0.3). Only fitting of the 5/18 brake power controller is permissible.



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Technical data

Steering		Rack and pinion steering, with hydraulic power assist
Steering wheel	Standard:	380 mm Ø 4 - spoke
	Optional	360 mm Ø 4 - spoke 360 mm Ø 4 - spoke with raised hub
Steering wheel ratio in center		Left-hand steering 18,85 : 1 Right-hand steering 18,96 : 1
Turning circle diameter		10,75 m
Track circle diameter		10,1 m
Steering wheel turns from stop to stop		Left-hand steering 3,24 Right-hand steering 3,26

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TIGHTENING TORQUE FOR STEERING

Location	Description	Thread	Material	Torque in Nm (ftlb)
Axle shaft to steering gear and steering shaft	Self-locking Hex nut	VM 8	12	30+5 (22+3.6)
Steering gear to cross member	Hex bolt	M 8	8.8	23 (17)
Cover for pinion bearing	Hex screw	M 6	8.8	7 (5)
Cover for thrust piece bearing	Hex bolt	M 6	8.8	7 (5)
Steering wheel to steering column	Hex nut	M16x1.5	17 H - 2	45 (33)
Steering column switch to outer tube	Hex bolt	M 5		4 (3)
Outer tube to body	Hex bolt	M 8	8.8	23 (17)
Mount to body	Hex screw	M 6	8.8	7 (5)
Tie rod to rack	Tie rod	M14x1.5		70 (51)
Tie rod joint to tie rod	Hex bolt	M14x1.5	17 H	70 (51)
Tie rod to steering knuckle	Castle nut	M12x1.5	8	30+20 (22+14)
	Lock nut	M12x1,5		50

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Location	Description	Thread	Material	Torque in Nm (ftlb)
Feed and return lines on steering gear	Hollow-core bolt	M 12 x 1.5	6.8	20 (14)
Feed line on power steering pump	Hollow-core bolt	M 14 x 1.5	6.8	30 (22)
Ring hose nipple for intake hose on power steering pump	Hollow-core bolt	M 16 x 1.5	6.8	45 (33)

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Checking and servicing the rack-and pinion power steering

General

Power steering damage occurs due to lack of oil in the hydraulic circuit. Even minor leaks may cause the fluid to escape due to the high oil pressure inside the hydraulic circuit and may result in damage to the power-steering pump.

Grunt sounds noticeable when turning the steering wheel or foaming in the supply tank indicate a lack of oil and/or air ingress. Before topping up the supply tank, however, eliminate any leaks in the inlet side and/or replace any defective parts of the pressure side.

Important note

Do not attempt to repair or dismantle rack-and-pinion steering gear and power-steering pump. Both steering gear and power steering pump are available on an exchange basis in various countries.
In countries that do not operate an exchange part scheme, the steering gear as well as the power steering pump may in certain cases be reconditioned by an authorized ZF dealership.

Checking the power steering pump drive belt tension

Adjustment of the drive belt is described on page 13 - 1.

Checking the steering system for leaks (visual inspection)

With the engine running at idle, turn the steering wheel to lock and keep in that position. This allows maximum line pressure to build up.

When the steering wheel in this position, check all line connections for tightness, re-tighten if necessary.

Run this check for max. 10 sec. If the check requires more time, allow for a short break every 10 seconds.

Checking the power steering fluid level

Screw off supply tank cover.

The supply tank is fitted to the right-hand wheel house wall inside the engine compartment.

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2. Run engine at idle. Wipe off dipstick, screw cover back on and remove again. The fluid level must be between both marks. If required, top up with ATF-DEXRON II D.

Bleeding the steering system

1. **To bleed the complete system after new steering components or lines have been fitted or after excessive hydraulic fluid loses have been remedied, start engine several times and turn off immediately as soon as it has started. This process causes the fluid level in the supply tank to drop rapidly. Make sure to top up continously using ATF Dexron II D. The supply tank must never run empty.**

Note

To facilitate refitting, establish the fluid level using a measuring tape while topping up constantly. Fluid level: approx. 40 mm from top edge ofsupply tank.

2. As soon as the fluid level no longer drops when the engine is started for a short moment, start the engine again and let it run at idle speed.

3. Turn steering wheel rapidly from lock to lock several times to allow air to escape from the cylinders. When reaching the end position of the piston, do not pull harder on the steering than is required for turning the steering (to avoid unnecessary pressure buidlup).

4. Check fluid level while performing this operation. If it continues to drop, top up until the fluid remains at a constant level and no more air bubbles rise in the supply tank when the steering wheel is turned.

Note

When stopping the engine, the fluid level in the supply tank must not rise by more than 10 mm.
If the fluid level with the engine stationary and running, respectively, deviates by more than 10 mm, trapped air remains in the hydraulic fluid.

5. With the engine running at idle, establish correct fluid level (between min. and max. marks) without turning the steering wheel.

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5. The oil level in the supply reservoir must not rise by more than 10 mm after turning off the engine.

N o t e

If the difference in oil level between a stopped engine and running engine exceeds 10 mm, too much air is trapped in the hydraulic fluid.

6. After wiping off dipstick, screw cap on supply tank and remove again (engine must be idling).
   If necessary, add a specified hydraulic fluid (see point 2 'Checking Power Steering Hydraulic Fluid Level').

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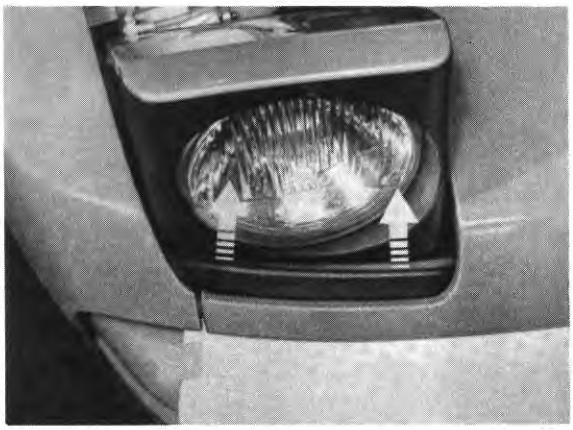
Replacing front hood cable

Removal:

1. Raise concealed headlights. Cover bumpers to avoid damaging the paint finish. Remove cover strips.



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2. Undo fastening nuts and remove bolts.

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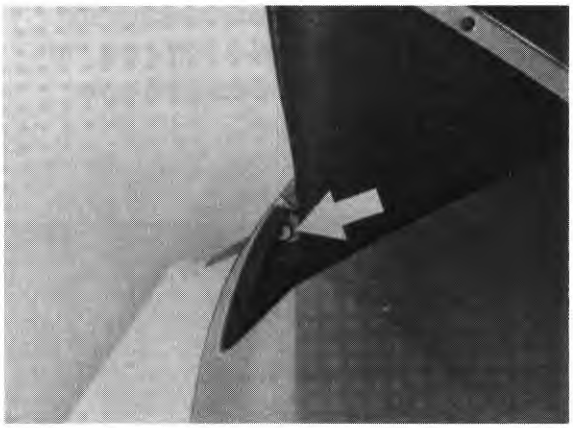

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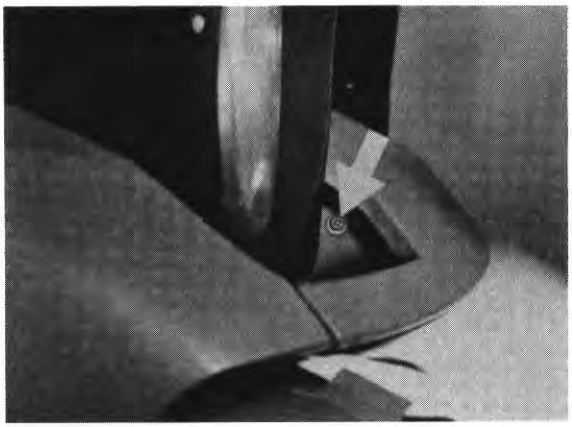

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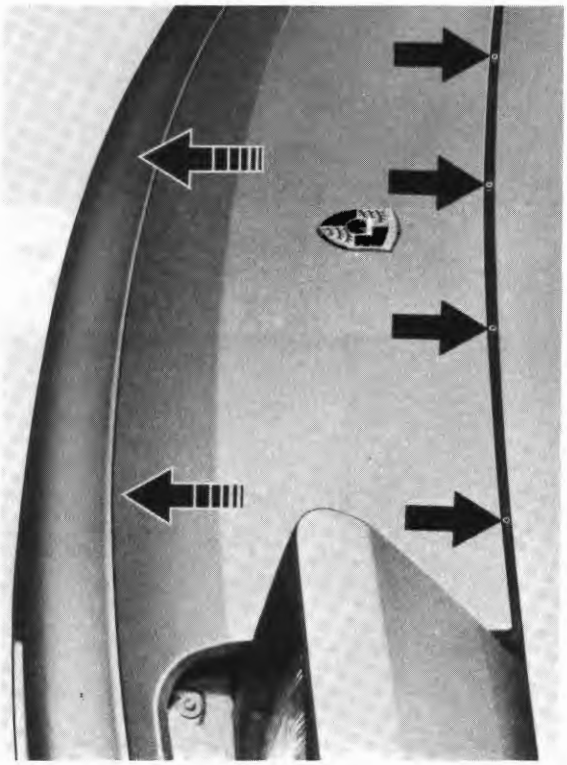
3. Pull the cover plate slightly forwards and undo the fastening screws with a fine Phillips screwdriver, then remove the cover plate from the vehicle.



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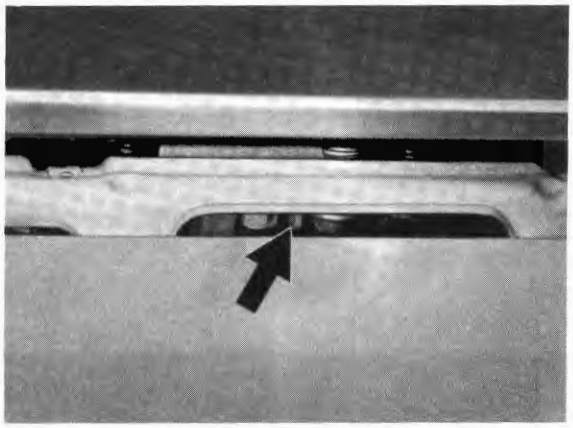
4. Open the hood lock with a suitable tool and raise the hood.



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5. Remove the complete air filter system and undo the clamping screw on the hood lock.

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6. Pull away the carpet in the area of the hood release handle.

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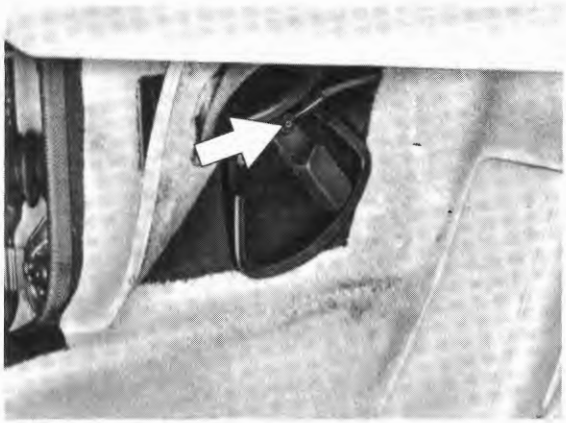
7. Remove and support the release handle. Drive out the roll pin and pull out the hood cable.



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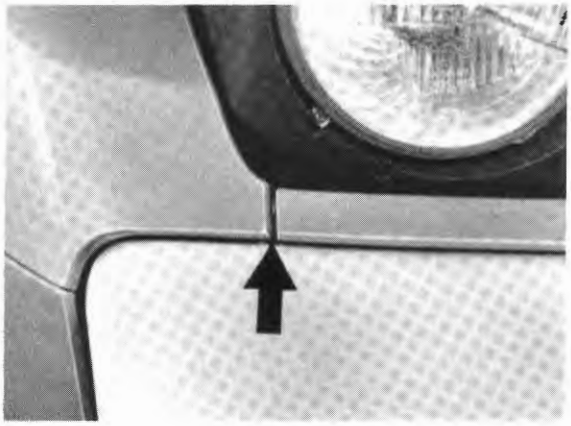
Installing

1. Install the new hood cable in reverse order.

2. Insert the cover plate from the front. Start turning the fastening screws. Adjust cover plate level with the fender. Tighten nuts and bolts.



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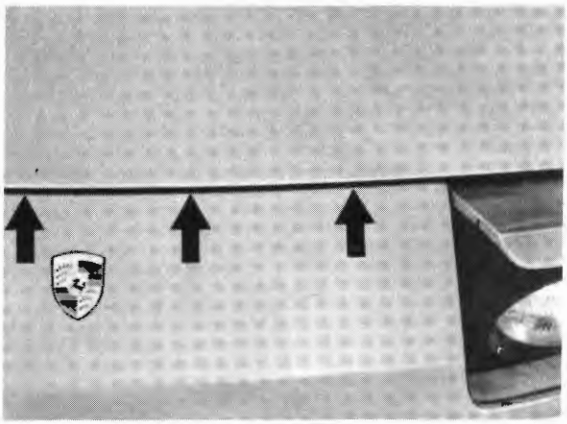
3. Close the hood and adjust the cover plate in such a way that the gap between it and the hood is the same all round. Open the hood and tighten the bolts.



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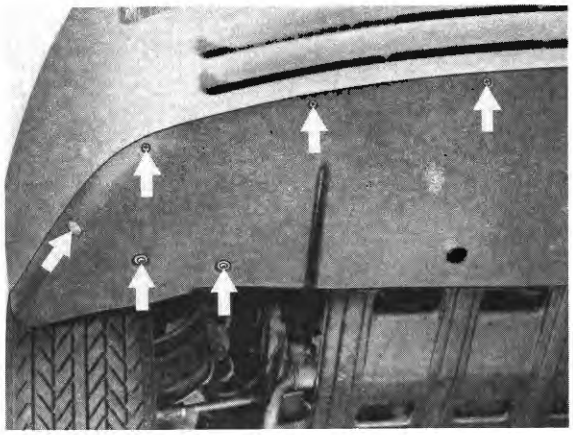
REMOVING AND INSTALLING LOWER TRIM PANEL

Removal

1. Unscrew sheet-metal screws between engine splashguard and lower trim panel.

2. Remove plugs, unscrew nuts and bolts and detach lower trim panel from vehicle.



Installation

Before installation, inspect all fasteners and if necessary replace. Installation is in the reverse order of the above steps.

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REMOVING AND INSTALLING SPOILER AND BUMPER

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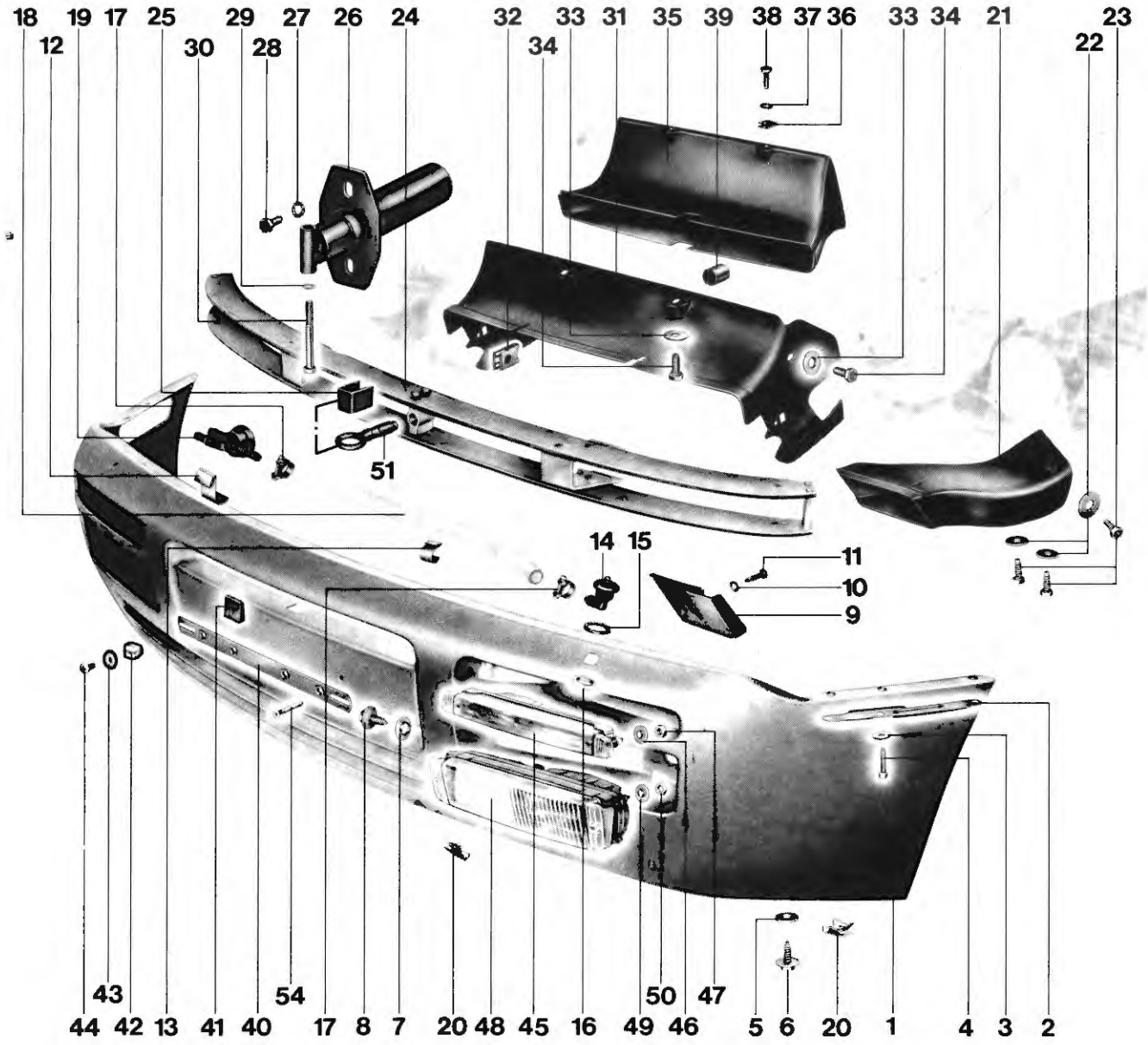
REMOVING AND INSTALLING SPOILER AND BUMPER



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No.	Description	Qty.	Note When: Removing	Installing
39	Plastic nut	2		
40	Licence plate holder	1		
41	Backing	2		
42	Nut	2		
43	Washer	2		
44	Sheet-metal screw	2		
45	Turn signal light	2		
46	Backing	4		
47	Nut	4		
48	Light	2		
49	Backing	6		
50	Nut	6		
51	Towline eye	1		

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REMOVING AND INSTALLING USA SPOILER AND BUMPER

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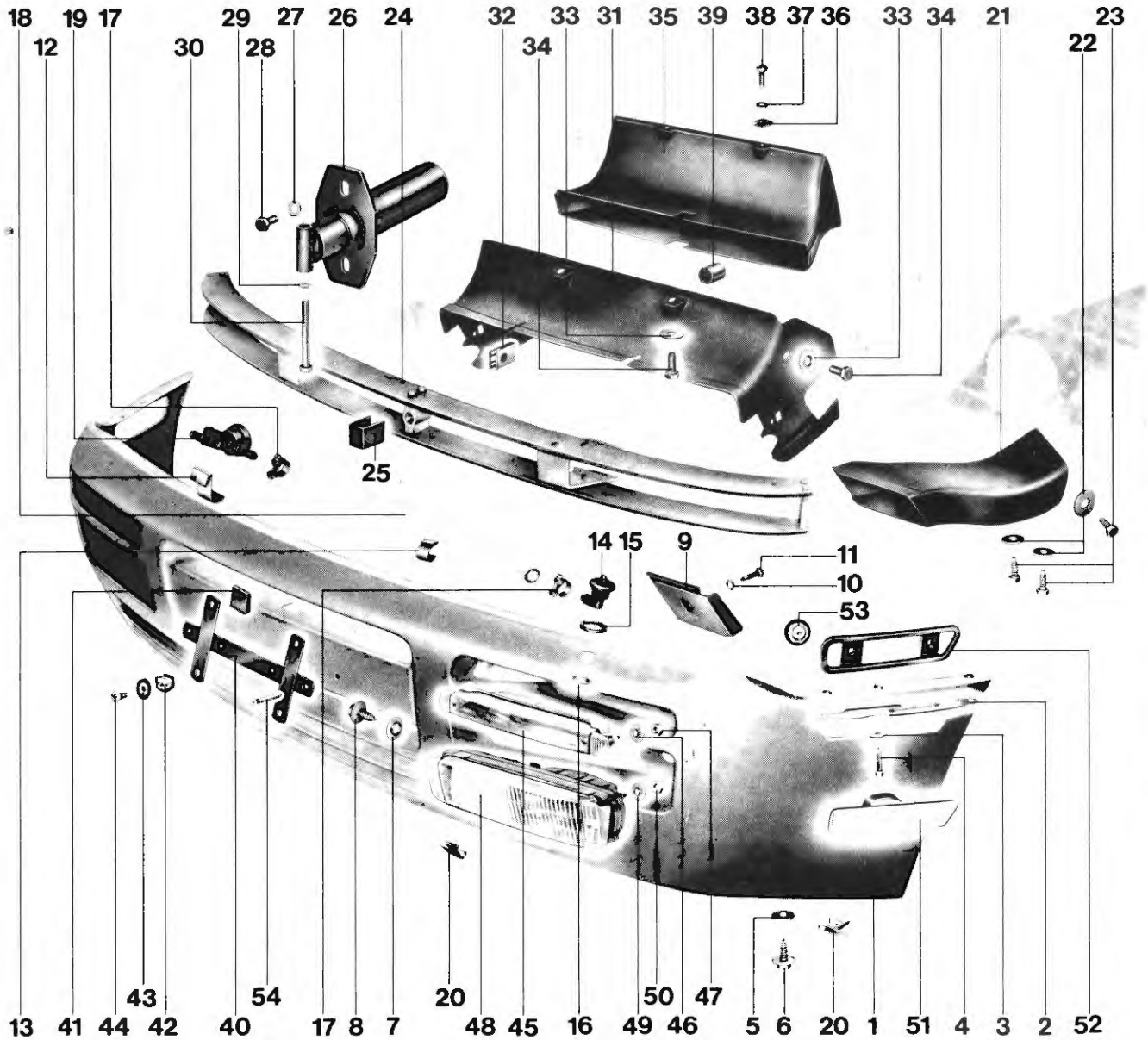
REMOVING AND INSTALLING USA SPOILER AND BUMPER



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No.	Description	Qty.	Note When: Removing	Installing
1	Front spoiler	1	Loosen screw connections to fenders, air ducts, and wheel wells.	Fit onto fender
2	Mounting strip	2		
3	Washer B6.4	6		
4	Hex bolt	6		
5	Washer B6.4	2		
6	Hex head sheet-metal screw	2		
7	Washer B6.4	2		
8	Sheet-metal screw	2		
9	Cutter	1		
10	Spring washer B3.7	1		
11	Sheet-metal screw B3.9 x 19	1		
12	Spring	4		
13	Cable clamp	6		
14	Nozzle	2		
15	Washer	2		
16	Nut	2		
17	Hose clamp	4		
18	Hose	1		

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No.	Description	Qty.	Note When: Removing	Installing
19	Valve	1		
20	Sheet-metal nut	9		
21	Air duct	2		
22	Washer B5.3	6		
23	Hex-head sheet metal bolt B2 4.8 x 13	6		
24	Bumper	1		
25	Cover	1		
26	Impact tube	2		
27	Washer	4		
28	Bolt M 8 x 25	4		
29	Washer 8.4	2		
30	Pan head bolt M 8 x 70	2		
31	Air duct	1		
32	Sheet-metal nut 4.8 x 19	2		
33	Spacer	4		
34	Hex bolt M6	4		
35	Air duct	1		
36	Sheet-metal nut 4.2 x 13	2		
37	Washer A4.3	2		
38	Sheet-metal screw B 4.2 x 13	2		

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No.	Description	Qty.	Note When: Removing	Installing
1	Front spoiler	1	Loosen screw connection to fenders, air ducts, and wheel wells	Fit onto fenders
2	Mounting strip	2		
3	Washer B6.4	6		
4	Hex bolt M6	6		
5	Washer B6.4	2		
6	Hex head sheet-metal screw	2		
7	Washer B6.4	2		
8	Sheet-metal screw	2		
9	Cover	1		
10	Spring washer B3.7	1		
11	Sheet-metal screw B3.9 x 19	1		
12	Spring	4		
13	Cable clamp	6		
14	Nozzle	2		
15	Washer	2		
16	Nut	2		
17	Hose clamp	4		
18	Hose	1		

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No.	Description	Qty.	Note When: Removing	Installing
19	Valve	1		
20	Sheet-metal nut	9		
21	Air duct	2		
22	Washer B5.3	6		
23	Hex head sheet-metal screw BZ 4.8 x 13	6		
24	Bumper	1		
25	Cover	1		
26	Impact absorber	2		
27	Washer	4		
28	Bolt M8 x 25	4		
29	Washer 8.4	2		
30	Pan head bolt M8 x 70	2		
31	Air duct	1		
32	Sheet-metal nut 4.8 x 19	2		
33	Spacer	4		
34	Hex bolt 6	4		
35	Air duct	1		
36	Sheet-metal nut 4.2 x 13	2		
37	Washer A 4.3	2		
38	Sheet-metal screw B 4.2 x 13	2		

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No.	Description	Qty.	Note When: Removing	Installing
39	Plastic nut	2		
40	Licence plate holder	1		
41	Backing	2		
42	Nut	4		
43	Washer	4		
44	Sheet-metal screw	4		
45	Turn signal light	2		
46	Backing	4		
47	Nut	4		
48	Light	2		
49	Backing	6		
50	Nut	6		
51	Side marker light	2		
52	Mount	2		
53	Knurled nut	4		
54	Sheet-metal screw	2		

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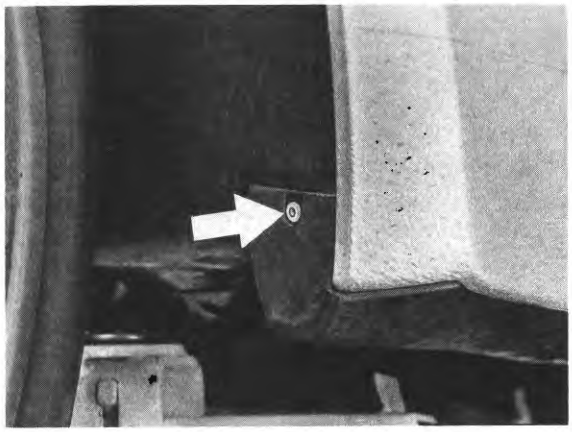
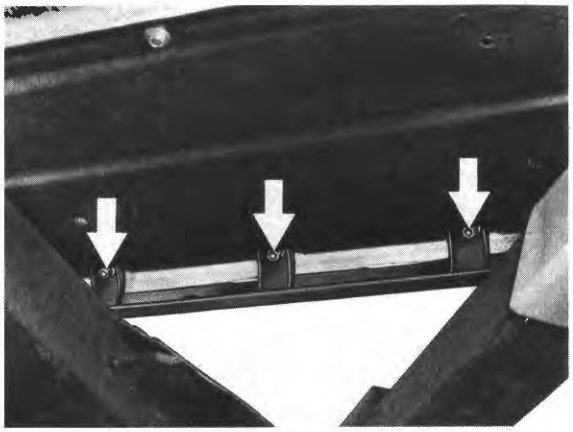
REMOVING AND INSTALLING ROCKER PANEL COVERS

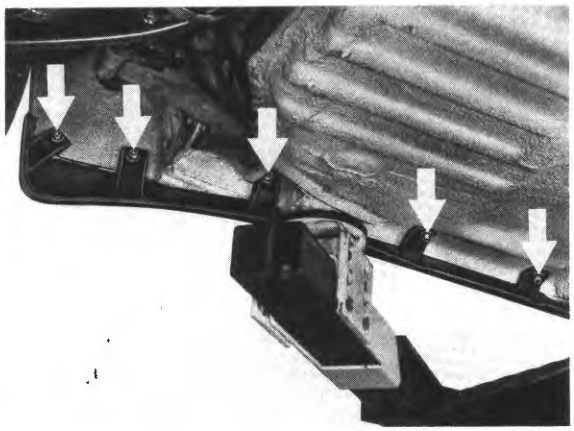
Removal

1. Bore open tubular rivets, if bolted unscrew mounting bolts of front rocker panel covers and remove rocker panel covers from vehicle.



2. Unscrew plastic mounting nuts for rear rocker panel covers, remove washers and detach rocker panel covers from vehicle.





Installation

Prior to installation check all fastening parts. Replace where necessary. Installation is the reverse of the removal procedure.

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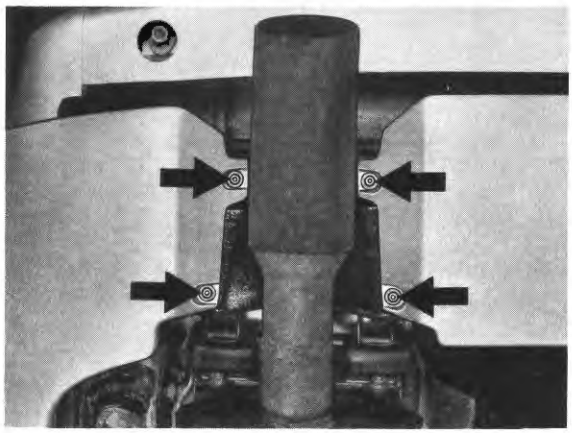
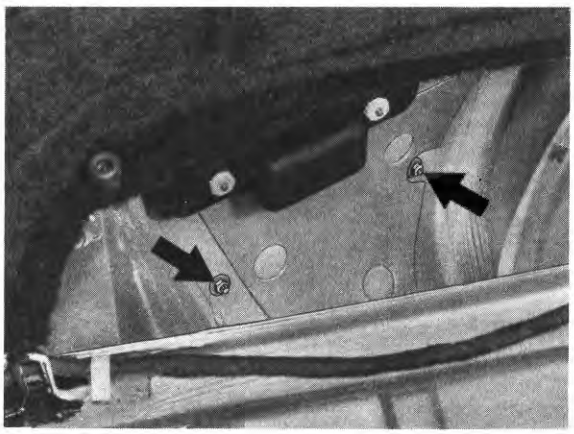
REMOVING AND INSTALLING REAR APRON SPOILER

R e m o v a l

1. Unscrew lower mounting bolts for rear apron spoiler.



2. Open trunk lid, and lift trunk floor cover out of vehicle. Unscrew mounting nuts on rear side pieces and remove rear apron spoiler from vehicle.



I n s t a l l a t i o n

Prior to installation, check all fastening parts and replace where necessary. Installation is the reverse of the removal steps above.

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FINISHES AVAILABLE, 86 MODELS ONWARD

Standard:		Special:	
Indian red	LM 3 A	Sapphire metallic	LY 5 V
Black	L 041	Zermatt silver metallic	LY 7 Y
Alpine white	L 90 E	Mahagony brown metallic	LB 8 Z
Copenhagen blue	LY 5 B	Crystal green metallic	LM 6 Y
Pastel beige	LM 1 N	Garnet red metallic	LM 3 Y
		Kalahari beige metallic	LA 1 Y
		Stone grey metallic	LY 7 U
		Graphite metallic	LB 7 V
		Pearl luster white metallic	LO A 9

FINISHES AVAILABLE, 87 MODELS ONWARD

Standard:		Special:	
Black	L 041	Zermatt silver metallic	L Y7Y
Alpine white	L 90E	Stone grey metallic	L Y7U
Lemon yellow	L MIA	Satin black metallic	L Y9Y
Azurite blue	L Y5D	Nautic metallic	L Y5Z
Malven red	L Y3E	Flamingo metallic	L Y4Z
India red	L M3A	Maraschino red metallic	L Y3V
		Almond beige metallic	L YIY
		Nile green metallic	L Y6Y
		Diamond blue metallic	L M5U
		Nougat brown metallic	L M8V

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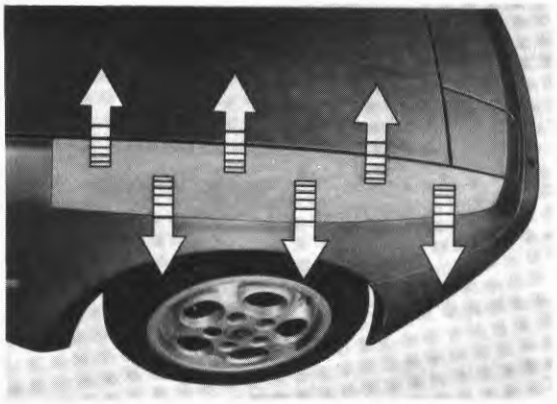
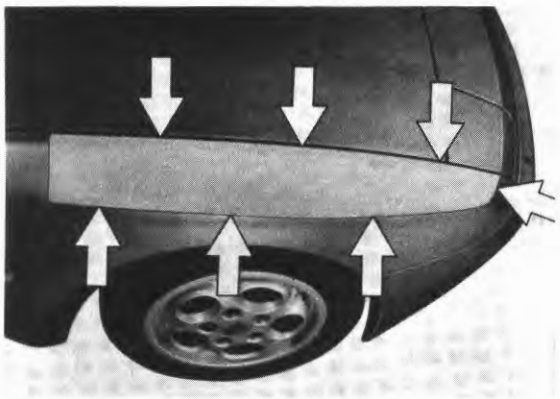
APPLYING TURBO EMBLEM

1. Remove all traces of soiling from the surface and clean with white spirit.

2. Wet surface with a 50% alcohol-water mixture to prevent the film adhering immediately.

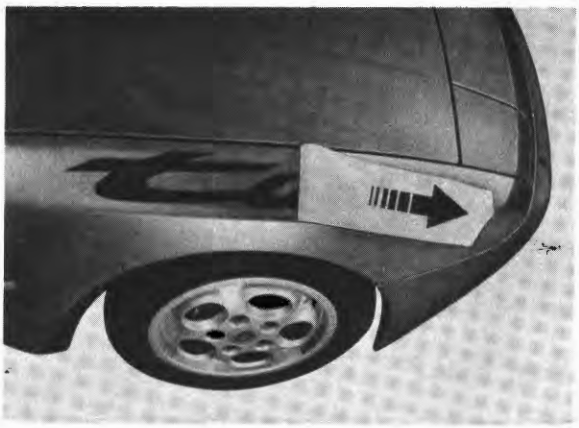
3. Remove beige protective paper from the film and position film parallel with edge of fender.





4. Use a plastic spatula or the like to squeeze moisture from beneath the film. Work from the middle towards the edges and ensure that no air bubbles are trapped beneath the film.

5. Remove outer protective paper, pierce any remaining air bubbles with a needle and press film down again.



Note:

The film and car temperatures must not be less than +20°C.

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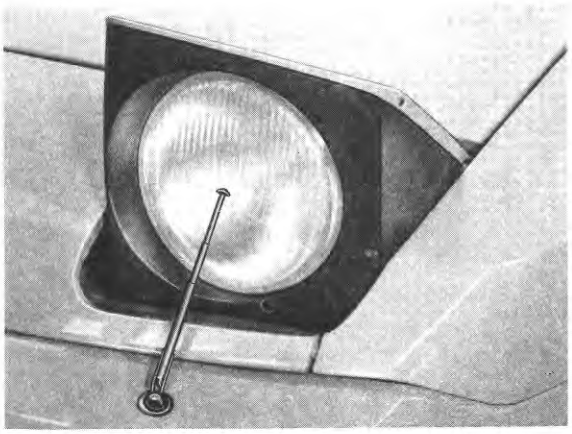
AIMING HEADLIGHT CLEANER SPRAY JETS

Special aiming tool No. 3019 A

1. Run headlights out.

2. Insert aiming tool in spray jet. With the help of the aiming tool, turn spray jet so that the telescopic extension of the tool points to the middle of the lens.



3. Activate cleaning and check spray effectiveness.

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AIMING HEADLIGHTS

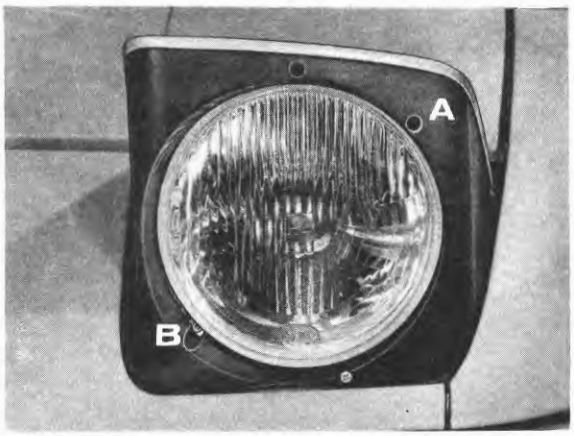
R e q u i r e m e n t s:

Proper tire inflation pressure, full fuel tank, person or a weight of about 70 kg (155 lbs) in driver's seat.

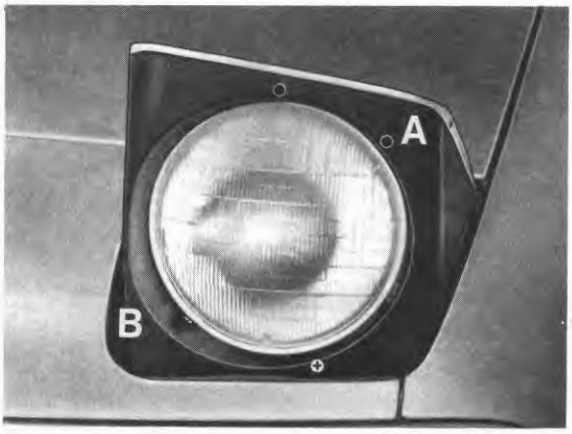
1. Turn on low beams (USA version: high beams) and clean lens.

2. Correct aiming with an optical headlight aimer.

Rest of World Version



USA Version



A = Lateral control

B = Vertical control

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AIMING FOG LIGHTS

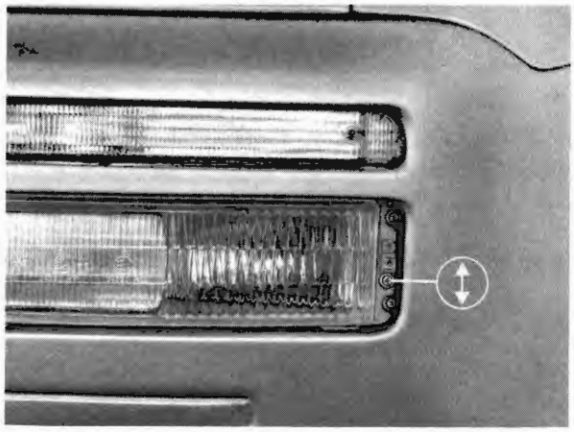
R e q u i r e m e n t s:

Proper tire inflation pressure, full fuel tank, person or a weight of about 70 kg (155 lbs) in driver's seat.

1. Unscrew and remove transparent covers.

2. Correct aim with an optical headlight aimer.

USA Version



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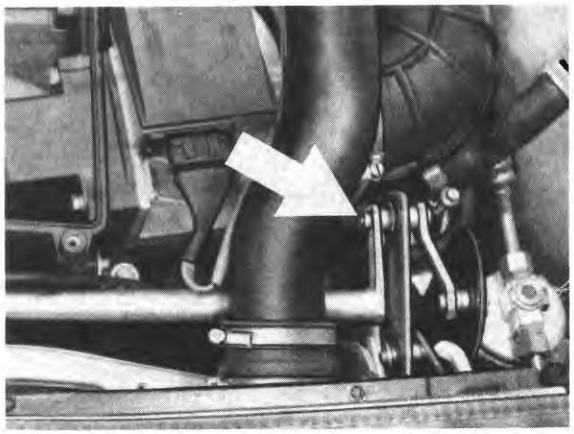
LUBRICATING CONCEALED HEADLIGHT LINKAGE

Lubricate linkage of concealed headlights with a standard multi-purpose grease at each inspection or after every engine cleaning.



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