Workshop Manual

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This repair manual describes all important operations for which special instructions are required to assure proper completion. This manual is essential for the shop foremen and mechanics, who need this information to keep the vehicles in safe operating condition. The basic safety rules, of course, also apply to repairs on vehicles without exception.

The 912 E Repair Manual only describes repair operations which differ from those for 911 models. Refer to the 911 Repair Manual for all other information.

The information is grouped according to repair numbers, which are identical to the first two digits of the repair time and warranty code.

The repair group index and alphabetical index are quick guides to find information in the manual.

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

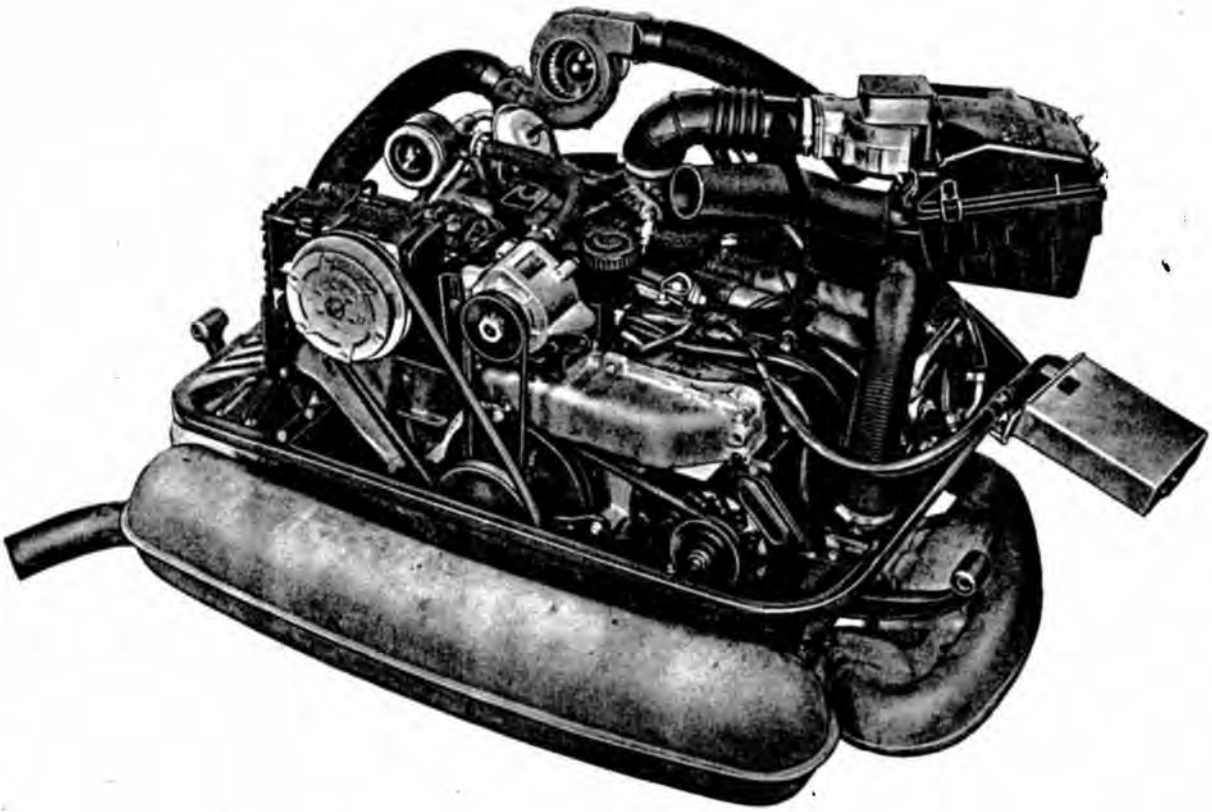
This repair manual will be kept up to date with workshop bulletins; the information of these bulletins will be made part of the manual from time to time. We recommend that the Workshop Bulletins be filed in the special folder provided for this purpose.

REGISTRATION OF SUPPLEMENTS FILED FOR REPAIR MANUAL

912 E

Please file the supplements according to the repair groups and make appropriate entries in the table below.

Supplement No.	Filing Date	Signature
I		
II		
III		
IV		
V		
VI		
VII		
VIII		
IX		
X		
XI		
XII		
XIII		
XIV		



TECHNICAL DATA

(Refer to the different repair groups for adjustment data and wear limits.)

Engine

Bore	mm/in.	94/3.70	
Stroke	mm/in.	71/2.80	
Displacement	$cm^3/in.^3$	1971/120.3	
Compression ratio		7.6 : 1	
Horse power SAE Net	kW/HP	64/86	at engine speed of 4900 rpm

Torque SAE Net	Nm/ft lb	133/98	at engine speed of 4000 rpm
Horse power per liter SAE Net	kW/HP	32.5/43.6	
Max. engine speed	rpm	5800	
Max. cruising speed	rpm	5000	
Cutoff speed of speed limiter in control unit	rpm	5800 $\pm$ 100	
Engine weight with muffler (dry)	kg/lb	155/342	

Engine Design

Crankcase	Light alloy, two piece
Crankshaft	Forged
Crankshaft bearings	4 plain bearings
Connecting rods	Forged steel
Connecting rods bearings	Tri-metal plain bearing shells
Piston pin bushing	Press fit steel bushing with lead/brass bearing surface
Pistons	Cast light alloy with steel insert
Piston pins	Floating type, locked by circlips
Piston rings	2 compression rings, 1 oil scraper ring
Cylinders	Special gray cast single cylinders
Cylinder head	One per 2 cylinders, light alloy
Valve seat inserts	Shrunk fit, annealed sinterred steel
Valve guides	Press fit, intake: special brass exhaust: thermohedul
Valve arrangement per cylinder	1 intake, 1 exhaust, parallel overhead
Exhaust Valves	Sodium filled reinforced seat
Valve springs	1 coil spring per valve
Valve drive	1 camshaft, followers, push rods and rocker arms
Camshaft (021.109.101 K)	Gray cast, 3 plain bearings
Camshaft bearings	Steel shells with white metal bearing surface
Camshaft drive	Bevel gears

Timing with 1 mm valve clearance:		
Intake opens	BTDC	12^{o}
Intake closes	ABDC	42^{o}
Exhaust opens	BBDC	43^{o}
Exhaust closes	ATDC	4^{o}

Ignition	Battery ignition
Ignition coil	12 volt
Speed limiter	5800 ± 100 rpm
Ignition timing	27^{o} BTDC at 3500 rpm (vacuum hose disconnected)
Firing order	1 - 4 - 3 - 2
Ignition control	Centrifugal and vacuum
Dwell angle	$44 - 50^{o}$
Spark plugs	M 14 x 1,25 x 19, heat range 175
Electrode gap	0,7 mm (0.028 in.)

Cooling

Engine	Air cooled
Fan drive	Fan on crankshaft
Crankshaft/fan ratio	1 : 1
Air delivery rate	800 1/sec at 4600 rpm of crankshaft

Engine Lubrication

Lubrication		Forced feed by gear pump
Oil cooling		Oil cooler in fan air stream
Oil filter		Full flow
Oil pressure gauge		Indicator lamp
Max. oil temperature		Up to red field
Oil consumption	gt/600mi.	0.5 to 1.0

Emission Control

Air injection, thermoreactor and EGR

Heater

Warm air heater dependent on engine temperature with electric blower. Heating can be adjusted continuously with control lever.

Fuel system		AFC fuel injection into intake manifold	
Fuel delivery		Electric roller cell pump	
Fuel octane	RON	91 (reg. grade fuels)	
Electrical System			
Battery voltage	V	12	
Battery capacity	Ah	44	
Battery capacity (optional extra)	Ah	66	
Alternator output	W	980, 70 A, 14 V (Bosch)	
Ignition		Battery ignition	
Ignition coil		12 V Bosch	
Firing order		1 - 4 - 3 - 2	
Ignition control		Centrifugal and vacuum	
Dimensions	(DIN Curb Weight)		
Length	mm/in.	4291/168.94	
Width	mm/in.	1610/63.39	
Height	mm/in.	1340/52.76	
Wheelbase	mm/in.	2271/89.41	
Track, front	mm/in.	1360/53.54	
Track, rear	mm/in.	1330/52.36	
Ground clearance	mm/in.	180/7.10	(unloaded)
	mm/in.	140/5.51	(with max. payload)
Approach angle, front limited by apron		16°	(with max. payload)
Departure angle, rear limited by apron		17°	(with max. payload)
Weights	(DIN 70020)		
Curb weight	kg/lb	1160/2558	
Max. total weight	kg/lb	1400/3087	
Max. axle load, front	kg/lb	600/1323	
Max. axle load, rear	kg/lb	815/1797	
Payload	kg/lb	240/529	
Max. roof load incl. luggage carrier	kg/lb	35/77	

Filling Capacities

Engine as measured with oil dipstick according to Owner's Manual	Premium HD oil according to API Classification SD or SE of viscosity SAE 30 for summer, SAE 20 for winter, SAE 20 W 20 for year round temperatures between -15°C to 0°C, (+ 5° F to + 32°F) or SAE 10 W for year round temperatures below -15° C (+ 5°F).	
Oil change with replacement of filter	ltr/gt	approx 3.5/3.7
Oil change without filter replacement	ltr/gt	approx 3.0/3.2
Transmission with differential	ltr/gt	approx 3.0/3.2 gear lube acc. to MIL-L 2105 B SAE 90
Fuel tank	ltr/gal.	80, 21.1, of which 8 l / 2.1 gal. in reserve
Brake fluid tank	ltr/gt	approx 0.2/0.21
Windshield washer	ltr/gt	approx 8.0/8.5

Performance

Top speed	kph/mph	178/110.6
Acceleration from 0 to 100 kph (0 to 62 mph)	sec	13.5 (DIN curb weight and 1/2 payload)
Kilometer from standing start	sec	34.0
Weight per HP	kg/lb	12/26
Climbing ability in % 5 speed transmission		1st gear 50% 2nd gear 27% 3rd gear 17% 4th gear 11% 5th gear 7%

TOLERANCES AND WEAR LIMITS

The term "wear limits" indicates parts which are near or have already reached the dimensions given should not be reinstalled during an overhaul. When determining the wear limit of pistons and cylinders, the oil consumption of the pertinent engine must be taken into account.

Note: The values are in mm if not otherwise specified.

	Upon Install. (New)	Wear Limit
Cooling System		
Thermostat . . . . . Opening temp.	85 - 90°C/185-194°F	
Fan/pulley . . . . . Imbalance	max. 5 cmg	
Oil Circuit		
1-Oil pressure (SAE 30 oils only) at 70°C/158°F oil temp. at 2500 rpm . . . . . Pressure	approx 64 psi (4.5 atm)	28psi (2 atm)
2-Oil check valve spring compressed length: 39.0 mm . . . . . Load	15 - 19 lb (6.8-8.8 kg)	
3-Oil pressure control valve spring compressed length: 16.8 mm . . . . . Load	9.6 lb (4.35 kg)	
4-Oil pressure switch opens at . . . . . Pressure	2.1-6.4psi (0.15-0.45atm)	
Cylinder Head and Valves		
1-Cylinder seat depth in cylinder	5.4 - 6.6	
2-Combustion chamber volume	58.7-60.2 cm^3	
3-a) Rocker arm . . . . . Inside dia.	20.0-20.02	20.04
b) Rocker shaft . . . . . Diameter	19.95-19.97	19.93
4-Valve springs compr. length 30 . . . . . Load	160-184lb (72.5-83.5kg)	
5-Valve seats		
a) Intake . . . . . Width	1.8 - 2.2	
b) Exhaust . . . . . Width	2.0 - 2.5	
c) Intake . . . . . Seat angle	45°	
d) Exhaust . . . . . Seat angle	45°	
e) Outer correction angle . . .	15°	
f) Inner correction angle	75°	
6-Valve guide		
Intake . . . . . Inside dia.	8.00 - 8.02	8.06
Exhaust . . . . . Inside dia.	9.00 - 9.02	9.06
7-Valve stem		
Intake . . . . . Diameter	7.94 - 7.95	7.90
Exhaust . . . . . Diameter	8.91 - 8.92	8.87
8-Valve guide/valve stem		
Intake + exhaust . . . . . Side clearance	Max. 0.30	1.2
9-Valve head		
Intake . . . . . Diameter	42.0	
Exhaust . . . . . Diameter	36.0	
10-Valve clearance (cold)		
Intake . . . . . Adjustment	0.15	
Exhaust . . . . . Adjustment	0.20	

	Upon Install. (New)	Wear Limit
11-Compression pressure (with open throttle and engine at operating temperature, all spark plugs removed, practically no blowby with gauge in spark plug seat, engine cranked by starter motor). . . . . Pressure	121 - 156 psi (8.5-11.0 atm)	92 psi (6.5 atm)
Pressure difference between cylinders		ma.21psi (1.5 atm)
Cylinders and Pistons		
2 oversizes, each with 0.5 mm greater diameter		
1-Cylinder . . . . . Out-of-round	ma. 0.01	
2-Cylinder/piston . . . . . Clearance	0.02 - 0.05	0.20
3-a) Upper piston ring . . . . . Side clearance	0.04 - 0.07	0.12
b) Lower piston ring . . . . . Side clearance	0.04 - 0.07	0.10
4-Oil scraper ring . . . . . Side clearance	0.02 - 0.05	0.10
5-a) Upper ring . . . . . End gap	0.35 - 0.55	0.90
b) Lower ring . . . . . End gap	0.35 - 0.55	0.90
6-Oil scraper ring . . . . . End gap	0.25 - 0.40	0.95
7-Piston weight		
8-Weight difference between pistons of one engine	Max. 4 g	Max. 10 g [1]
[1] In the event of repairs		
Crankcase		
1-Main bearing bore		
a) Bearings 1-3 . . . . . Diameter	70.00-70.02	70.03
b) Bearing 4 . . . . . Diameter	50.00-50.04	50.04
2-Flywheel end seal bore . . . . . Diameter	95.00-95.05	
3-Fan end seal bore . . . . . Diameter	62.00-62.05	
4-Camshaft brg. bore . . . . . Diameter	27.50-27.52	
5-Oil pump housing bore . . . . . Diameter	70.00-70.03	
6-Cam follower bore . . . . . Diameter	24.00-24.02	24.05
Camshaft		
1-Bearings 1-3 . . . . . Diameter	24.99-25.00	
2-Center bearing runout (Bearings 1 and 3 on V-blocks) . . . Runout	Max. 0.02	0.04
3-Camshaft/camshaft bearing (including preload exerted by housing) . . . . . Radial play	0.02-0.05	0.12
Thrust bearing . . . . . End play	0.04-0.13	0.16
4-Camshaft gear . . . . . Backlash	0.00-0.05	
5-Cam follower . . . . . Diameter	0.04-0.13	0.16
6-Housing bore/cam follower . . . . . Radial play	0.02-0.06	0.12
7-Push rod. . . . . Runout	Max. 0.3	

		Upon Install. (New)	Wear Limit
Crankshaft and Connecting Rods			
3 undersizes, each 0.25 mm smaller in diameter			
1-a) Bearings 1-3	Diameter	59.97-59.99	
b) Bearing 4	Diameter	39.98-40.00	
c) Connecting rod brg	Diameter	49.98-49.99	
2-Crankshaft runout at bearings 2 and 4 (1 and 3 on V-blocks)	Runout		0.02
3-	Imbalance	Max. 12 cmg	
4-Main bearing journal	Out-of-round		0.03
5-Connecting rod bearing journal	Out-of-round		0.03
6-Crankshaft/main bearing (including preload exerted by housing)			
a) Bearings 1-3	Radial play	0.05-0.10	0.18
b) Steel bearing 2	Radial play	0.03-0.09	0.17
c) Bearing 4	Radial play	0.05-0.10	0.19
7-Crankshaft/main bearing 1	End play	0.07-0.13	0.15
8-Crankpin/connecting rod	Radial play	0.02-0.07	0.15
	End play	0.10-0.40	0.70
9-Connecting rod weight			
10-Weight difference between connecting rods of one engine		Max. 6 g	
11-Piston pin	Diameter	23.99-24.00	
12-Connecting rod bushing	Diameter	24.01-24.02	
13-Piston pin/connecting rod bushing	Radial play	0.02-0.03	0.04
14-Flywheel (measured in center of clutch friction surface)	Lateral runout	Max. 0.4	
	Imbalance	Max. 20 cmg	
Oil seal contact flange	Outside dia.	74.9-75.1	74.4
Machining flywheel teeth			max. 2.0
Clutch			
1-Total pressure	Pressure	1100-1232 lb (500-560 kg)	
2-Total clutch	Imbalance	Max. 15 cmg	
3-Clutch pressure plate	Runout		0.10
4-Clutch disc (measured at 210 mm dia.)	Lateral runout	Max. 0.5	

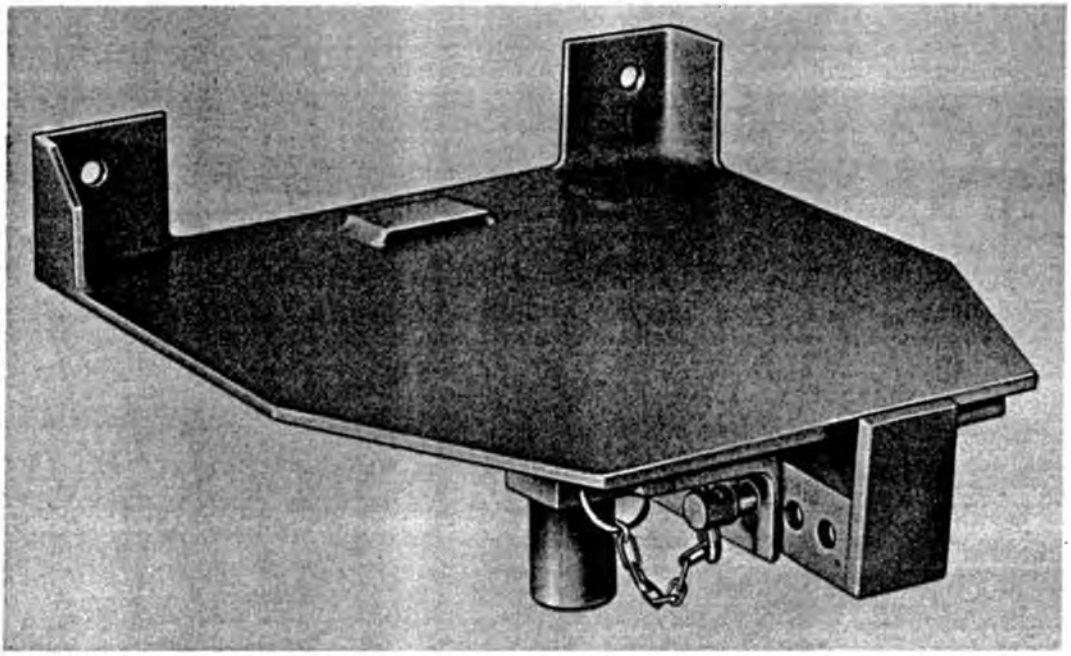
TIGHTENING TORQUES FOR ENGINE

Discription	Thread	Nm (mkp)
1 - Drive shaft screws	M 8 x 1.5	42 (4.2)
2 - Transmission carrier to body	M 12 x 1.5	80 (8.0)
3 - Engine carrier to body	M 10	49 (4.9)
4 - Engine to transmission	M 10	47 (4.7)
5 - Spark plugs	M 14 x 1.25	34.3 (3.5)
6 - Small pulley nut	M 14 x 1.5	58.8 (6.0)
7 - Fan bolts	M 8	19.6 (2.0)
8 - Oil pump nuts	M 8	19.6 (2.0)
9 - Oil drain plug	M 12 x 1.5	21.6 (2.2)
10 - Oil screen cover locking nut	M 8	12.7 (1.3)
11 - Rocker arm shaft nuts	M 7	13.7 (1.4)
12 - Cylinder head nuts	M 10	31.4 (3.2)[1)]
13 - Engine carrier bolts (crankcase)	M 8	29.4 (3.0)
14 - Fan hub bolt	M 8	31.4 (3.2)
15 - Flywheel bolts	M 12 x 1.5	107.9 (11.0)
16 - Crankcase half bolts and nuts	M 8	19.6 (2.0)
17 - Nuts for crankcase halves	M 10 x 1.25	32.4 (3.3)
18 - Connecting rod nuts	M 9 x 1	32.4 (3.3)[2)]
19 - Mid grip nuts for reactor	M 8	22.0 (2.2)
20 - Clutch bolts	M 8	23.5 (2.5)

[1)] Tighten in sequence.

[2)] Replace, lubricate bearing surface.

TOOLS



No.	Description	Special Tool	Remarks
1	Engine holder for floor jack with transmission arm	VW 612/4 VW 612/3	or US 612/5

REMOVING AND INSTALLING ENGINE

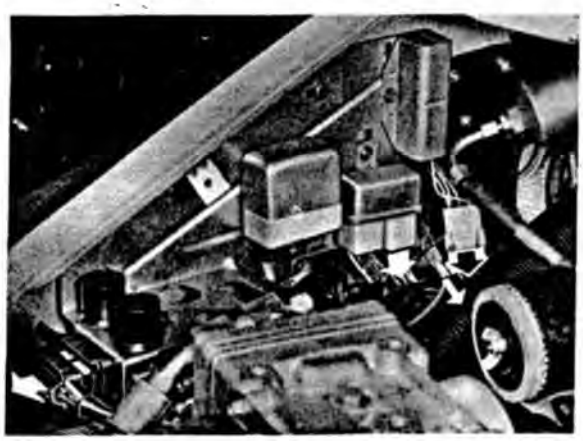
The engine/transmission assembly is lowered as a unit to remove.

Removing

1. Jack up car.

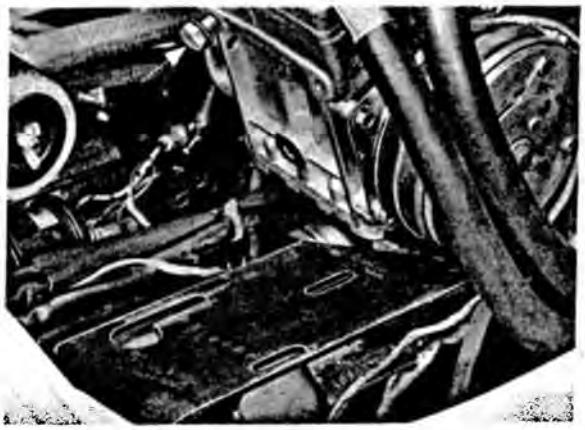
2. Disconnect battery ground cable.

3. Take off relay plate cover, pull off 14-point plug, pull off front plug on double relay, separate plug at resistor (if car has air conditioning, detach plug to compressor).

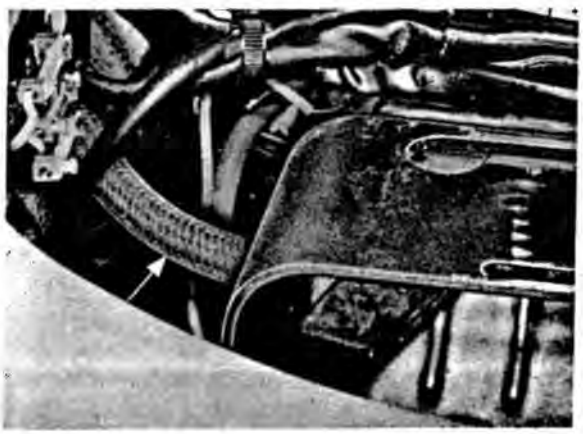


4. If car has air conditioning, take compressor off of console by loosening and removing the two rear bolts. Loosen the front bolt slightly, push out the compressor to the left and leave it connected to hoses in the car.

Caution
If compressor hoses are to be disconnected, refrigerant must be discharged from air conditioner system before loosening hoses.

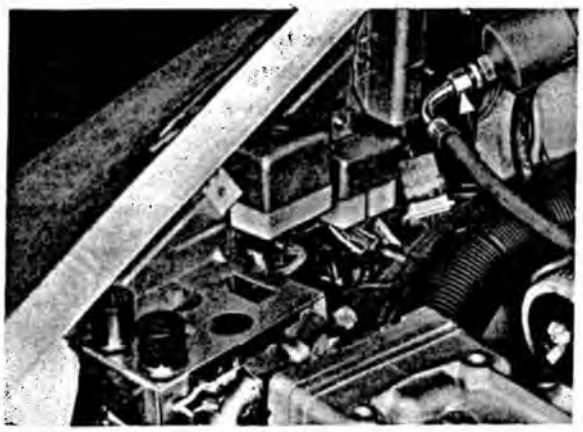


5. Disconnect charcoal filter/fan housing hose.

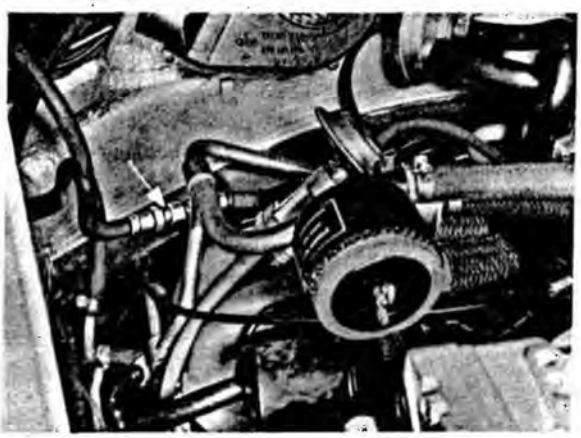


6. Disconnect both heater hoses at heater blower.

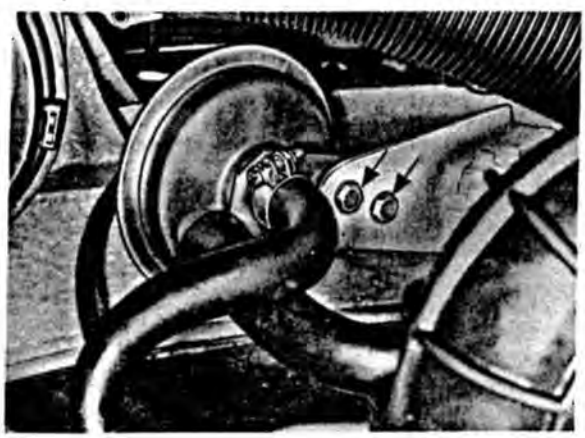
7. Detach fuel feed hose at fuel filter.



8. Detach fuel return line.

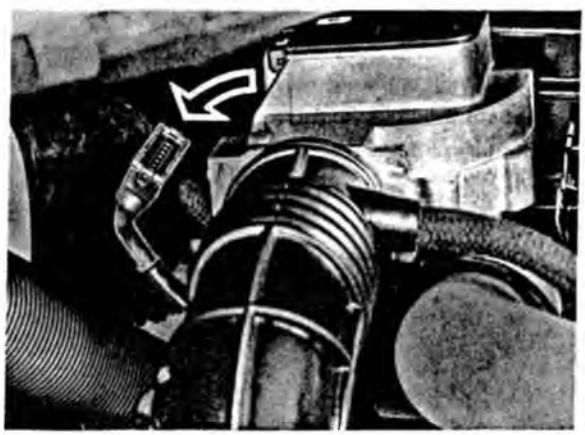


9. Detach deceleration valve from body (leave on engine).

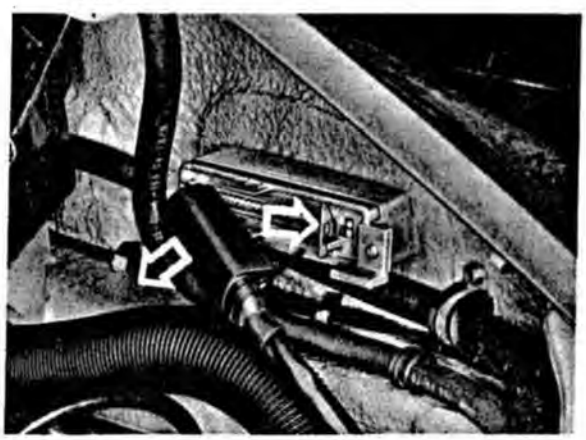


10. Disconnect return spring, detach operating cable on throttle housing and mounting bracket and slide it down through the engine guard.

11. Disconnect strap and plug at intake air sensor.



12. Loosen plug at control unit, pull back spring clip and pull it out of socket at the same time.



13. Loosen screws on cover for rear tunnel and remove cover.

14. Pull boot off of body and slide it forward over the selector rod.

15. Loosen socket head set screw of shift rod coupling and pull coupling off of inner shift rod on transmission.

16. Disconnect electronic speedometer sensor wire in tunnel and remove rubber grommet with wire plug toward the outside.

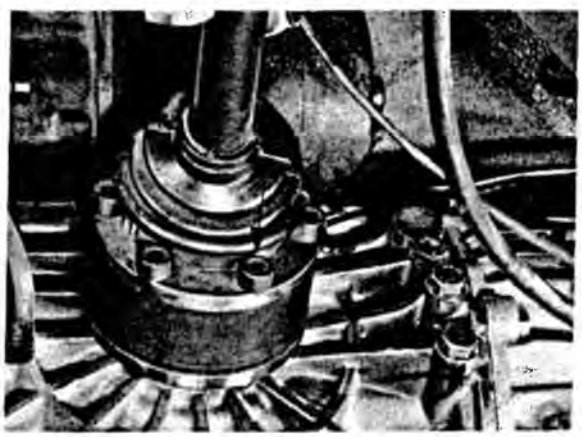
17. Loosen and disconnect heater hoses at heat exchangers.

18. Disconnect ground strap between transmission and body.

19. Disconnect wire at starter.

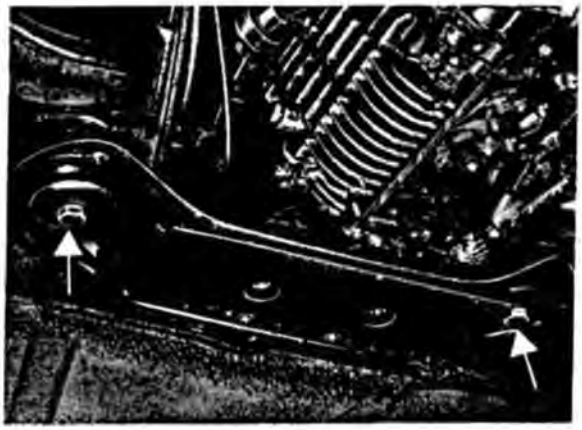
20. Loosen and detach clutch cable at transmission.

21. Loosen drive shaft screws at differential flanges.

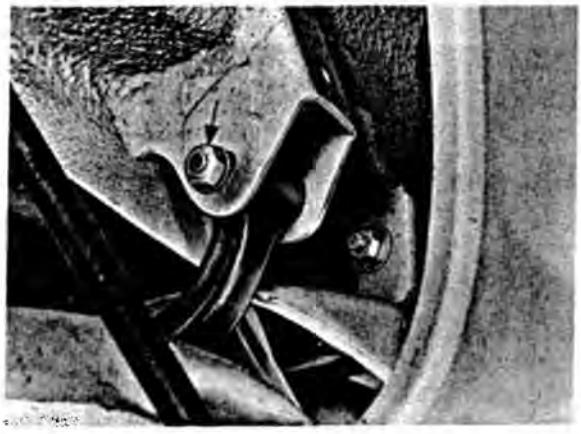


22. Place floor jack with appropriate holder underneath the engine/transmission assembly at its center of gravity, with slight preload.

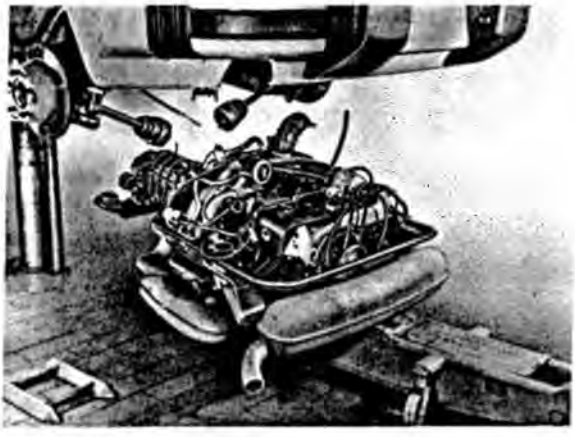
23. Loosen bolts at transmission carrier.



24. Loosen bolts at engine carrier.



25. Lower floor jack with engine/transmission assembly carefully and roll out toward rear.



Caution

Do not place engine on the reactors, which would cause them to leak.

If vehicle is to be moved (with the engine/transmission removed), drive shafts must be supported so that they hang horizontally to prevent damage to drive shaft boots.

Installing

Note the following points on installation.

Caution

1. Be careful not to pinch the heater hoses. Connect them to the heat exchangers just before the engine/transmission assembly is positioned correctly.

2. Torque specifications:
   Socket head screws of drive shaft flange
   42 Nm (4.2 kpm)
   Transmission carrier to body mountings
   80 Nm (8.0 kpm)
   Engine carrier to body mountings
   49 Nm (4.9 kpm)

3. Engage the plug on the control unit and press it into the socket until the spring clip engages with an audible click.

DISMANTLING AND ASSEMBLING ENGINE/TRANSMISSION ASSEMBLY

Dismantling

1. Remove wire at starter and backup light switch.

2. Loosen engine mounting bolt and nuts.

3. Pull transmission off engine.

Assembling

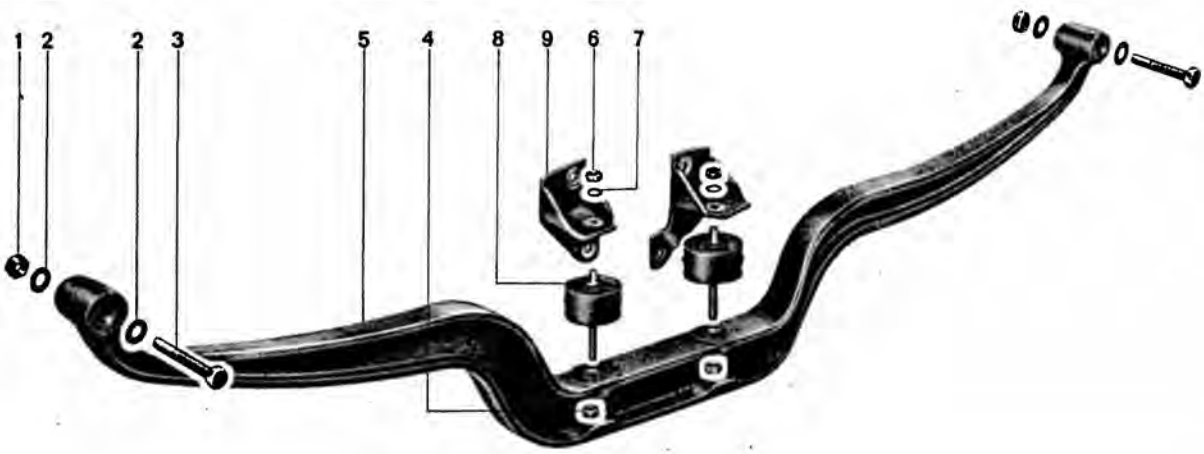
Note the following points.

1. Apply a coat of all purpose grease with MoS_2 to all bearing surfaces of the clutch release as well as the splines of the input shaft.

2. Place transmission on engine.

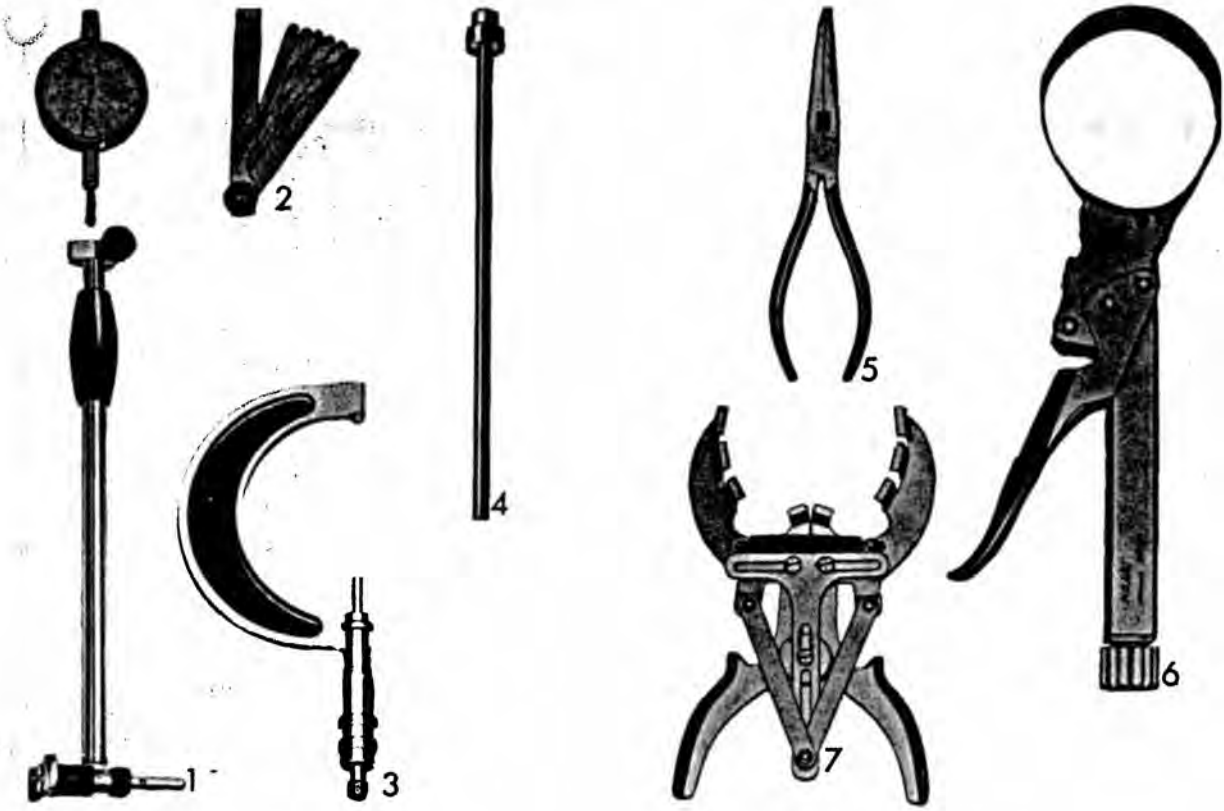
3. Torque engine mounting bolt and nuts to 47 Nm (4.7 kpm).

ENGINE CARRIER ASSEMBLY

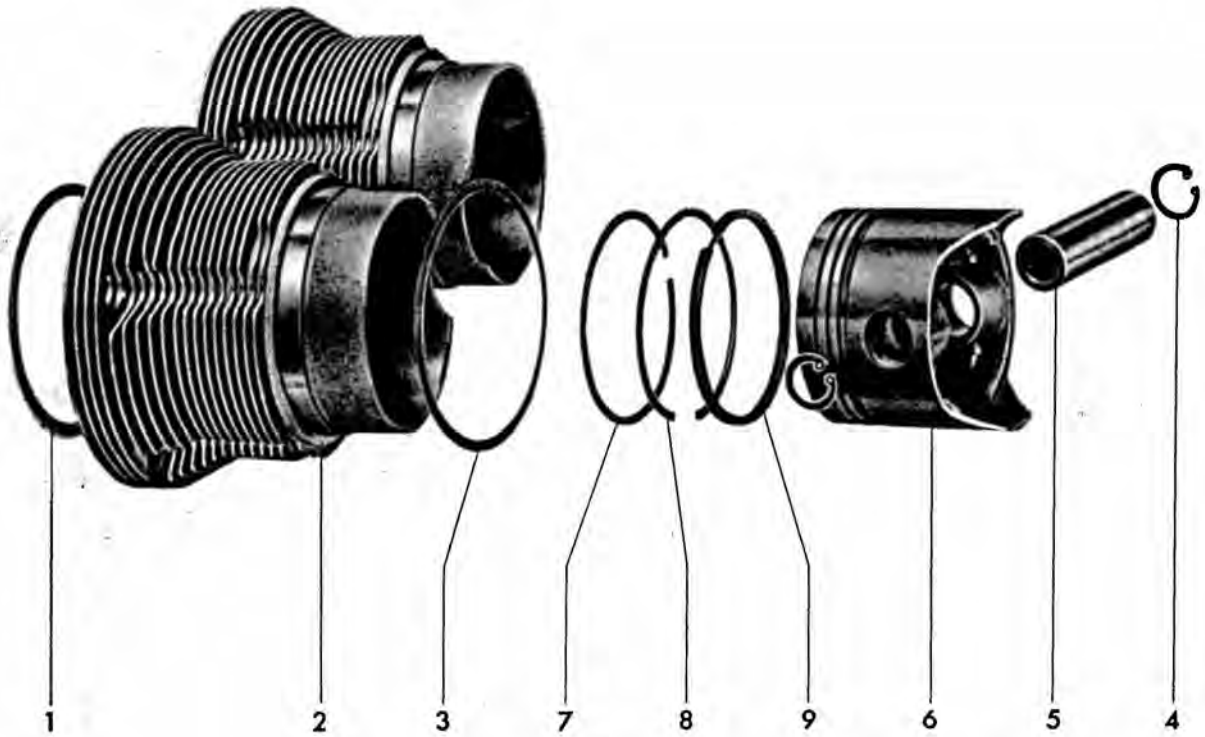


No.	Description	Qty.	Note when Removing	Note when Installing	Remarks
1	Lock nut	2		Replace, install correctly, torque 49 Nm (4.9 kpm)	
2	Washer	4			
3	Bolt	2			
4	Mid grip nut	2		Replace, do not damage rubber of engine mount when tightening	
5	Engine carrier	1		Install in correct position, cast in part number faces rear of vehicle	
6	Nut	2			
7	Washer	2			
8	Engine mount	2		Check for cracks, replace if necessary	
9	Support	2		Install correctly	

TOOLS



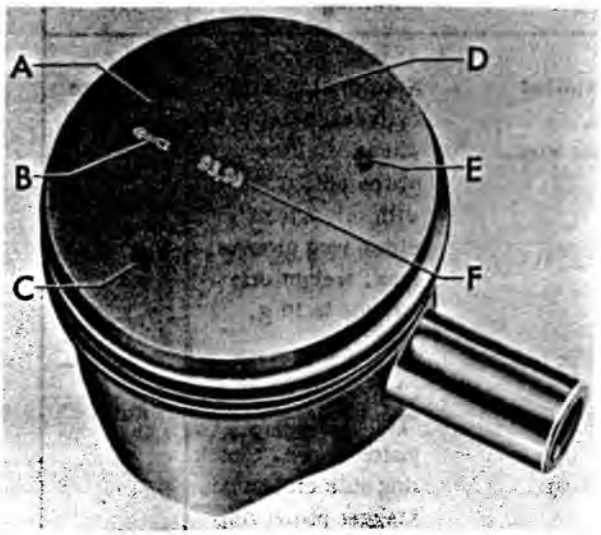
No.	Description	Special Tool	Remarks
1	Inside micrometer	US 1032	
2	Feeler gauge		Commercial item
3	Micrometer 75 - 100 mm	US 1075	
4	Piston pin drift	VW 207c	
5	Angled circlip pliers		Commercial item
6	Piston ring compressor	US 1008a	
7	Piston ring pliers		Commercial item



No.	Description	Qty.	Note when Removing	Note when Installing	Remarks
1	Cylinder head gasket	4		Replace	
2	Cylinder	4	Mark installed position. Check for wear. If necessary, install new cylinder and piston of same size group.	Cylinder seat in crankcase and cylinder head, as well as bearing surfaces in cylinder, and gasket surfaces must be perfectly clean since foreign particles will lead to leaks.	
				Coat with oil. Studs must not be in contact with cooling fins. Use piston ring compressor.	See page 13-6
3	Cylinder base gasket	4		Replace.	
4	Circlip	8	Use circlip pliers.		
5	Piston pin	4	Use piston pin drift VW 207c.	Coat with oil. If pin is tight, heat piston to approx. 80°C/176°F.	

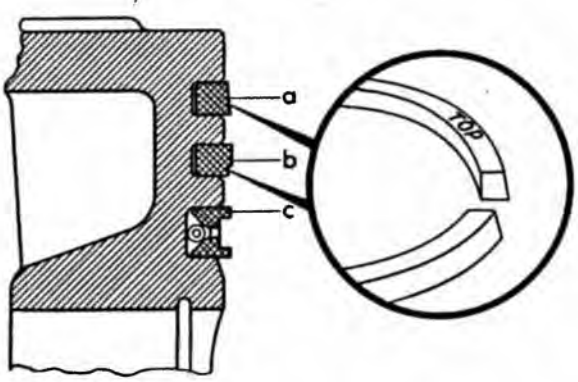
No.	Description	Qty.	Note when Removing	Note when Installing	Remarks
6	Piston	4	Mark installed position. Check for wear.	Note mating with cylinder. Heat when installing piston pin. Coat with oil. Clean piston ring grooves. Max. weight difference is 10 g.	See page 13 - 6
7	Upper ring	4	Always use piston ring pliers for removal and installation (page 13-6)	Fit rings. Check ring gaps. "Top" must face piston crown. Check ring side clearance. Stagger piston ring gaps.	See page 13 - 4
8	Lower ring	4			
9	Oil scraper ring	4			

PISTON MARKINGS



A - Letter adjacent to arrow corresponds with index of spare part number of respective piston; it serves as an identification mark.
B - Arrow (embossed) shows direction piston must be installed towards flywheel.
C - Paint mark indicating size group (blue, pink).
D - Weight group indication (+ or -) embossed or stamped in ink.
E - Weight group indication by paint mark (brown = - weight, gray = + weight).
F - Piston size in mm.

CHECKING PISTONS



a - Upper compression ring
b - Lower compression ring
c - Oil scraper ring with spring

Checking piston ring end gap.

Slide in ring at right angles through bottom of cylinder opening, at approximately 4 to 5 mm from edge of cylinder.

	End Grap mm	Wear Limit mm
Upper compression ring	0.35-0.55	0.90
Lower compression ring	0.35-0.55	0.90
Oil scraper ring	0.25-0.40	0.95

Checking piston ring side clearance.

	Side Clearance mm	Wear Limit mm
Upper compression ring	0.04-0.07	0.12
Lower compression ring	0.04-0.07	0.10
Oil scraper ring	0.02-0.05	0.10

Inspect and fit pistons. Depending on given tolerances, some piston pins can be pushed into the cold piston by hand. This is normal, even if the pin should slide out of the piston under its own weight. It is not appropriate in such cases to replace either the piston pin or piston, or both.

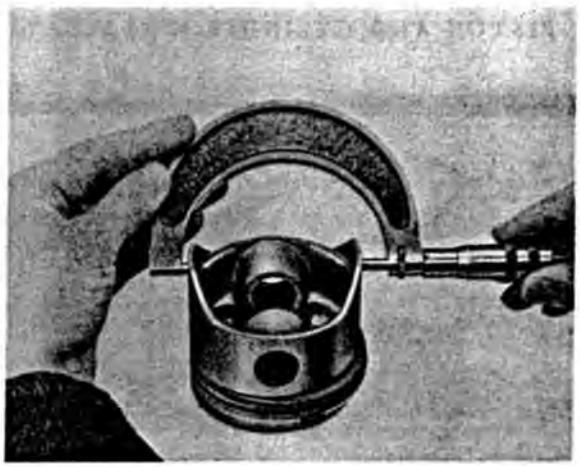
CHECKING CYLINDER TO PISTON CLEARANCE

The cylinder bore is measured with an inside micrometer. First adjust the inside micrometer with a master gauge.

Checking cylinder bore.

Measure the cylinder bore approximately 10 to 15 mm below the top edge of the cylinder.

Installed Clearance	Wear Limit
0.02 - 0.05 mm	0.2 mm



Checking piston diameter.

The nominal piston diameter is embossed on the piston crown. Measurements are made at the lower end of skirt, perpendicular to the piston pin axis.

Cylinders and pistons are matched in size groups shown in the chart below.

Size Group	Color Code	Cylinder Dia. mm	Matching Piston Dia. mm
Standard size Nominal dia. 94.0 mm			
1st oversize Nominal dia. mm			
2nd oversize Nominal dia. mm			

If the measurement reveals that clearance between piston and cylinder is close to 0.2 mm, replace piston and cylinder with a set of same size group (standard or oversize). The weight of pistons in a given engine should not differ more than 10 g. Damaged pistons from cylinders which show traces of wear should not be replaced alone. However, if the given cylinder shows no traces of wear, its piston may be replaced alone with one of the respective size group.
To maintain normal compression ratio, bored out cylinders are fitted with oversize pistons of lower height (measured between piston pin bore and piston crown).

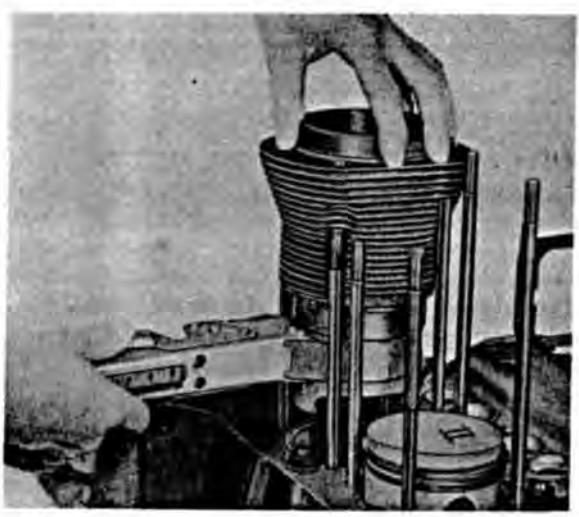
CAUTION

Only cylinders and pistons of one given size group may be installed in a given engine.

Engine oil consumption, together with wear, is a determining factor in replacing pistons and cylinders. If the oil consumption exceeds 1.5 ltr/gt per 600 mi, it is generally an indication for the need of an engine overhaul.

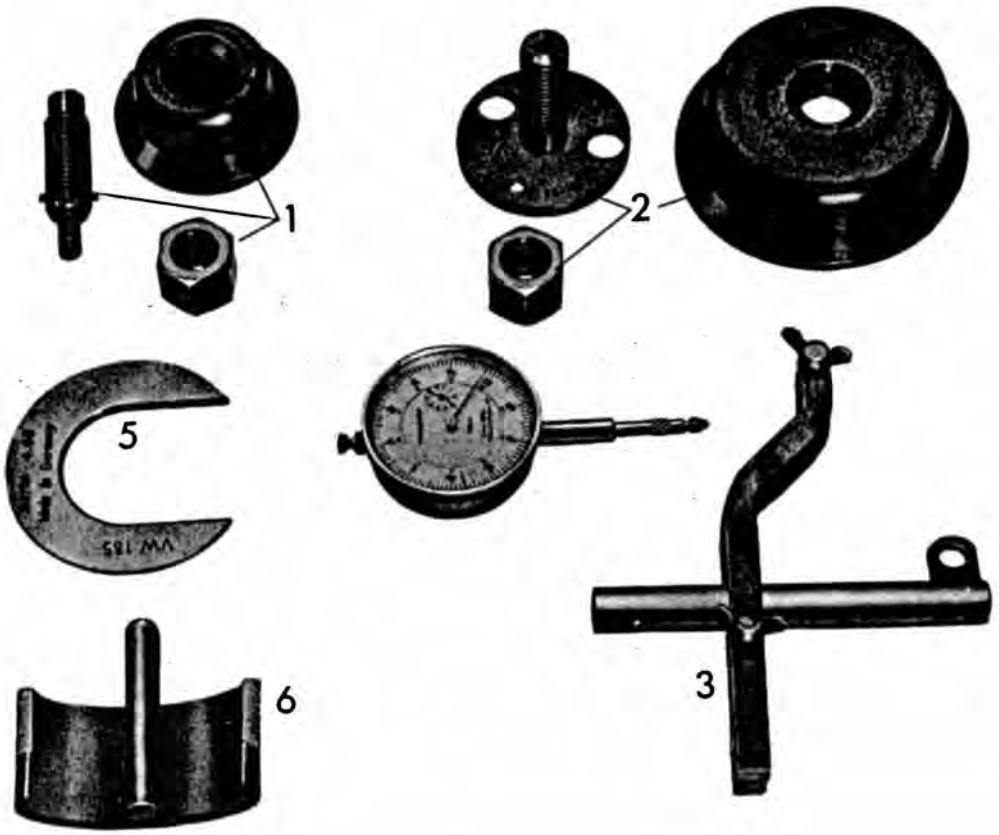
PISTON AND CYLINDER INSTALLATION

Piston rings, removing and installing

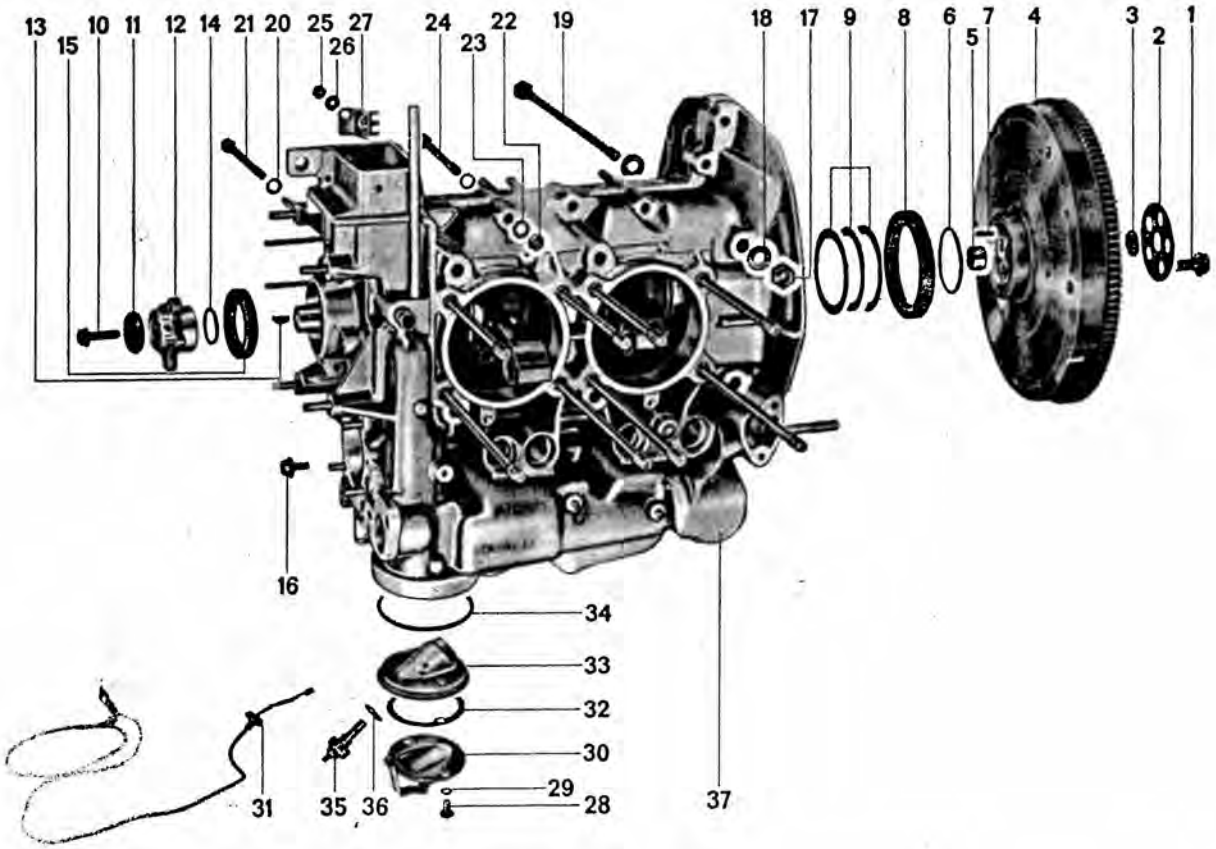


Cylinder on piston, installing

TOOLS



No.	Description	Special Tool	Remarks
1	Crankshaft seal installer (fan pulley end)	VW 190	
2	Crankshaft seal installer (flywheel end)	VW 191	
3	Dial gauge holder	VW 659/2 or VW 387	
4	Not applicable		
5	Fan hub thrust plate	VW 185	
6	Flywheel lock	VW 215c	

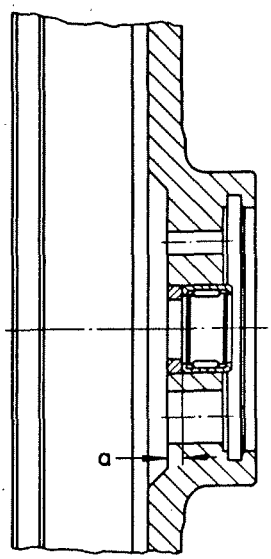


No.	Description	Qty.	Note when Removing	Note when Installing	Remarks
1	Bolt M 12 x 1.5 self locking	5		Torque to 107.9 Nm (11 mkg).	
2	Washer	1		Replace.	
3	Felt ring, needle bearing	1		Dip in oil.	
4	Flywheel	1	Damaged teeth can be machined up to max. 2 mm on clutch end. Machine chamfer on teeth. Replace flywheel if bolt holes are worn too large. Make sure that needle bearing fits properly.	Clutch disc contact surface must be free of grease or oil. Lubricate oil seal seating surface. Use flywheel lock VW 215c.	

No.	Description	Qty.	Note when Removing	Note when Installing	Remarks
5	Needle bearing	1		Lubricate if it was washed. Note installation depth.	See page 13 - 11
6	Rubber seal, flywheel	1		Replace. Lubricate lightly.	
7	Spring pin	1		Replace flywheel if spring pin is loose.	
8	Seal 95 mm dia., crankshaft	1		Replace. Lubricate lightly. Install with VW 191 all the way in. Do not cant.	See page 13 - 13
9	Spacer	3		Determine thickness by adjusting end play. Use dial gauge holder VW 659/2 or VW 387.	See page 13 - 12
10	Bolt M 8 x 30 self locking	1		Torque to 31.4 Nm (3.2 mkg)	
11	Washer	1			
12	Hub, fan	1	Use 3 bolts M8 and VW 185		See page 13 - 13
13	Woodruff key	1			
14	Rubber seal, hub	1		Replace. Lubricate lightly.	
15	Seal 65 mm dia., crankshaft	1		Replace. Lubricate lightly. Use installer VW 190.	See page 13 - 13
16	Bolt M 8 self locking	4		Torque to 29.4 Nm (3.0 mkg)	
17	Nut M 10 x 1.25	6		Torque to 32.4 Nm (3.3 mkg). Replace damaged nuts. Coat with sealing compound D 3.	

No.	Description	Qty.	Note when Removing	Installing	Remarks
19	Bolt M 10 x 1.25 x 213	6		Coat bolt heads with sealing compound D 3	
20	Seal	1		Replace	
21	Bolt M 8 x 113 (oil pipe)	1			
22	Nut M 8	10		Torque to 19.6 Nm (2.0 mkg).	
23	Washer	20			
24	Bolt M 8	5			
25	Nut M 6	2			
26	Washer	2			
27	Ignition cable holder	1			
28	Bolt M 6	2			
29	Seal	2		Replace.	
30	Cover	1			
31	Cable	1			
32	Gasket	1		Replace. Coat both sides with sealing compound.	
33	Cover	1		Replace.	
34	Seal	1		Replace.	
35	Temperature sensor	1			
36	Seal	1		Replace.	
37	Crankcase	1	Use rubber mallet. Do not damage mating surfaces by using sharp edged tools	Check for external damage and cracks. Clean mating surfaces with cleaning solution. Check flatness. Break edges of bearing bores if necessary. Flush oil passages dry with compressed air. Check tightness of studs.	

CHECKING FLYWHEEL



"a" = 3.2 mm

CHECKING ASSEMBLING CRANKCASE

1. Check cam follower bores in crankcase.

2. Join crankcase halves and torque bolts to specifications. Use inside micrometer and master gauge to check crankshaft bearing bores in crankcase.

Assembling

1. Apply an even thin coat of sealing compound to the mating surfaces of the crankcase halves. Make sure that no sealing compound comes in the oil passages for the crankshaft and camshaft bearings.

2. Join crankcase halves and first tighten the oil suction pipe mounting screw slightly, using a new seal.

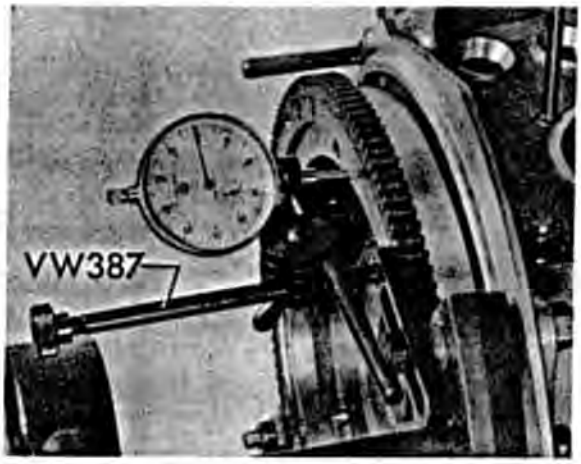
3. Then install and tighten the M 10 x 1.25 nuts.

4. Now tighten the M 8 and M 6 nuts.

5. Turn crankshaft to check for free rotation.

CRANKSHAFT END PLAY

End play: New: 0.07 - 0.13 mm
Wear limit: 0.15 mm



Adjusting End Play

1. Install flywheel with two spacers, but without the seals for crankshaft and flywheel.

2. Install dial gauge holder with a dial gauge on crankcase.

3. Move crankshaft back and forth. Read end play on dial gauge.

4. Determine thickness of third shim.
   Dial gauge reading
   - 0.10 mm mean end play
   = 3rd shim thickness

5. Remove flywheel.

6. Insert seals for crankshaft and flywheel as well as felt ring.

7. Install flywheel with all three shims and a new washer.

8. Recheck end play.

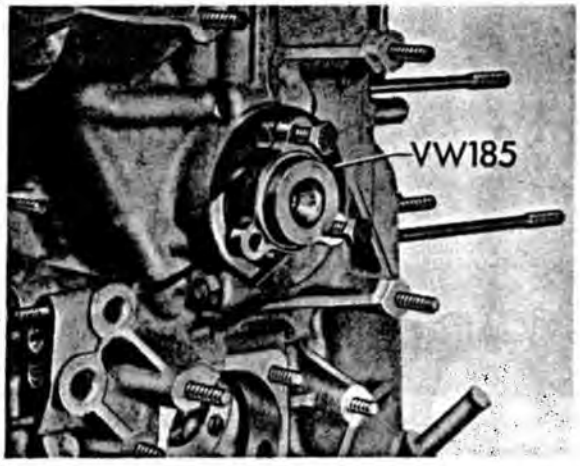
Shims are available in the following thicknesses.

0.24 mm	0.34 mm
0.30 mm	0.36 mm
0.32 mm	0.38 mm

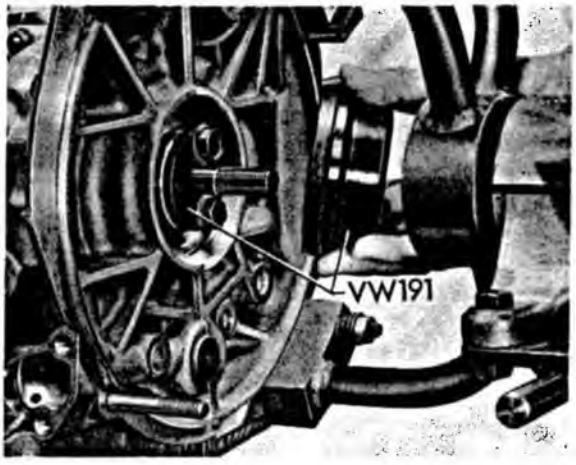
The thickness is etched on each shim. If necessary check the shim thickness with a micrometer.

Three shims must always be used to make up the given total thickness.

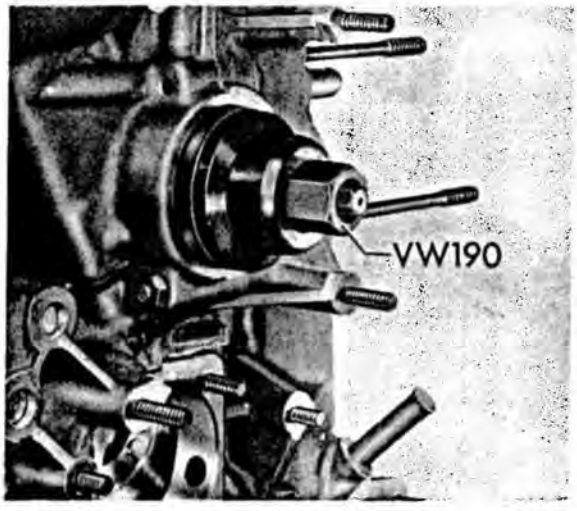
REMOVING AND INSTALLING CRANKSHAFT SEALS



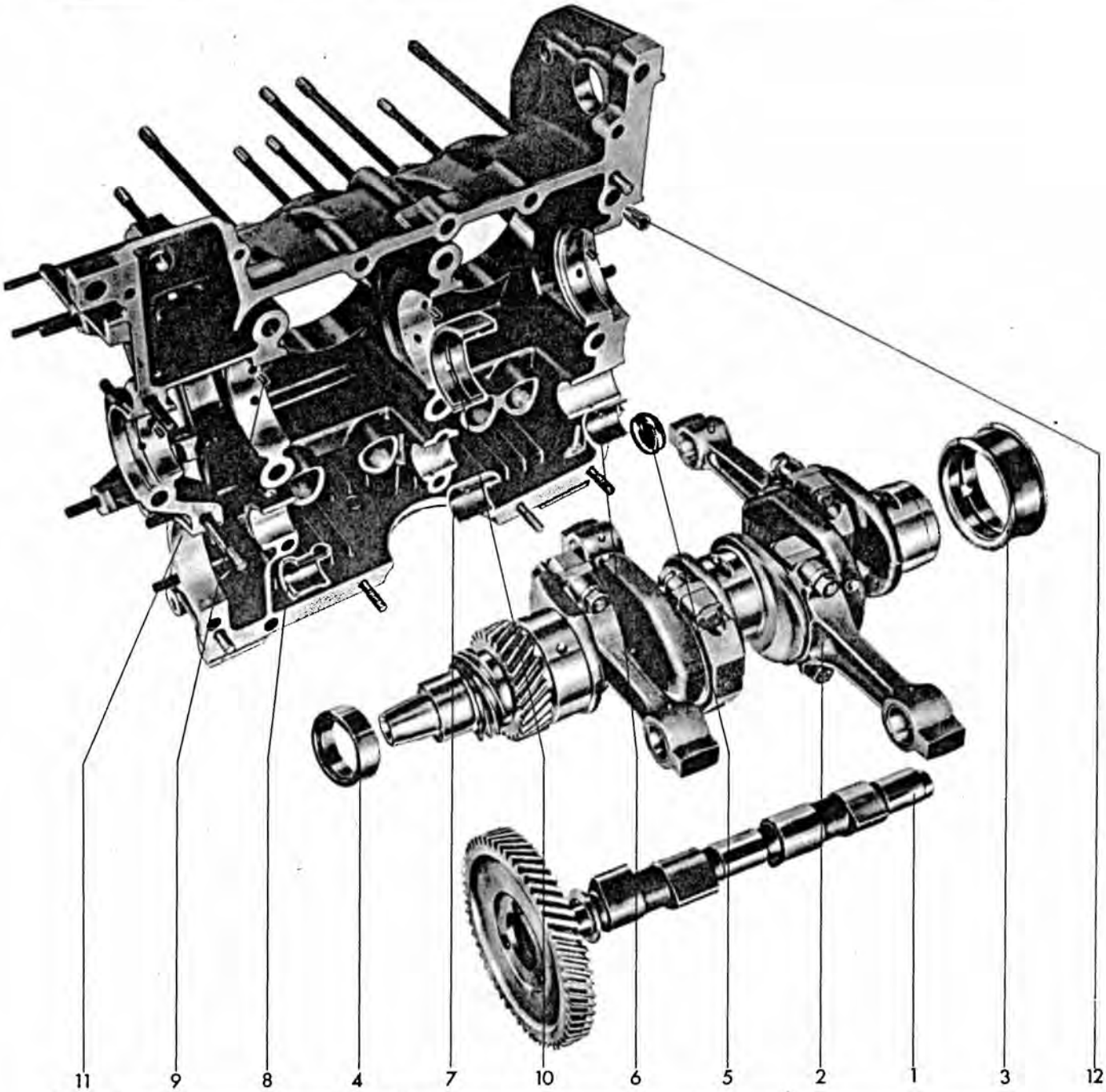
Hub for fan, removing



Seal - crankshaft, installing (flywheel end)



Seal - crankshaft, installing (fan end)

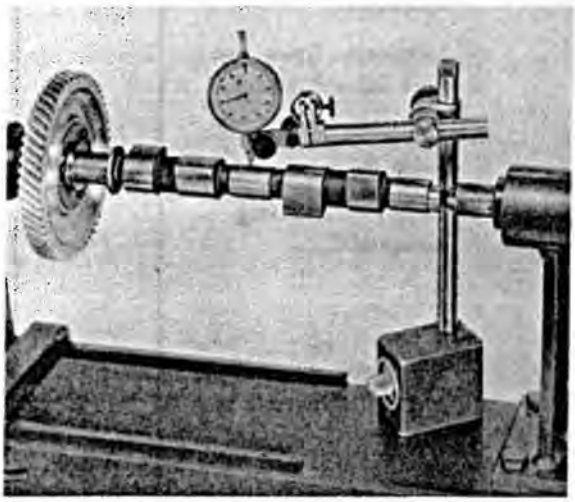


No.	Description	Qty.	Note when Removing	Note when Installing	Remarks
1	Camshaft	1	Check rivets securing gear to camshaft. Check cams and bearing journals for wear and contact pattern.	Check runout. Check end play at thrust bearing. Note pairing and timing with crankshaft. Check backlash over entire camshaft gear	See page 13 - 16

No.	Description	Qty.	Note when Removing	Note when Installing	Remarks
2	Crankshaft with connecting rods	1		Oil bores in crankshaft journals and bearings should not have sharp edges. Check that dowel pins fit properly in bearings.	
3	Crankshaft bearing 1	1	Check for wear.	Lubricate. Dowel pin bore faces flywheel.	
4	Crankshaft bearing 4	1	Check for wear.	Lubricate. Groove faces fan.	
5	End plug, camshaft	1		Install with sealing compound.	
6	Bearing shell, camshaft bearing 1	1			
7	Bearing shell, camshaft bearing 2	1	Check for wear.	Lubricate. Be sure tabs engage in recesses in crankcase.	
8	Bearing shell, left, camshaft bearing 3 (with shoulder)	1			
9	Dowel pin, crankshaft bearing	4		Check tightness.	
10	Bearing shell, crankshaft bearing 2	1	Check for wear	Lubricate.	
11	Crankcase, left half	1		Crankcase with circumferential retaining web for oil splash shield.	
12	Vibration dampers	6	The following parts are not illustrated, but must be installed in right crankcase half prior to assembly.		
13	Dowel pin, crankshaft bearing 2	1		Check tightness.	
14	Bearing shell, crankshaft bearing 2	1	Check for wear	Lubricate.	
15	Bearing shell, camshaft bearing 1	1			
16	Bearing shell, camshaft bearing 2	1	Check for wear.	Lubricate. Be sure tabs engage in recesses in crankcase.	
17	Bearing shell, right, camshaft bearing 3	1			
18	Oil suction pipe	1			
19	Seal, oil suction pipe	1		Replace.	
20	Oil splash shield	1			

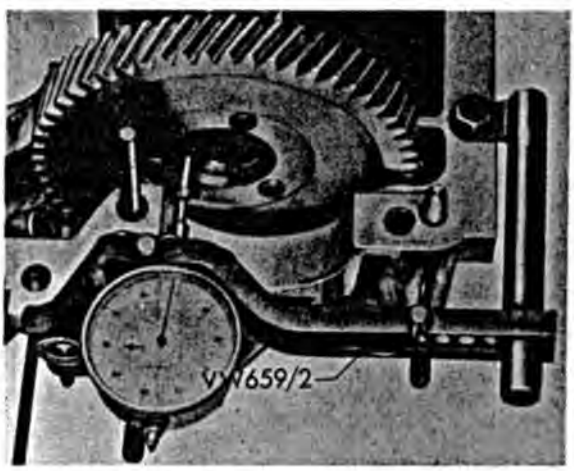
Checking and Installing Camshaft

Checking Runout:
New: Max. 0.02 mm
Wear limit: Max. 0.04 mm



Camshaft runout, checking

Checking End Play (at thrust bearing)
New: 0.04 - 0.13 mm
Wear limit: 0.16 mm



Camshaft end play, checking

Check backlash over entire circumference of camshaft gear.

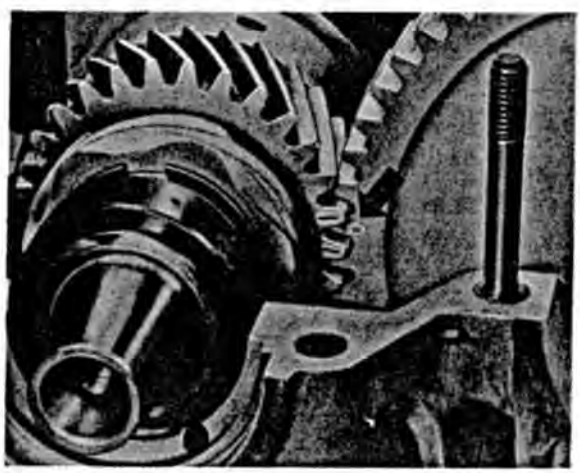
The backlash between the camshaft gear and crankshaft gear is 0.00 - 0.05 mm.
The camshaft gear is of the right size when the backlash is hardly noticeable and the camshaft does not lift when the crankshaft is turned in reverse direction .

To obtain the specified backlash, camshafts are available with various sized timing gears under different part numbers.

The gears are marked on the side facing the cams below the teeth with stamped numerals such as "-1", "O", "+1", "+2" etc.. The numerals indicate by 1/100 mm how the pitch circle radius differs from the blueprint dimension "O".

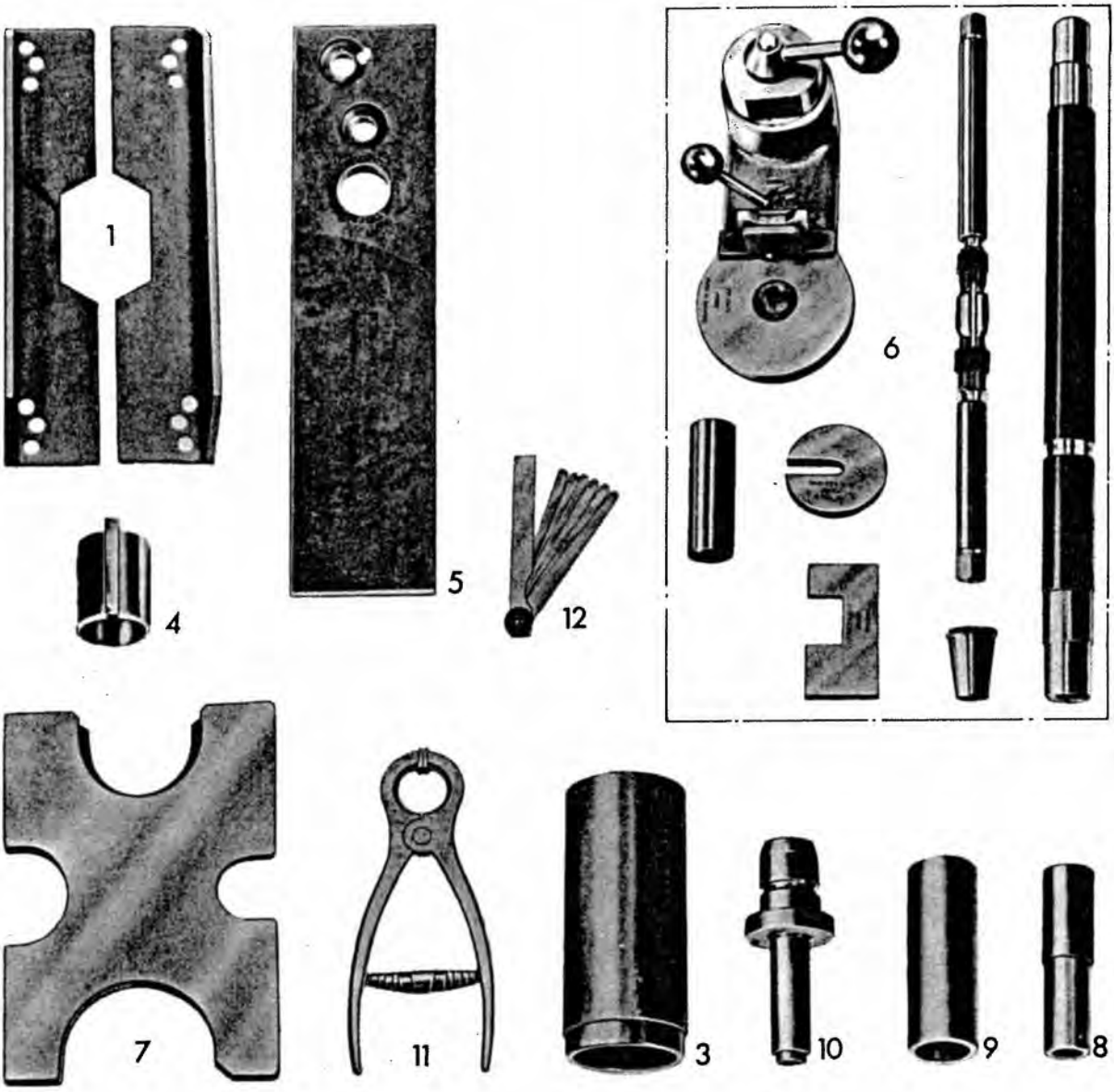
Caution!

Do not confuse the numeral O with the symbol O which is a timing mark.
Crankshaft gears are available in one size only and bear no size markings.



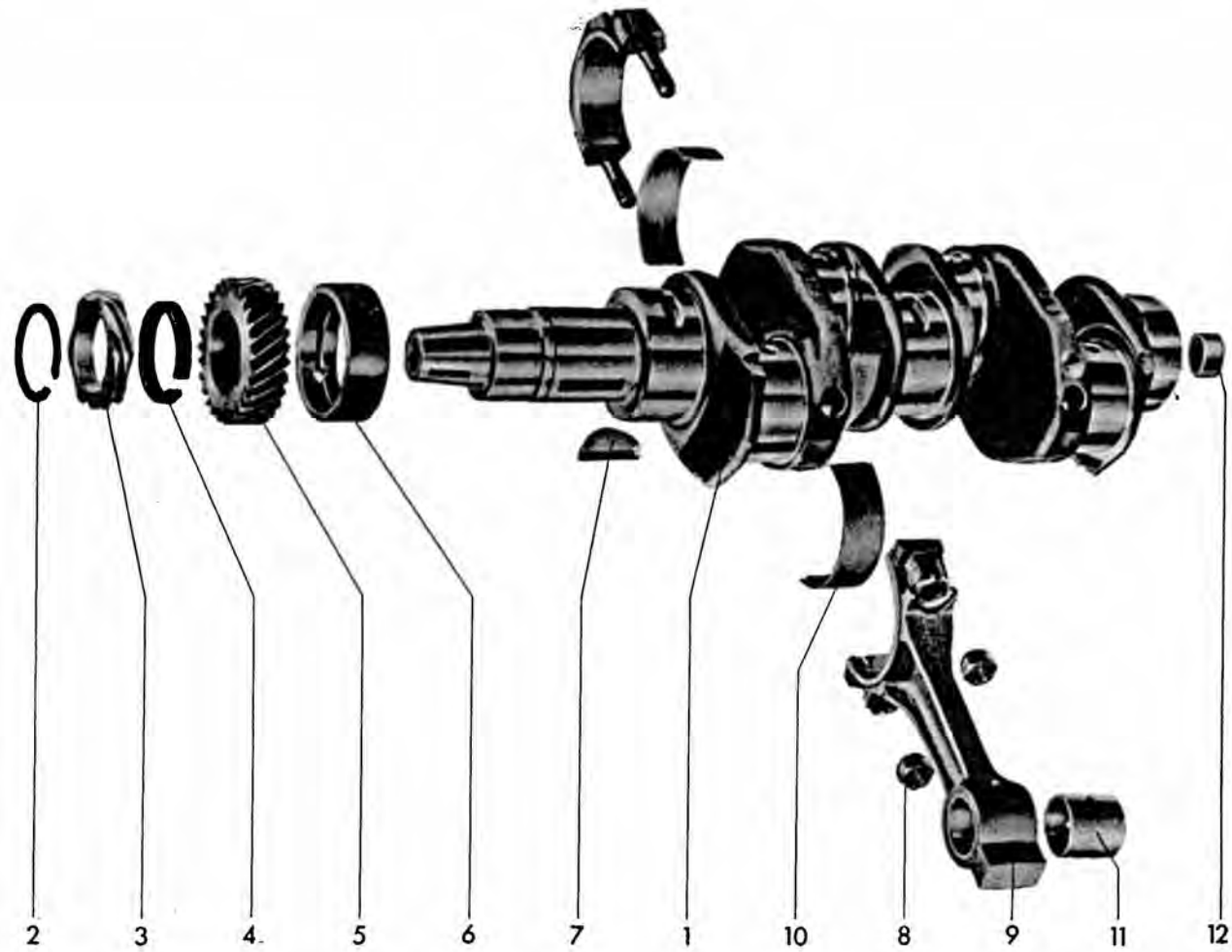
Camshaft - Installation Position

TOOLS



No.	Description	Special Tool	Remarks
1	Support (adapter) plates	VW 457	
2	Not applicable		
3	Tube 60 mm dia.	VW 415a	
4	Guide sleeve, tapered	VW 428a	
5	Crankshaft holder	VW 801	
6	Connecting rod aligning and reaming set	VW 214f	
7	Press plate	VW 402	
8	Tube	VW 421	
9	Tube	VW 416b	
10	Press block	VW 409	
11	Circlip pliers	VW 161a	
12	Feeler gauge		Commercial item

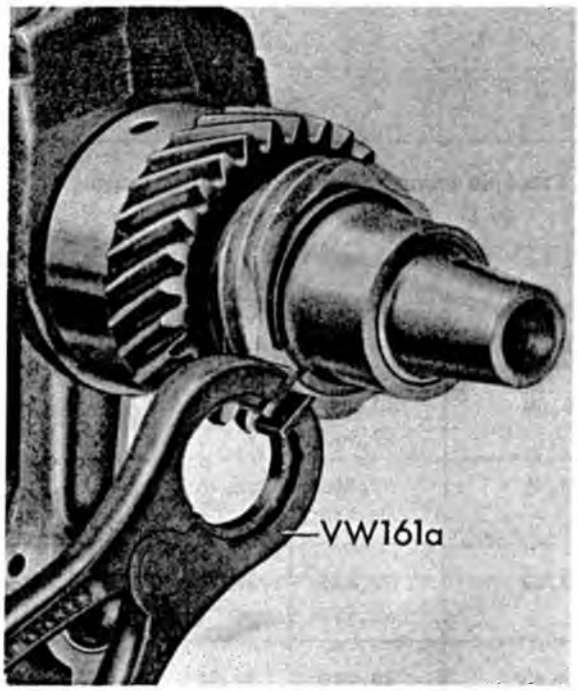
Printed in Germany



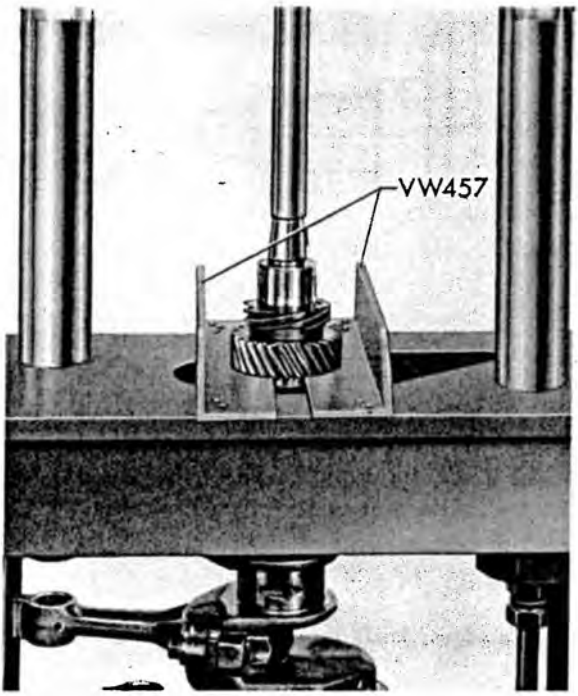
No.	Description	Qty.	Note when Removing	Note when Installing	Remarks
1	Crankshaft	1	Check for wear. Ring test.	Clean oil passages with compressed air. Check runout. Do not store without oiling or greasing. Minor seizure burrs on crankshaft or distributor drive gears can be removed carefully.	
2	Circlip	1	Use VW 161a	Use VW 415a and VW 428a	See page 13 - 21

No.	Description	Qty.	Note when Removing	Note when Installing	Remarks
3	Distributor drive gear	1	Use VW 457. Check for wear.	Heat to approx 80°C/ 176°F. Use VW 415a and VW 428a. Check teeth.	See page 13 - 21
4	Spacer	1			
5	Crankshaft gear	1	Use press and VW 457	Heat to approx 80°C/ 176°F. Chamfer faces bearing 3. Use VW 415a and VW 428a. Check teeth.	See page 13 - 21
6	Crankshaft bearing 3	1	Check for wear.	Lubricate. Dowel pin bore faces crankshaft web.	
7	Woodruff key	1	Replace, if damaged.		
8	Nut, connecting rod	8		Replace. Torque to 32.4 Nm (3.3 mkg). Lubricate bearing surface.	
9	Connecting rod	4	Check with VW 214f	Max. weight difference 6 g. Note position and weight. Check end play.	See page 13 - 24 See page 13 - 23
10	Connecting rod bearing shell	8	Check for wear.	Lubricate.	
11	Connecting rod bushing	4	Check for wear. Use VW 402, VW 409, VW 416b and VW 421	Use VW 402, VW 409 and VW 421. Piston pin must slide in under light finger pressure.	See page 13 - 24
12	Spacer	1			

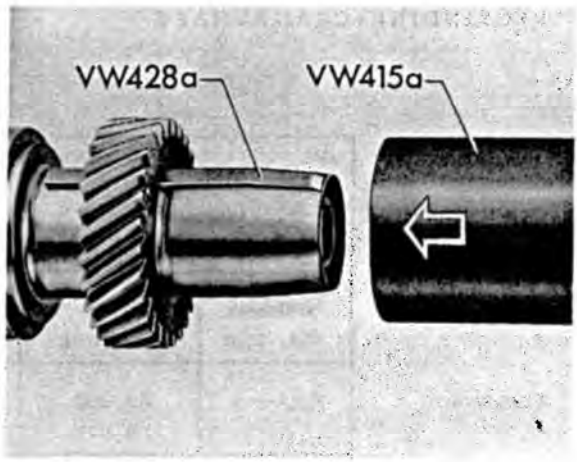
DISASSEMBLING AND PREASSEMBLING CRANKSHAFT



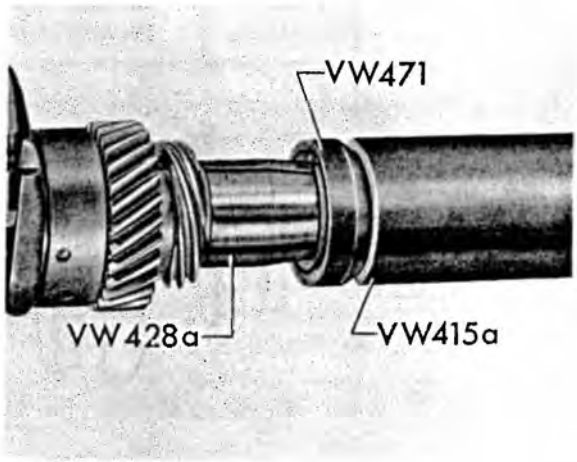
Circlip, removing



Crankshaft gear and distributor drive gear, pressing off



Crankshaft gear and distributor drive gear, pressing on

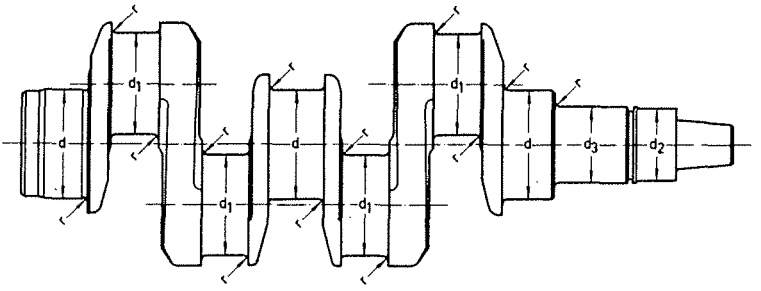


Circlip, assembling

Runout at bearings 2 and 4 (bearings 1 and 3 on V-block)	Bearing journal out of round	Imbalance
Max. 0.02 mm	Max.0.03mm	Max.12cmg

REGRINDING CRANKSHAFT

	Main bearing journals 1, 2 and 3 (d)		Crankpin journals (d 1)		Main bearing journal 4 (d 2)	
	Nominal dia. mm	Lapped dia. mm	Nominal dia. mm	Lapped dia. mm	Nominal dia. mm	Lapped dia. mm
Standard	60.00	59.990 59.971	50.00	49.996 49.983	40.00	40.000 39.984
1st Undersize	59.75	59.740 59.721	49.75	49.746 49.733	39.75	39.750 39.734
2nd Undersize	59.50	59.490 59.471	49.50	49.496 49.483	39.50	39.500 39.484
3rd Undersize	59.25	59.240 59.221	49.25	49.246 49.233	39.25	39.250 39.234



$d_3 = \frac{42{,}006}{41{,}995}$ mm Ø $r = \frac{2{,}5}{2{,}0}$ mm

Careful grinding of main bearing and crankpin journal radii is very important for the service life of the crankshaft. A radius of 2.5 mm would be ideal. The radii surfaces must be polished smooth.

Never recondition the bearing shells.

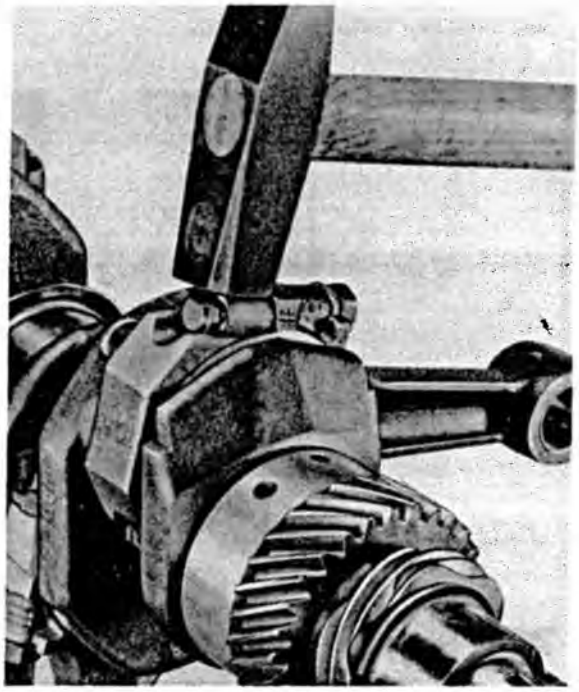
Make sure that after grinding the oil bores do not have sharp edges. Break the edges slightly, if necessary.

The crankshaft gear and distributor drive gear must have an interference fit of $\frac{42.006 \text{ mm dia.}}{41.995 \text{ mm dia.}}$ on the crankshaft. If frequent removal and installation of these gears have resulted in the loss of the interference fit, it can be restored by chroming or metal spraying in the appropriate areas.

Make sure that the crankshaft has no cracks by checking it with a ringing test. Then check the crankshaft for runout.

CHECKING AND INSTALLING CONNECTING RODS

Check connecting rod weight.



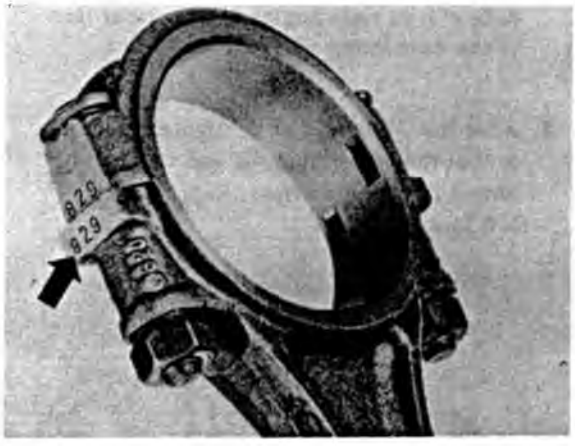
Connecting rods used in a given engine must not differ in weight by more than 6 g.

Note

Connecting rods cannot be reconditioned.

The installed weight classes are available as spare parts.

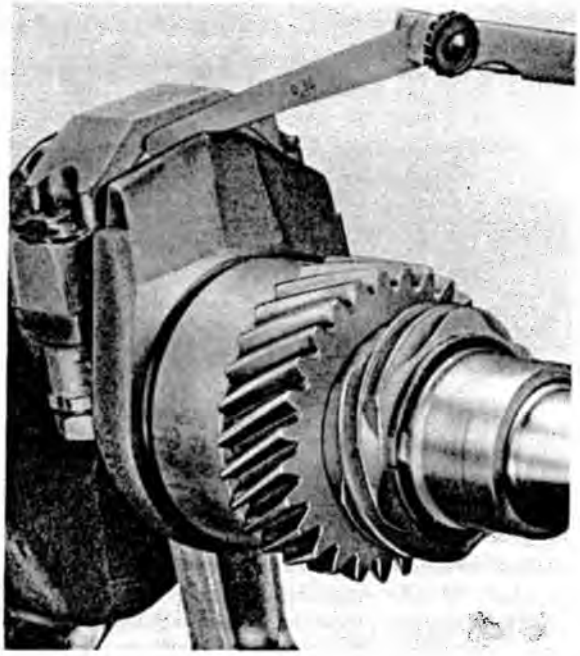
The codes on the mating surfaces of connecting rod and cap must be on the same side when assembled.



Minor binding, which can occur in the bearing shells when the connecting rod bolts are tightened, can be eliminated by applying light blows to both sides of the connecting rod with a hammer.

Side Play

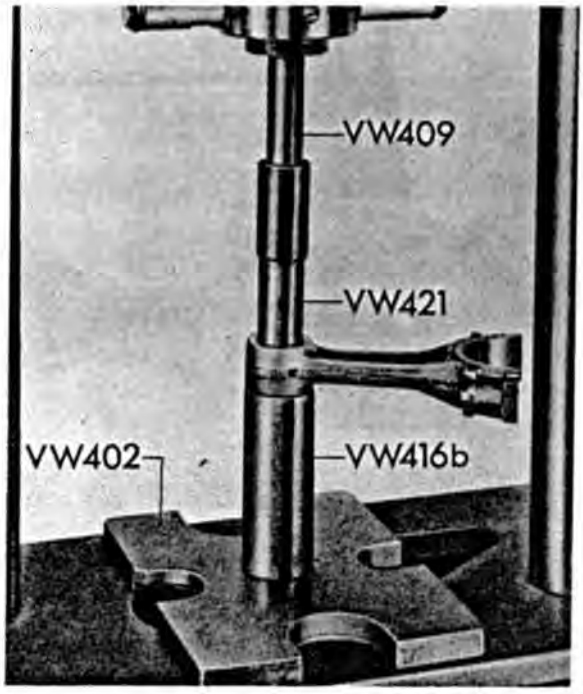
New:	0.1 - 0.4 mm
Wear limit:	0.7 mm



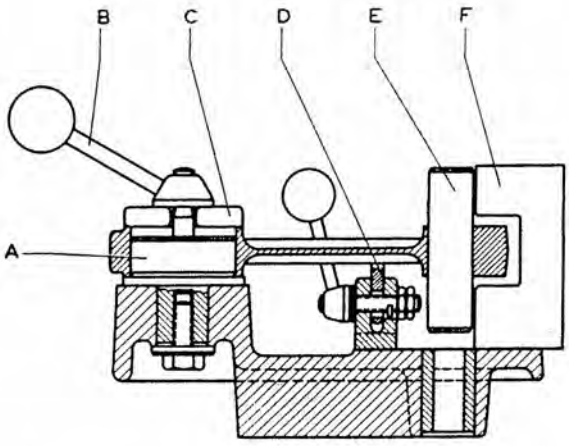
Connecting rod side play, checking.

RECONDITIONING CONNECTING RODS

Connecting rods which are slightly bent or have worn piston pin bushings should be straightened and have new bushings installed.



Connecting rod bushing, pressing out.

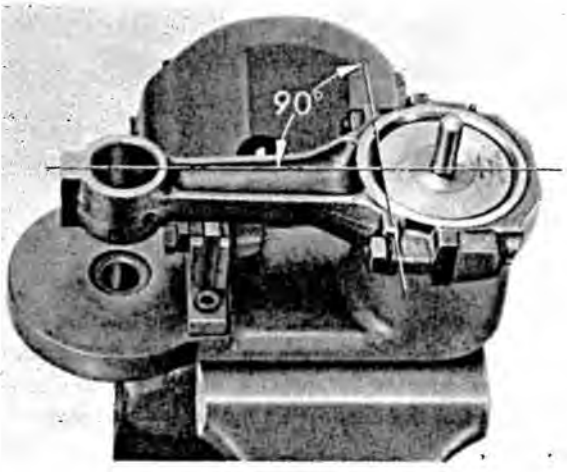


Clamp connecting rod in fixture VW 214f.

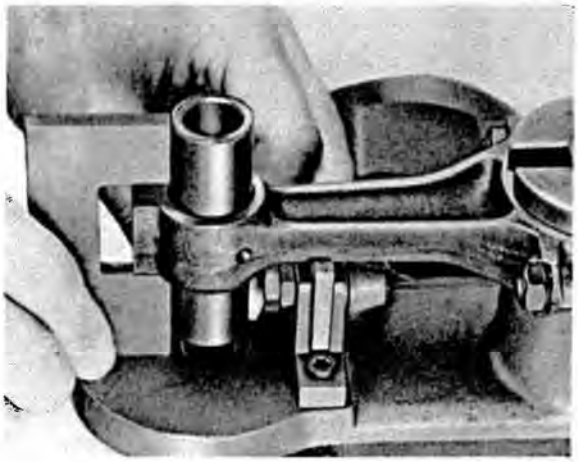
A - Mandrel
B - Locking lever
C - Washer
D - Support
E - Piston pin
F - Gauge

1. The mandrel A is turned until its milled surface is at right angles to the center line of the connecting rod.

2. After installing washer C, tighten lever B so that the connecting rod can still be turned in both directions. Support D is left loose.

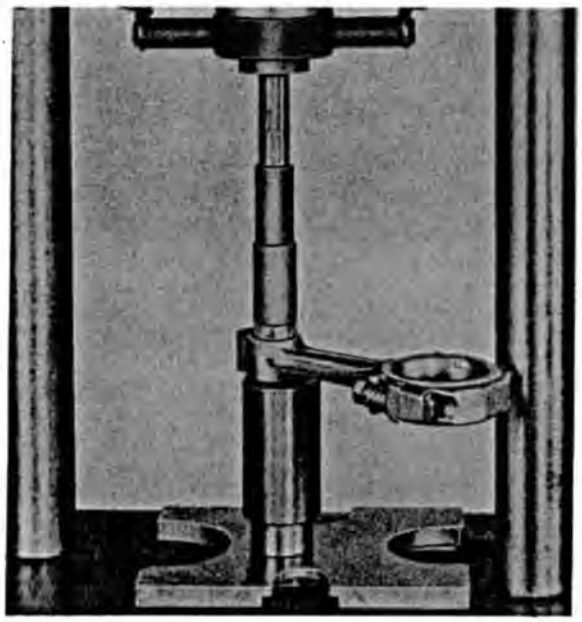


3. Insert pin E into connecting rod and press it with two fingers against mandrel A so that no tilting occurs between the mandrel and connecting rod or connecting rod bushing and pin.



4. Check connecting rod for twist and parallelism with the aid of the gauge. The illustration shows inspection for parallelism.

   If connecting rod is misaligned, tighten lever B and straighten with the aid of the bar.



Connecting rod bushing, pressing in.

5. Drill 3.5 mm dia. oil holes.

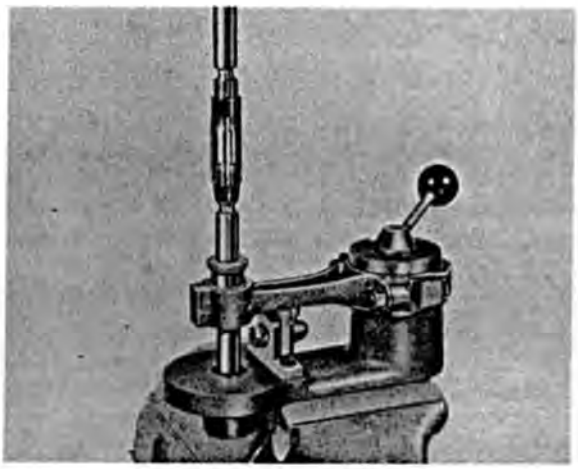
6. Insert shaft of reamer through the connecting rod small end and the respective hole in the working fixture. The conical bushing will center the small end of the connecting rod.

   Tighten lever B and support D.

Inside diameter of piston pin bushing:	24.015 - 24.024 mm

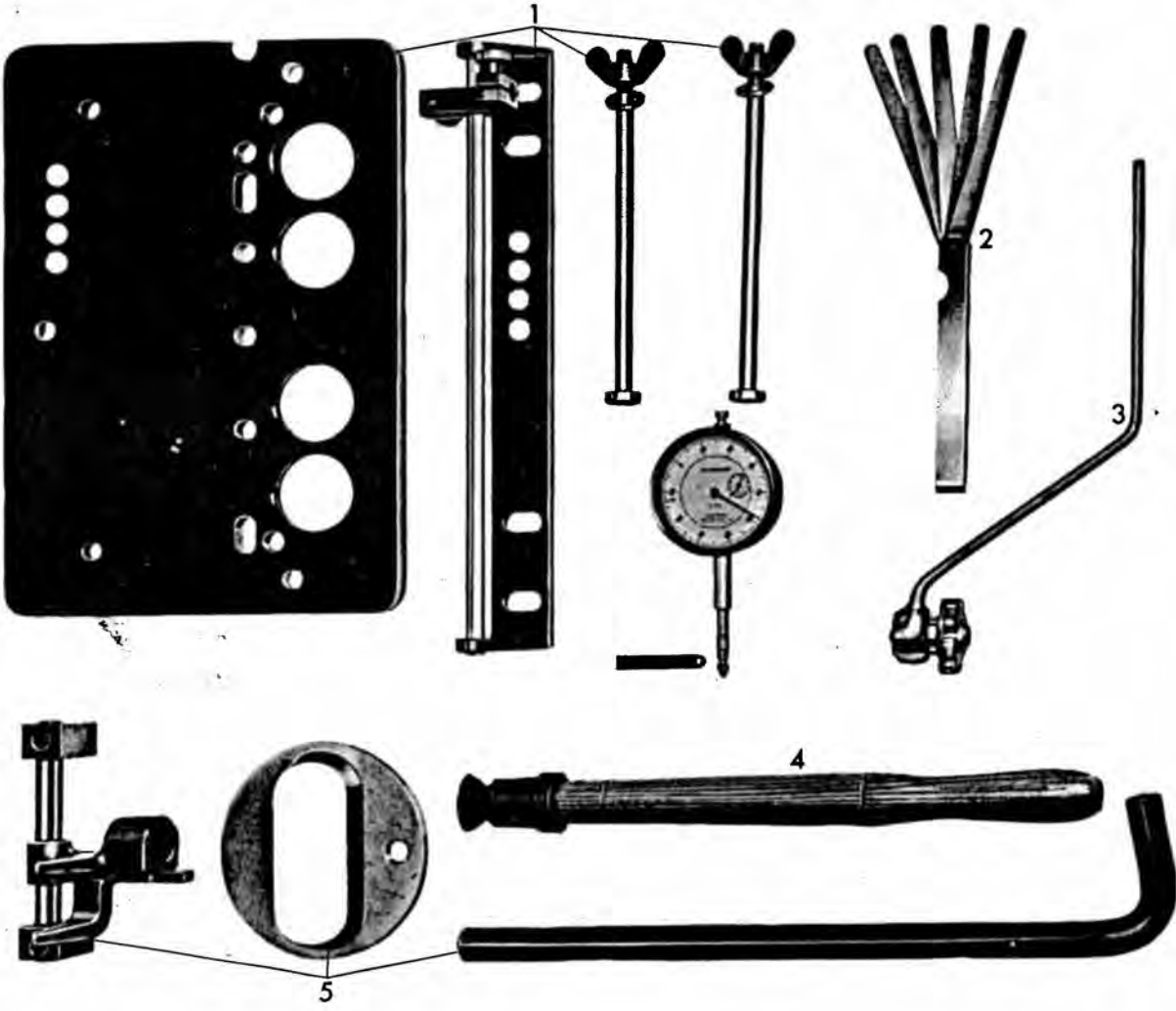
The inner surface of the bushing must be free of scoring or chatter marks. The piston pin must enter under light finger pressure without lubrication.

Always replace a bushing with excessive wear. Never install a piston pin with a larger diameter.

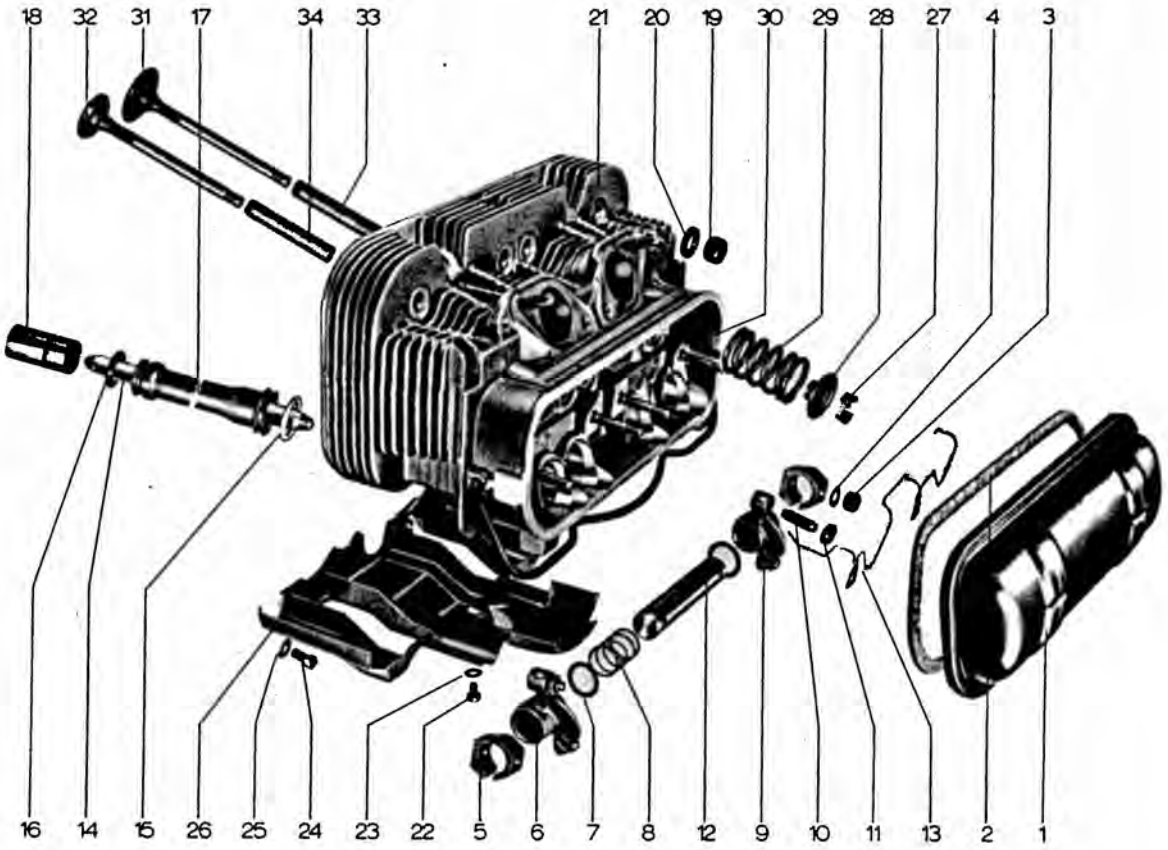


7. Recheck parallelism and twist, this time using the piston pin, in the manner described above. If there is still misalignment, it can be corrected with the aid of a bar inserted into the connecting rod small end.

TOOLS



No.	Description	Special Tool	Remarks
1	Checking device for valve guide clearance	US 4404A + US 4420	
2	Feeler gauge		Commercial item
3	Valve adjuster	US 1101	or commercial item
4	Valve lapper		Commercial item
5	Valve spring compressor	VW 311 s	

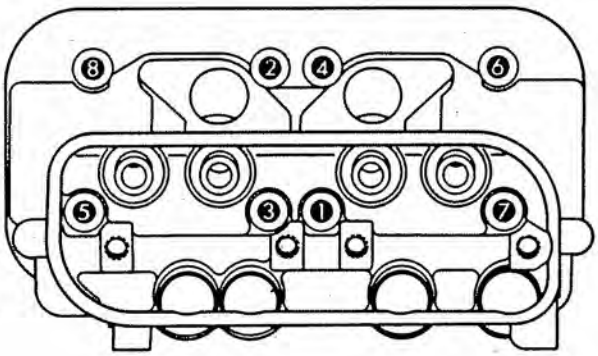


No.	Description	Qty.	Note when Removing	Note when Installing	Remarks
1	Cylinder head cover	2	Clean.		
2	Gasket, cylinder head cover	2		Replace, paste.	
3	Nut M 7	8		Torque to 13.7 Nm (1.4 mkg).	
4	Washer	8			
5	Bearing support	8	Check for wear and scoring marks.	Slot faces down. Chamfered edge faces outward.	See page 15 - 5

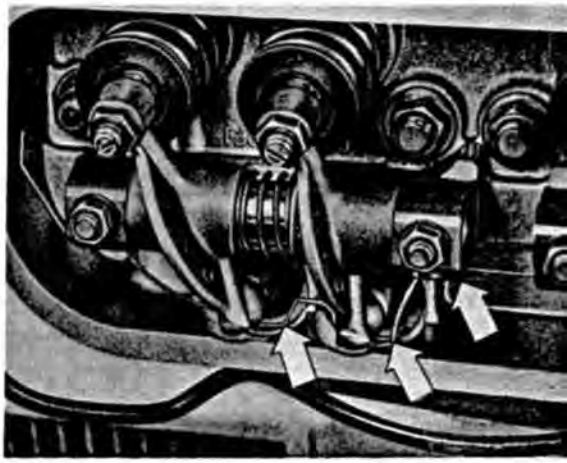
No.	Description	Qty.	Note when Removing	Note when Installing	Remarks
6	Exhaust rocker arm	4	Check for wear and scoring marks.		
7	Thrust washer	8			
8	Spring	4			
9	Intake rocker arm	4	Check for wear and scoring marks.		
10	Valve adjusting screw	8	Replace if binding.		
11	Nut M 10 x 1	8	Replace if binding.		
12	Rocker arm shaft	4	Check for wear and scoring marks.		
13	Retaining clip for push rod tubes	2		Must engage in bearing support slots and rest on lower edges of cover.	See page 15 - 5
14	Push rod	8	Mount on centers to check runout. Max. 0.3 mm.		
15	Seal, gray	8		Replace.	
16	Seal, black	8		Replace.	
17	Tube, push rod	8		Push in to stop.	
18	Cam follower	8	Check for wear and scoring marks.	Lubricate with engine oil when installing.	
19	Nut M 10	16		Tighten in sequence. Tighten lightly first, then torque to 31.4 Nm (3.2 mkg).	See page 15 - 5
20	Washer	16			

No.	Description	Qty.	Note when Removing	Note when Installing	Remarks
21	Cylinder head	2		Check for cracks in combustion chambers and exhaust ports, also for leaks along cylinder mating surfaces. Check spark plug threads for damage or tightness. Install heli-coil inserts if necessary. Left cylinder head has threaded bore for temperature sensor.	
22	Screw M 5 x 10	2			
23	Washer	2			
24	Screw M 6	4			
25	Washer	4			
26	Baffle	2		Left and right different.	
27	Valve keeper	16		Replace worn valve keeper.	
28	Valve spring retainer	8			
29	Valve spring	8			
30	Not applicable				
31	Intake valve	4	Use VW 311s. Check seat for burnt spots or wear, reface if necessary. Remove burrs from keeper bearing surfaces.	Coat valve stem with molybdenum disulfide paste.	See page 15 - 5
33	Intake valve guide	4	Check for wear.		See page 15 - 8
34	Exhaust valve guide	4			

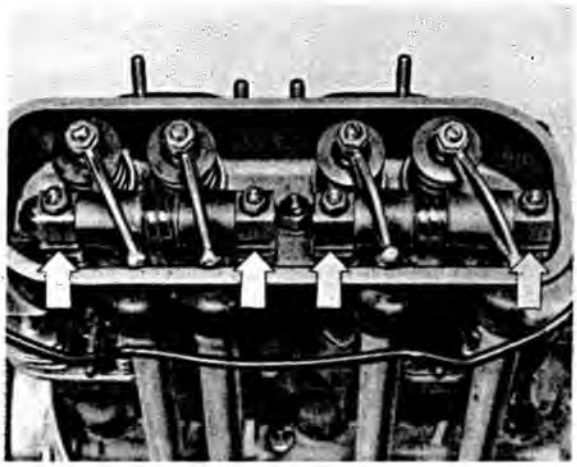
INSTALLATION NOTES ON CYLINDER HEAD AND VALVES



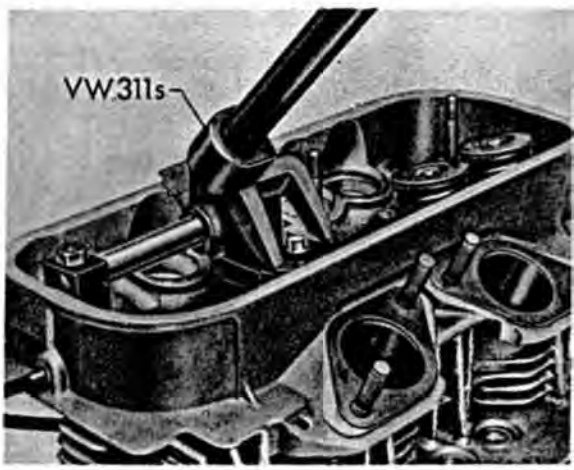
Screw on cylinder head nuts lightly and then tighten in sequence illustrated above.



Retaining clip, installing

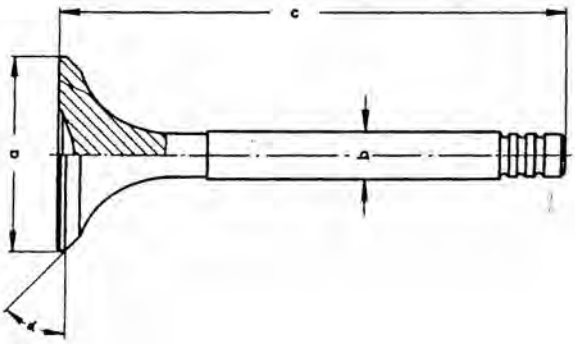


Bearing support, installing



Valve springs, removing and installing

MACHINING INTAKE VALVES

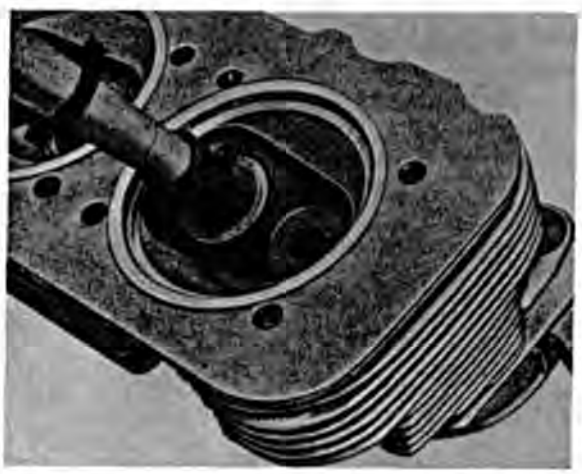


	Intake Valve	Exhaust Valve
a	41.8-42.2 mm dia.	35.8-36.2 mm dia.
b	7.94-7.95mm dia.	8.91-8.92 mm dia.
c	116.8 mm 45°	117 mm 45°

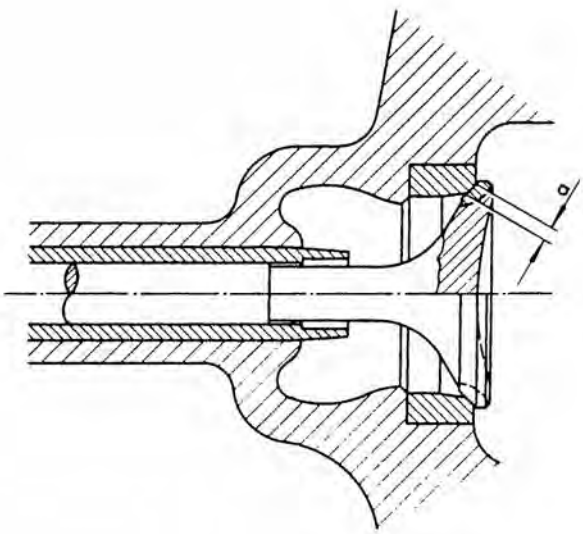
Caution

Exhaust valves must not be turned. Only grinding in is permissible.

When grinding in valves, frequently lift and turn valve to avoid scoring.



REFACING VALVE SEATS

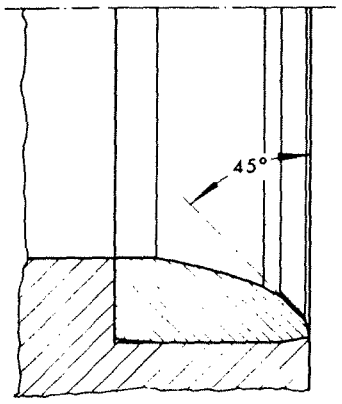


Valve seats showing wear or burnt spots can be refaced as long as the permissible seat width can be maintained and the 15° chamfer at its outer circumference does not exceed the outside diameter of the valve seat insert. If it does, replace cylinder head with a new or overhauled unit. The valve seat inserts cannot be replaced with conventional shop tools because the inserts are (cold) shrunk in.

Valve Seat Width (a)

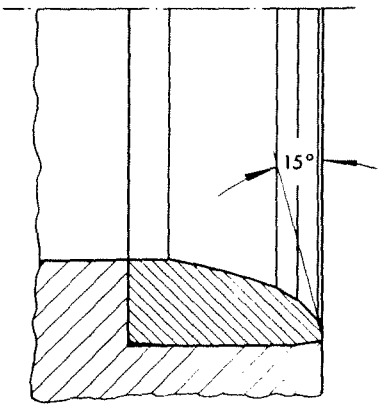
Intake 1.8 - 2.2 mm
Exhaust 2.0 - 2.5 mm

Machining 45° Surface



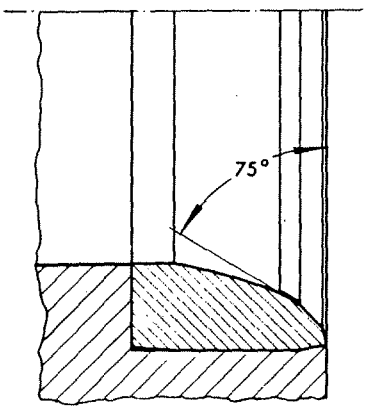
Remove a minimum of base material. Consequently the work must be stopped as soon as the whole seat surface has been machined.

Machining 15° Surface



Machine the upper edge of the valve seat insert until the specified seat width is reached.

Machining 75° Surface



Chamfer bottom edge of exhaust valve seat insert slightly.

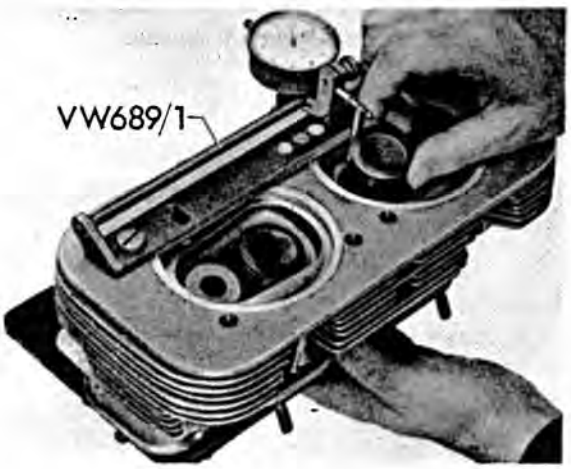
CHECKING VALVE GUIDES

1. Remove deposits with cleaning reamer.

2. Place cylinder head on mounting plate US 4420 and fasten with bracket.

3. Insert new valve in guide. End of valve stem must be flush with guide.

4. Determine side play.



	Intake valve guide	Exhaust valve guide	Wear limit
Side play	0.30 mm		1.2 mm
Inside diameter	8.02mm dia.	9.02mm dia.	9.06mm dia.

REPLACING VALVE GUIDES

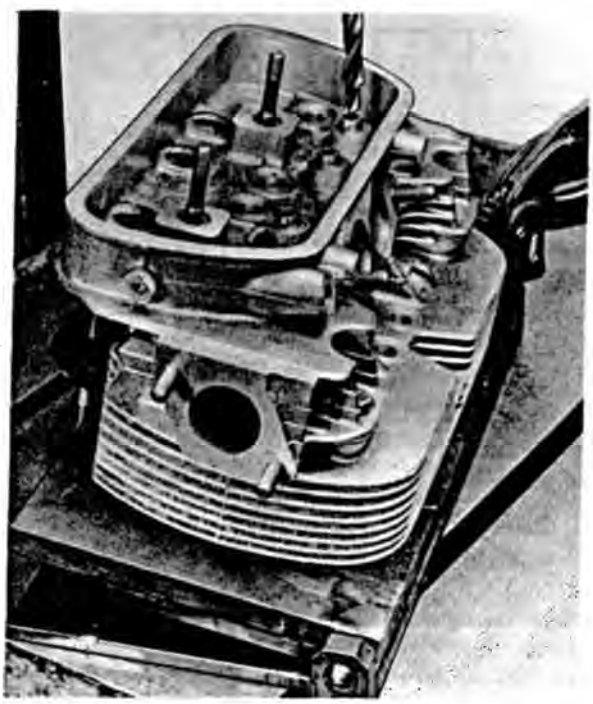
Worn or damaged valve guides can be replaced with the universal cylinder head repair set. Oversize valve guides with a shoulder are available for repairs.

1. Clean and check cylinder head. Cracked cylinder heads and or heads with valve seat inserts which cannot be refaced, are not suitable for the installation of new valve guides.

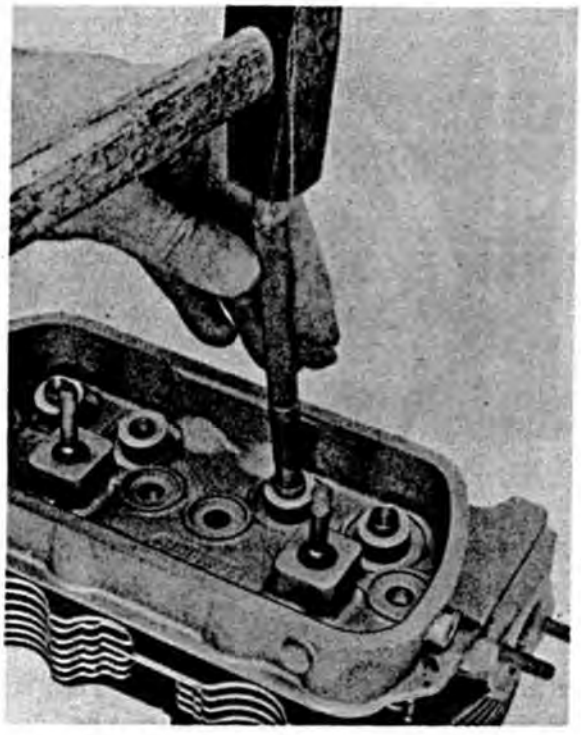
2. Fasten cylinder head with the combustion end facing the mounting plate.

3. Adjust inclination of mounting plate to 13°.

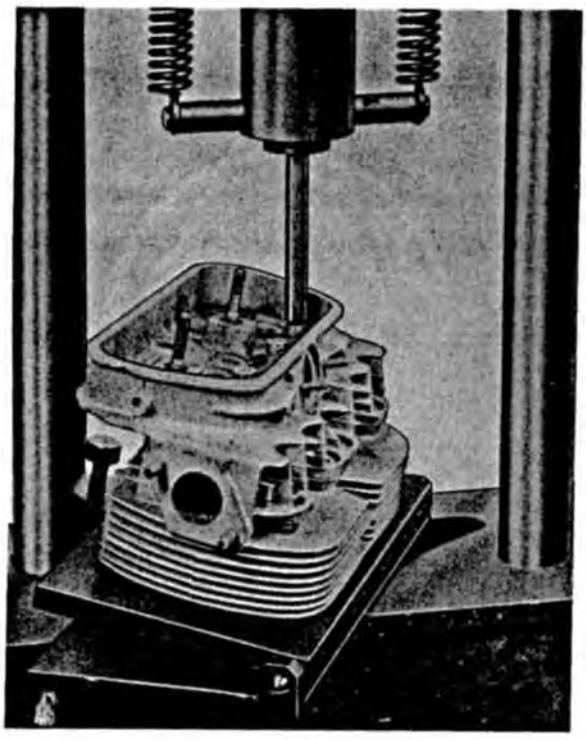
4. Drill out valve guides with a step drill to a depth of 40 - 50 mm (drill speed about 100 rpm).



5. Drive out drilled guides with a drift.



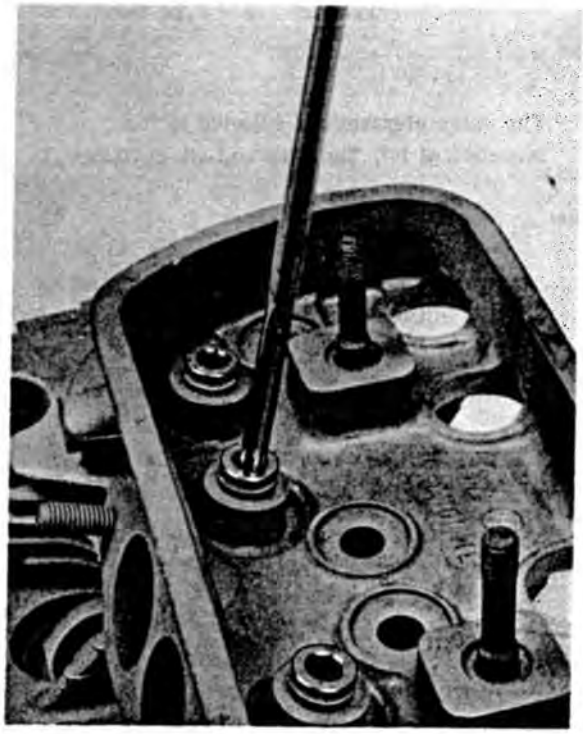
6. Coat 1st oversize valve guides with engine oil and install them with the aid of a press.



Caution

The pressure for installing should be between 1 and 2 tons.

7. Ream inside bores of valve guides. Always use a cutting solution while reaming.



8. Check dimensions of reamed valve guides.

9. Reface valve seats.

CHECKING AND ADJUSTING VALVE CLEARANCE

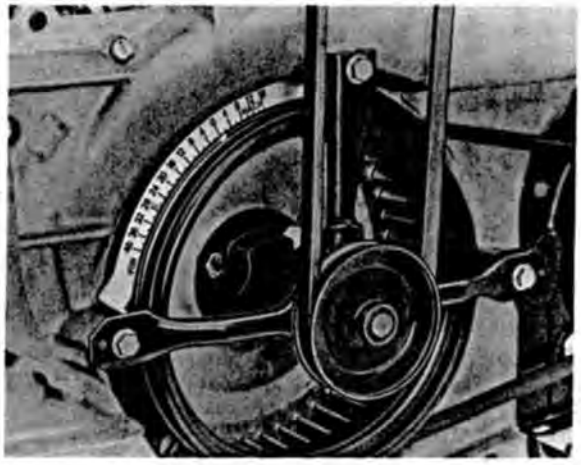
The valve clearance must always be checked and/or adjusted when the engine is cold.

Specifications: Intake = 0.15 mm
Exhaust = 0.20 mm

The valve clearance is adjusted in the sequence of 1st, 2nd, 3rd and 4th cylinders.

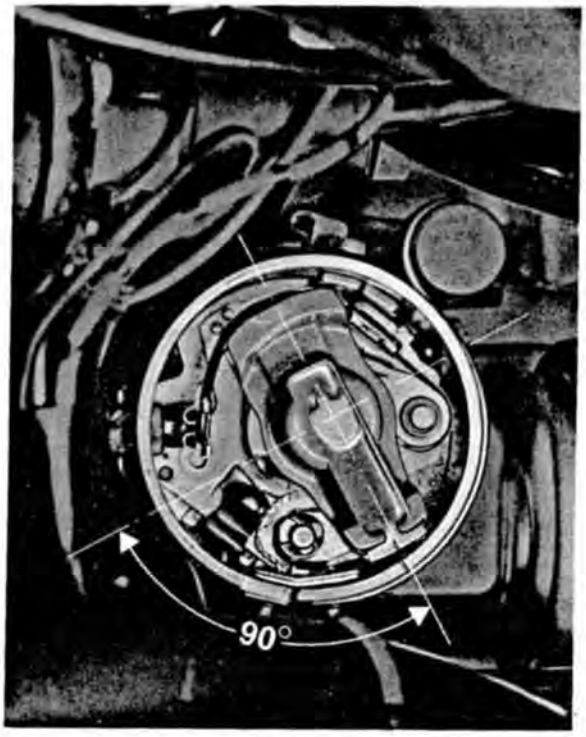
The piston of the cylinder in question must be at TDC of the compression cycle, because both valves are then closed.

1. Move cylinder 1 to TDC.

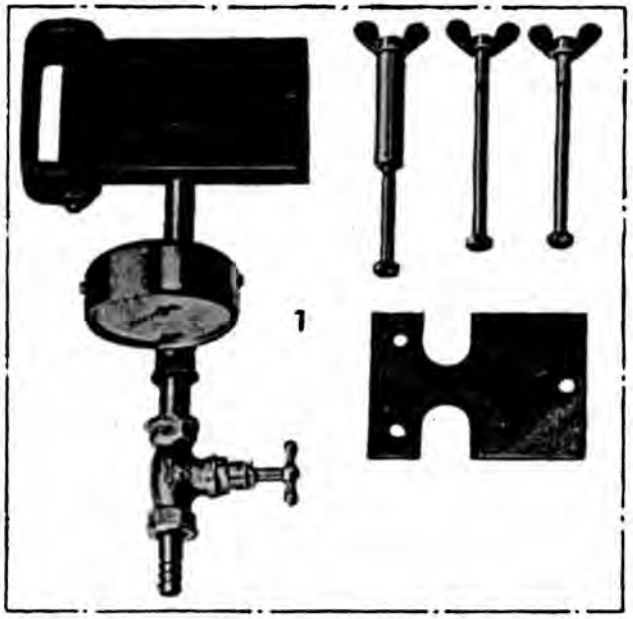


2. Check valve clearance with feeler gauge, adjusting to specifications if necessary.

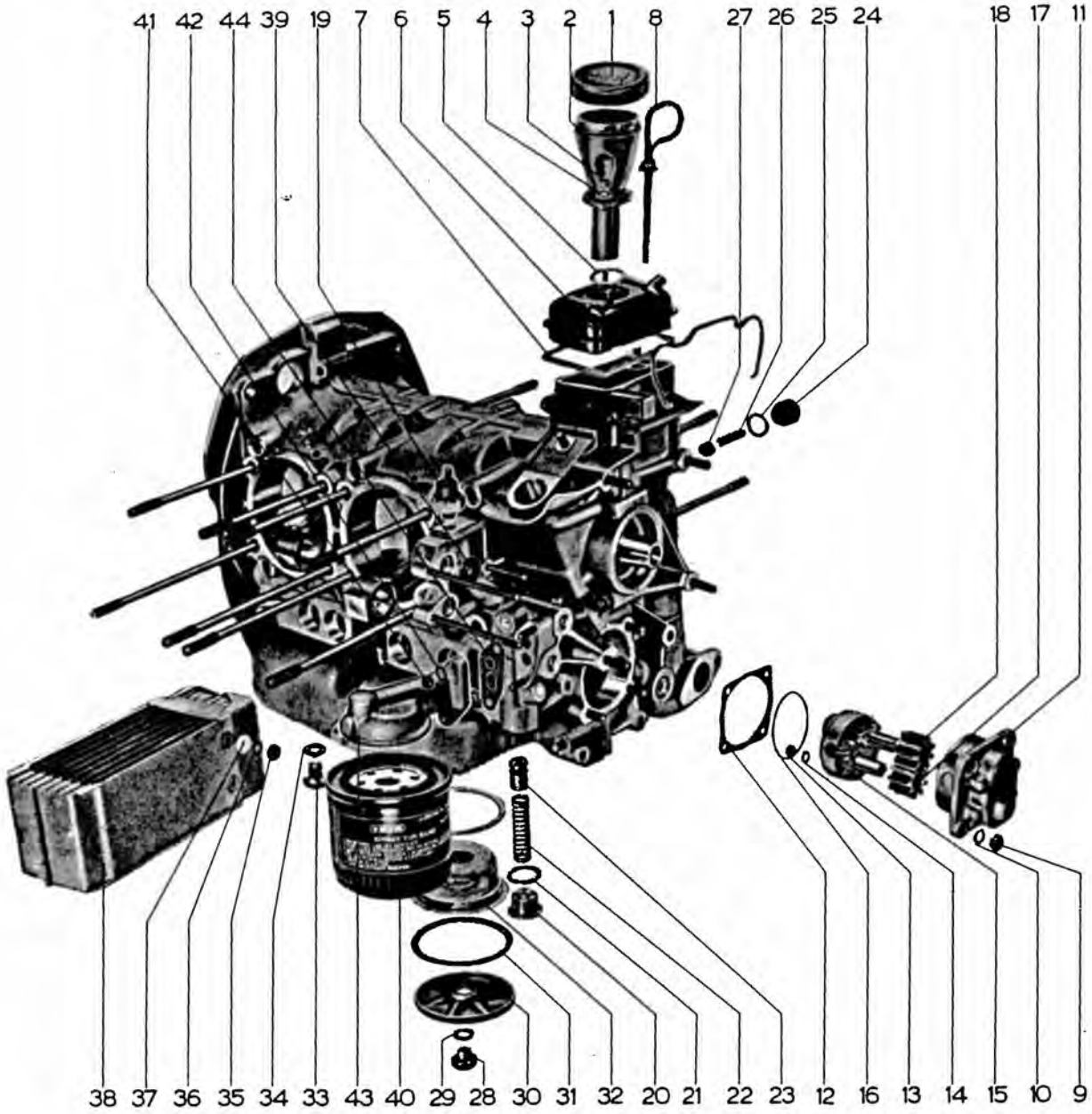
3. To adjust the valves of cylinders 2, 3 and 4, turn the crankshaft counterclockwise until the distributor rotor arm moves 90° each time.



TOOLS



No.	Description	Special Tool	Remarks
1	Oil cooler tester	VW 661/2	
2	Oil pump cover puller	VW 803	
3	Oil filter wrench	US 4462	or commercial item
4	Internal head socket, M 14	US 1007	or commercial item
5	Oil pressure and oil pressure switch test set	VW 662/2	
6	Oil pressure switch wrench		commercial item

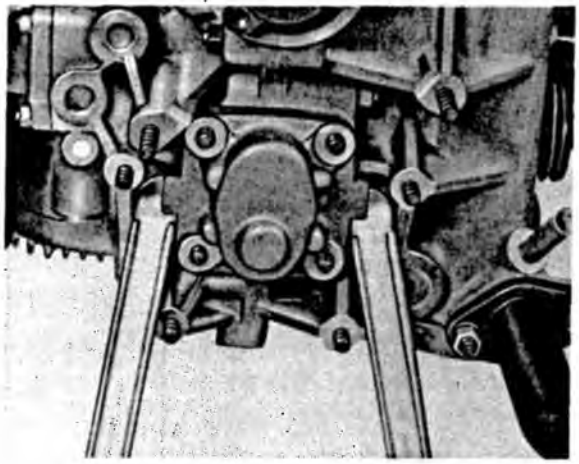


17 - 2 Oil Circuit - Exploded View

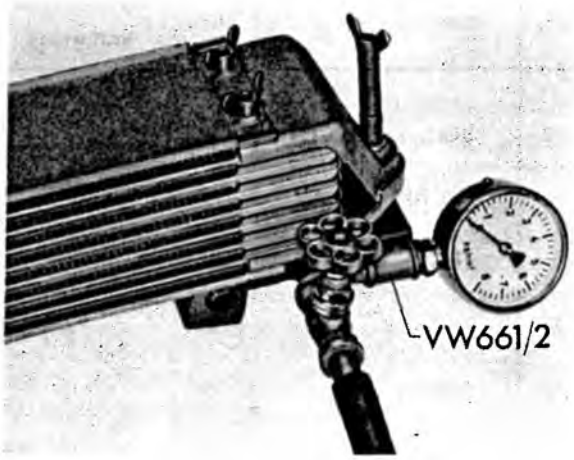
No.	Description	Qty.	Note when Removing	Note when Installing	Remarks
1	Oil filler cap	1			
2	Oil filler	1			
3	Nut M 6	2			
4	Washer	2			
5	Oil filler gasket	1		Replace	
6	Oil breather	1			
7	Gasket	1		Replace	
8	Oil dipstick	1			
9	Nut M 8	4		Torque to 19.6 Nm (2.0 mkg).	
10	Washer	4			
11	Oil pump housing	1	Check for wear. Use 2 levers. (especially gear bearing surface).	Clean gasket surface. Center by turning crankshaft twice. Tighten nuts.	See page 17 - 6
12	Gasket, oil pump housing	1		Replace.	
4	Nut M 6, self-locking				
14	Washer	4			
15	Oil pump cover	1	Use VW 803. Check for scoring.		See page 17 - 6
16	Seal, oil pump cover	1		Replace, Lubricate.	
17	Oil pump gear	1	Check for wear.	Lubricate. Check for free movement.	
18	Drive shaft	1	Check for wear.	Lubricate. Lug must be flush with slot in camshaft.	
19	Oil pressure switch	1			
20	Plug M 22 x 1.5	1			

No.	Description	Qty.	Note when Removing	Note when Installing	Remarks
21	Seal	1		Replace.	
22	Spring, oil pressure relief valve (bottom)	1		Check. Compressed spring length: 39.0mm. Load: 66.7-86.3 N (6.8 - 8.8 kg)	
23	Plunger, oil pressure relief valve	1	Check for wear.	Smooth scoring marks carefully. Use thread tap if necessary.	
24	Plug M 16 x 1.5	1	Use internal socket M 14.		
25	Seal	1		Replace.	
26	Spring, oil pressure relief valve (side)	1		Check. Compressed spring length: 16.8mm. Load: 42.7 N (4.35 kg).	
27	Plunger, oil pressure relief valve	1	Check for wear.	Smooth scoring marks carefully. Use thread tap if necessary.	
28	Nut M 8	1		Max. torque 12.7 Nm (1.3 mkg).	
29	Seal	1		Replace.	
30	Oil strainer cover	1		Gasket surface must be straight. Clean gasket surface.	
31	Gasket	2		Replace.	
32	Oil strainer	1		Clean. Check for damage.	
33	Plug	1		Torque to 21.6 Nm (2.2 mkg).	
34	Seal	1		Replace.	
35	Nut M 6	3			
36	Washer	3			
37	Washer	3			
38	Oil cooler	1	Check shrouding for tightness. Check for leaks with oil cooler tester VW 661/2. Test pressure 5.9 bar (6 atm). Check oil pressure relief valve, if cooler leaks.		See page 17 - 6

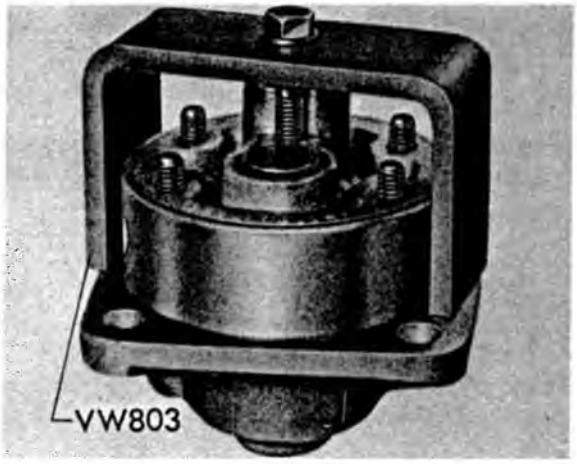
No.	Description	Qty.	Note when Removing	Note when Installing	Remarks
39	Seal, oil cooler	2		Replace	
40	Oil filter	1		Clean gasket surface and oil lightly. Tighten oil filter with wrench.	See page 17 - 6
41	Nut M 6	2			
42	Washer	2			
43	Flange, oil filter	1		Clean mating surface.	
44	Gasket	1		Replace	



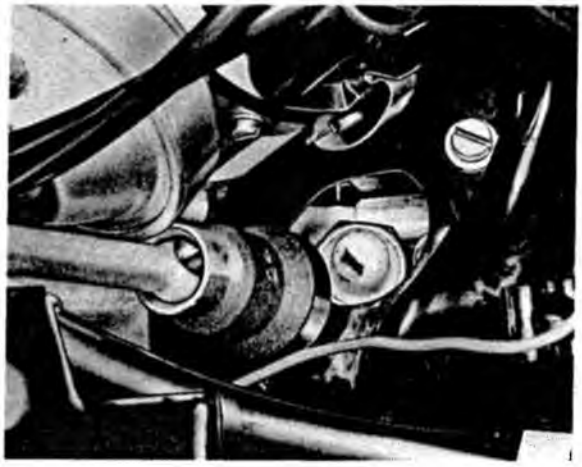
Oil pump housing, removing



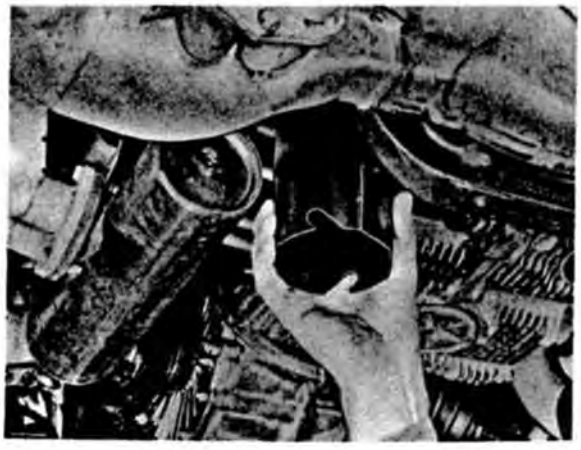
Oil cooler, checking for leaks



Oil pump cover, pulling off



Oil pressure switch, removing and installing

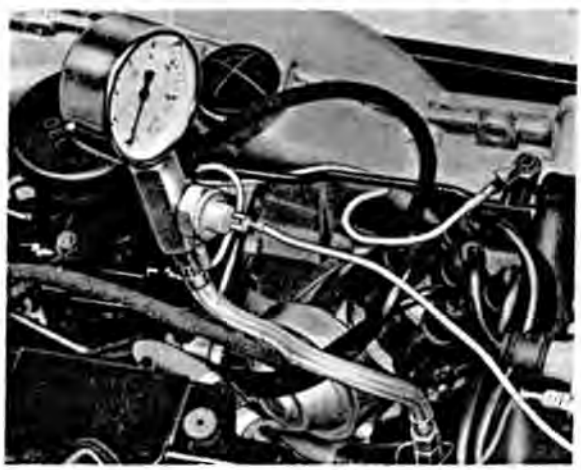


Oil filter, removing and installing

CHECKING OIL PRESSURE AND OIL PRESSURE SWITCH

1. Remove oil pressure switch and screw it into tester.

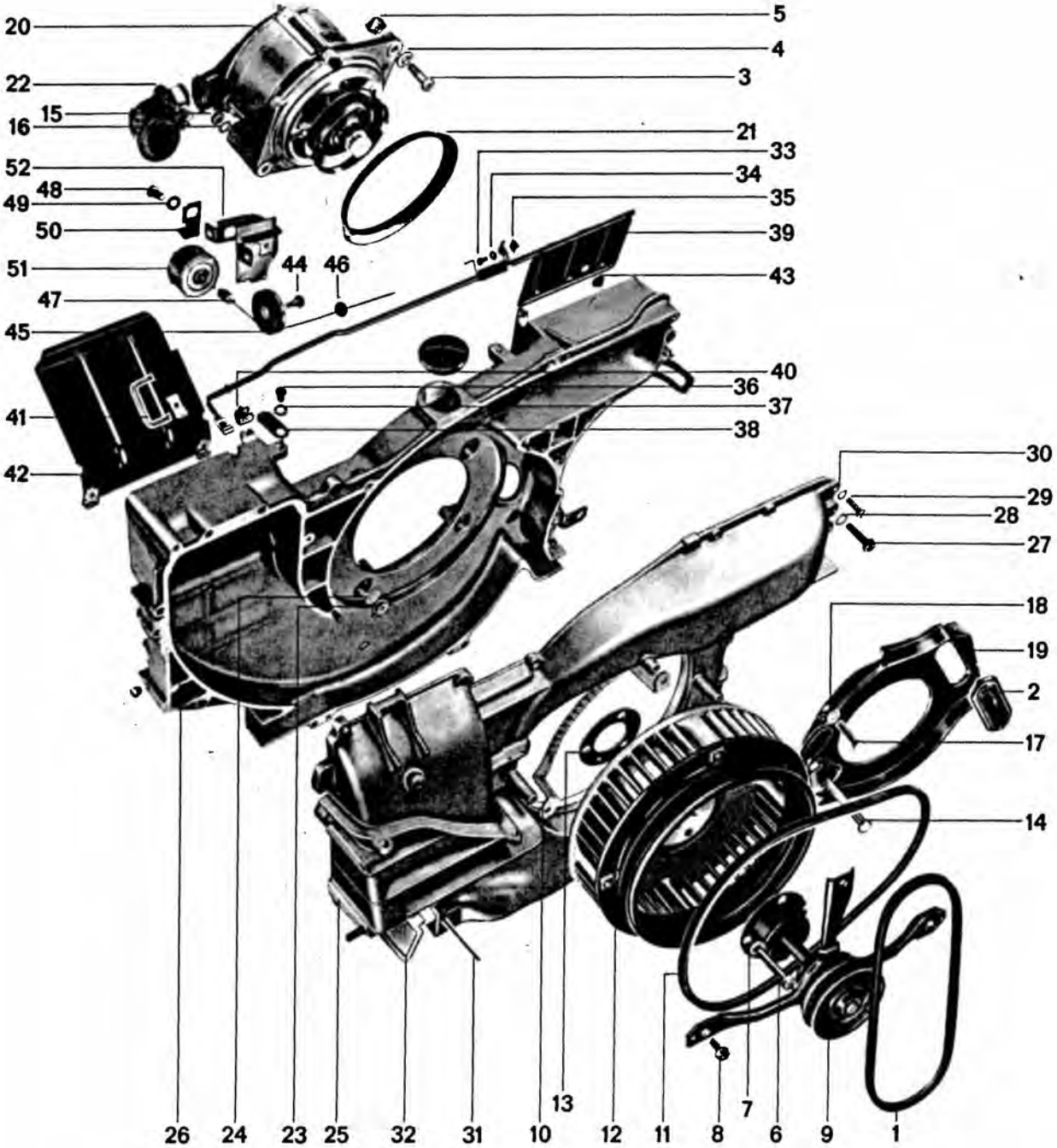
2. Install tester in crankcase in place of oil pressure switch. Connect test lamp to oil pressure switch and terminal 15 of ignition coil.



3. Turn on ignition.
   If test lamp does not light, replace switch.

4. Start engine. Increase speed slowly. Lamp must go out at pressure of 0.15 to 0.45 atm (2.1 to 6.4 psi).

5. Increase speed further.
   At 2000 rpm and 80 °C/176 °F oil temperature the oil pressure must be at least 2.0 atm (28 psi).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No.	Description	Qty.	Note when Removing	Note when Installing	Remarks
1	Belt, air pump	1	Check for wear. Replace if necessary.		
2	Cap, end cover	1			
3	Socket head screw	1		Loosen to adjust belt.	See page 19 - 5
4	Washer	1			
5	Square nut	1			
6	Bolt	3		Torque to 20 Nm (2.0 kpm).	
7	Washer	3			
8	Bolt	3			
9	Drive shaft with pulley	1			
10	Scale, ignition timing	1			
11	Belt	1	Check for wear. Replace if necessary.	Check tightness by applying heavy thumb pressure at middle of belt. Should deflect approx 15 mm.	
12	Fan	1			
13	Spacer	1			
14	Bolt	1			
15	Washer	1			
16	Nut	1			
17	Screw	1			
18	Washer	1			
19	Shroud, alternator	1			
20	Alternator	1			
21	Seal, alternator	1			

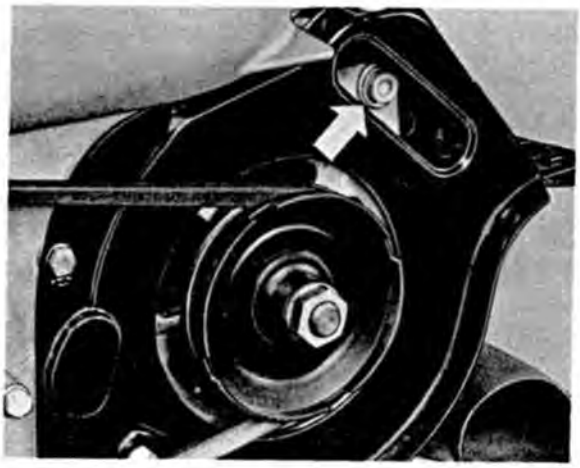
No.	Description	Qty.	Note when Removing	Note when Installing	Remarks
22	Adapter, alternator	1		Insert into front fan housing half.	
23	Nut	4		Torque to 20 Nm (2.0 kpm).	
24	Washer	4			
25	Fan housing half rear	1	Remove and install together.		
26	Fan housing half, front	1			
27	Bolt	3			
28	Washer	3			
29	Screw	7			
30	Washer	7			
31	Shaft	2			
32	Non-return air flap	2		Check for free movement.	
33	Bolt M 4 x 8	1			
34	Washer	1			
35	Square nut	1			
36	Screw	2			
37	Washer	2			
38	Support spring, shaft	2			
39	Control flap with shaft, right	1			
40	Support	2			
41	Bracket, control flap	1			
42	Control flap, left	1			
44	Bolt M 6	1			

No.	Description	Qty.	Note when Removing	Note when Installing	Remarks
45	Pulley, cooling air control cable	1			
46	Washer	1			
47	Cable, cooling air control	1	Detach before removing fan housing.		See page 19 - 6
48	Bolt	1			
49	Washer	1			
50	Washer, thermostat	1			
51	Thermostat	1		Test in water.	See page 19 - 6
52	Holder, thermostat	1			

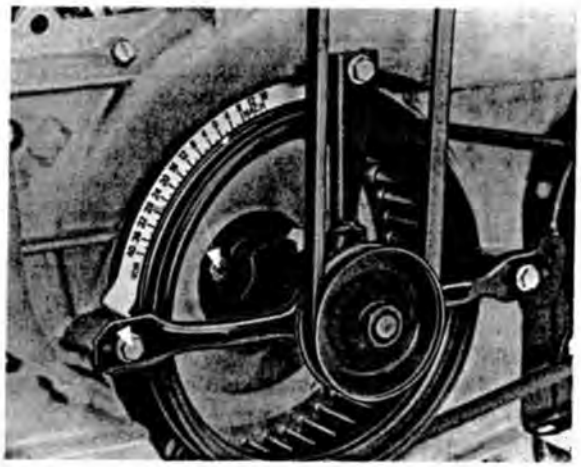
CHECKING AND ADJUSTING BELT TENSION

Check tightness of belt by applying considerable thumb pressure at center of belt.

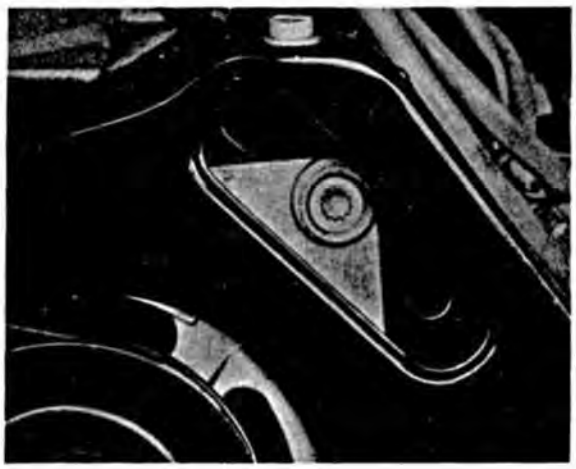
Deflection: ca. 15 mm



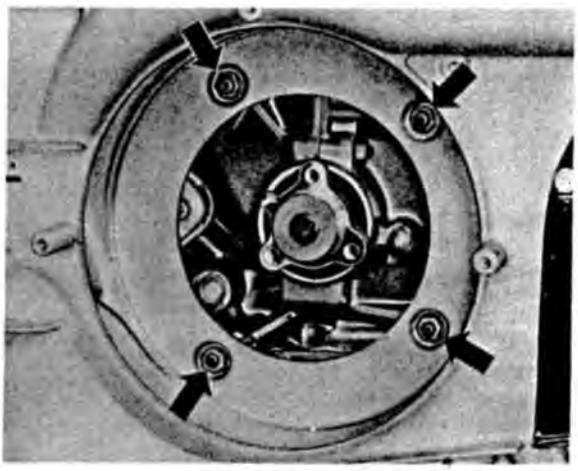
Socket head screw, loosening



Fan/pulley, removing and installing



Belt tension, adjusting

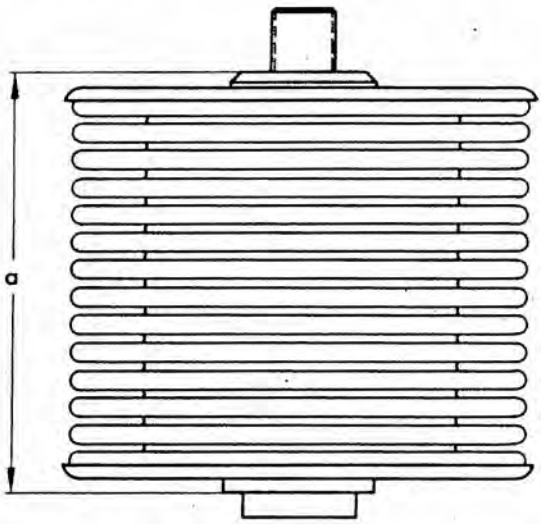


Fan housing, removing and installing

Detach the cooling air control cable before removing housing.

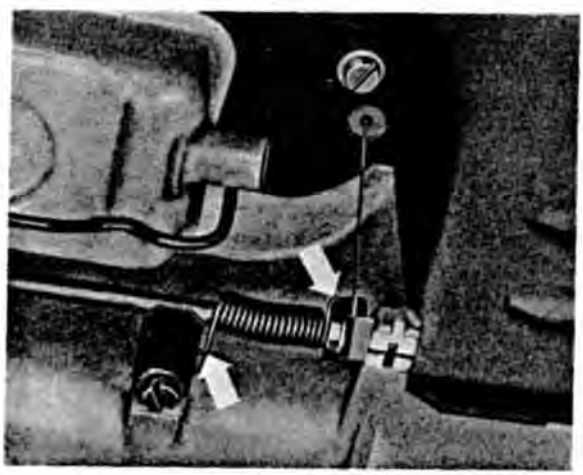
Note:
Both housing halves can be taken out together and without removal of the alternator.

CHECKING THERMOSTAT



Length "a" of the unit must be at least 46 mm when the water in which the thermostat is submerged has a temperature of 85 to 90 °C/ 185 to 194 °F.

ADJUSTING CONTROL FLAPS



The bent ends of the return spring must be located on the retaining spring boss and behind the cable guide (arrows).

Engine cold, ambient temperature ca. 20 °C/ 68 °F, press control flaps toward closed position and clamp the cable without tension.

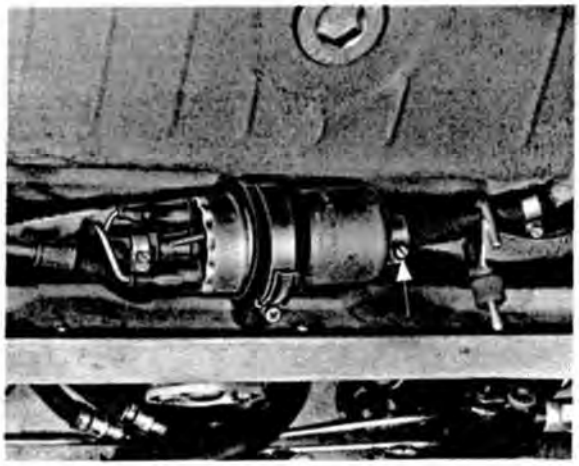
REMOVING AND INSTALLING FUEL PUMP

Removing

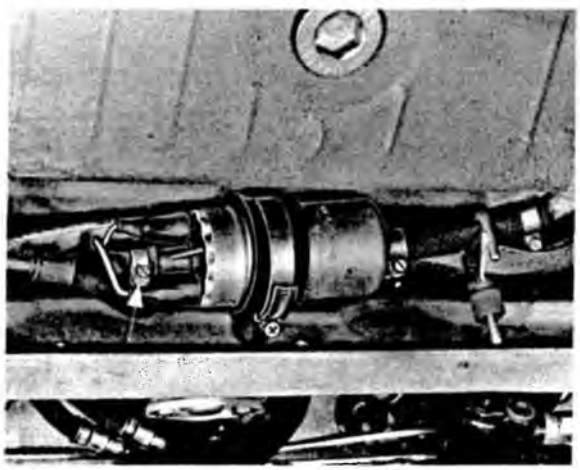
1. Disconnect battery ground strap.

2. Remove guard.

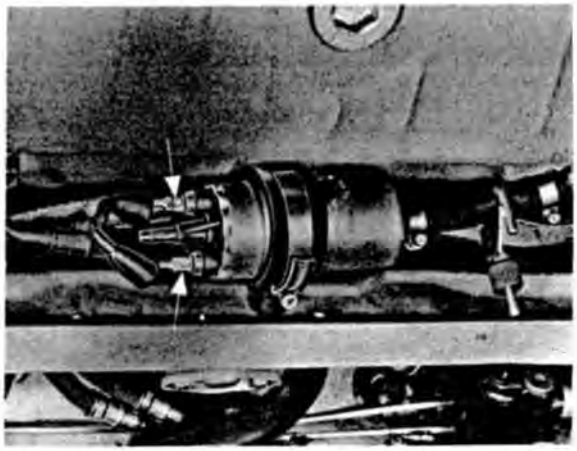
3. Pinch suction line with a commercial hose clip and loosen hose clamp.



4. Loosen pressure hose clamp and pull off hose. Catch escaping fuel.



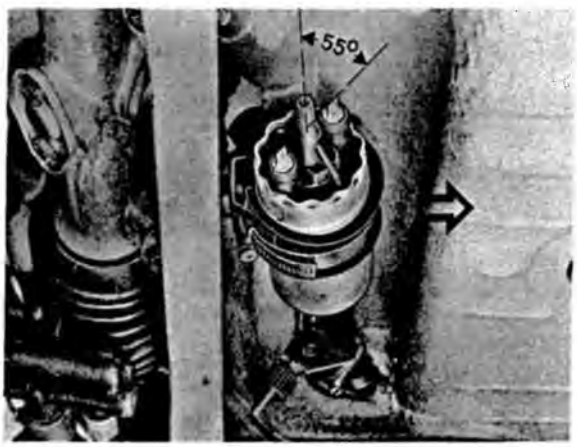
5. Remove rubber boots and detach electrical connections.



6. Loosen fuel pump strap and remove pump.

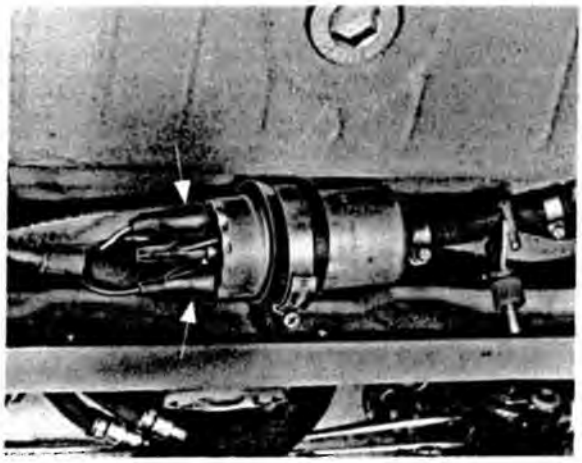
Installing

1. Slide fuel pump onto suction hose, place rubber band around pump and fasten pump with strap.
   Install pump with negative connection on top at an angle of about 55° toward front.



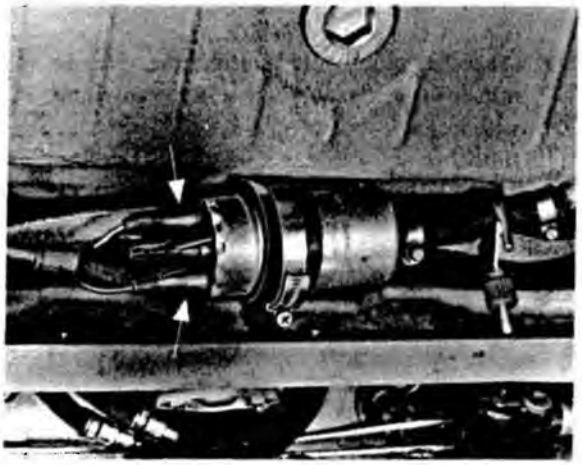
2. Tighten suction hose clamp.

3. Make electrical connections. Watch polarity marks.



4. Install rubber boots.

Note
Make sure that the boots fit properly to prevent corrosion on the terminals.



5. Connect pressure hose and hold tight with hose clamp.

6. Remove commercial hose clip.

7. Check hose connections for leaks.

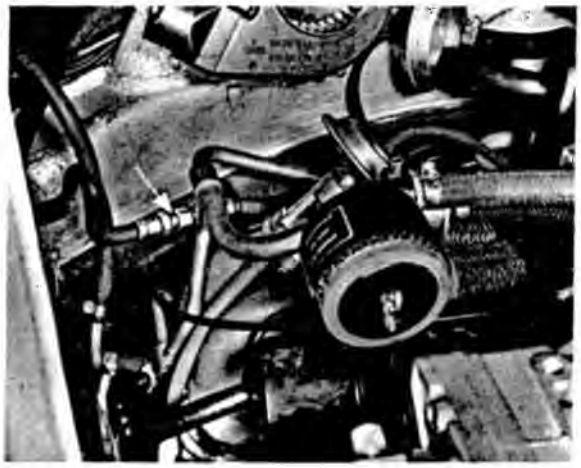
8. Install guard.

9. Connect battery ground strap.

CHECKING FUEL PUMP DELIVERY RATE

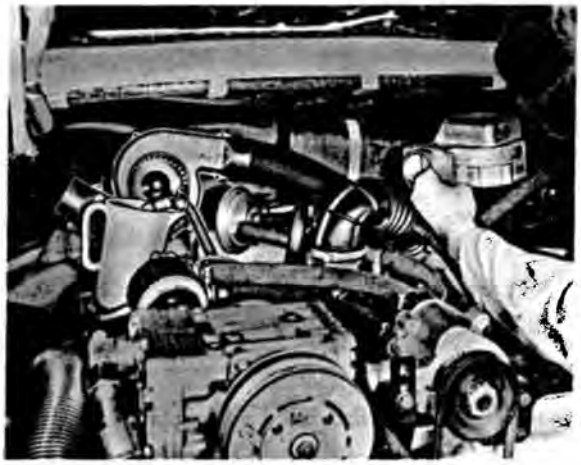
1. Loosen adapter hose clamp and pull adapter off of air volume control.

2. Detach fuel return line in engine compartment and loosen clamp.



3. Turn on ignition.

4. Hold end of fuel return line in a measuring glass (approx 1000 cc) and open flap by hand until the pump delivers fuel. Let fuel run into glass for 30 seconds.



5. Release flap after 30 seconds. Flap closed, pump contact breaks and pump stops delivering fuel.

6. The amount of fuel must be at least 500 cc.

Note
Check the fuel pump current draw if the amount of fuel does not meet specifications. Replace fuel pump if necessary.

Fuel Pump Test Specifications

The fuel pump delivery rate for testing is 500 cc at 30 seconds and 12 volt nominal.

Nominal voltage	=	12 V
Operating voltage	=	7 - 15 V
Current draw	=	Max. 4.5 A
Operating pressure	=	Max. 2.5 (35psi)

REMOVING AND INSTALLING FUEL FILTER

Removing

1. Disconnect battery ground strap.

2. Detach fuel hoses, pinching ends.

Warning:
Catch escaping fuel in an appropriate container.

3. Loosen clamp and remove filter.

Installing

1. Install filter so that the arrow on the filter faces in the direction of flow.

2. Fasten clamp and fuel hoses.

Caution!
Clamp must not be too tight to prevent damaging the filter.

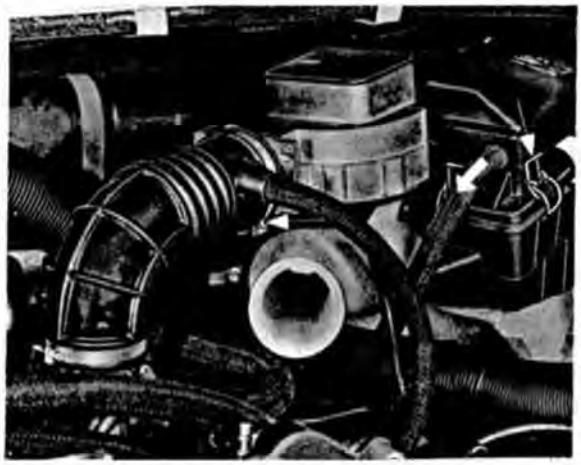
3. Connect battery ground strap. Let engine run briefly and check connections for leaks.

Effective (912 E)	Control Unit	Intake Air Sensor	Thermoswitch	Auxiliary Air Regulator	Temperature Sensor II	Throttle Valve Switch
August 75	923 618 101 00	923 606 111 00	923 605 101 00	022 906 045 A	022 906 041	022 906 111 D

REMOVING AND INSTALLING INTAKE AIR SENSOR WITH AIR CLEANER

Removing

1. Detach strap, breather hose and clips.



2. Disconnect electrical plugs.

3. Remove intake air sensor with top section of air cleaner.

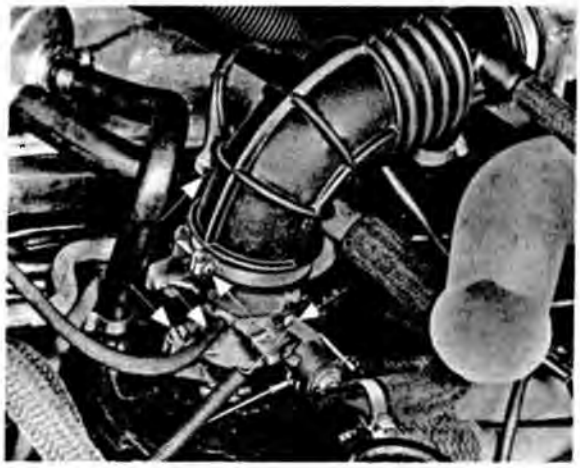
4. Loosen winged screw and remove air cleaner.

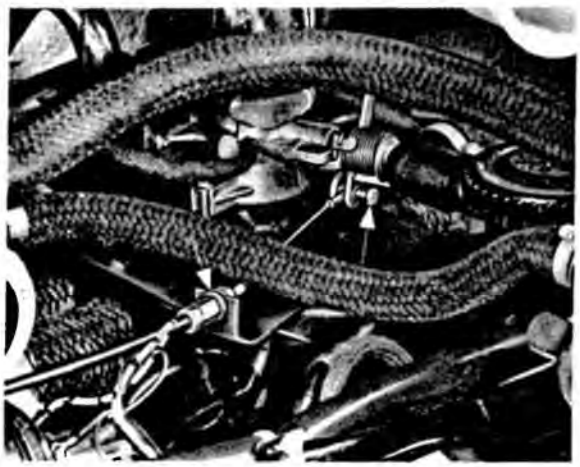
REMOVING AND INSTALLING THROTTLE VALVE HOUSING

Removing

1. Loosen and remove hose between intake air sensor and throttle valve housing.

2. Detach return spring, disconnect operating cable, pull off vacuum hoses, loosen mounting screws and remove throttle valve housing with gasket.





Installing

1. When installing make sure that the gasket is positioned correctly between air distributor and throttle valve housing. Screws must not be too tight.

2. Engage long end of return spring on throttle valve housing.

REMOVING AND INSTALLING THROTTLE VALVE SWITCH

1. Remove throttle valve housing.

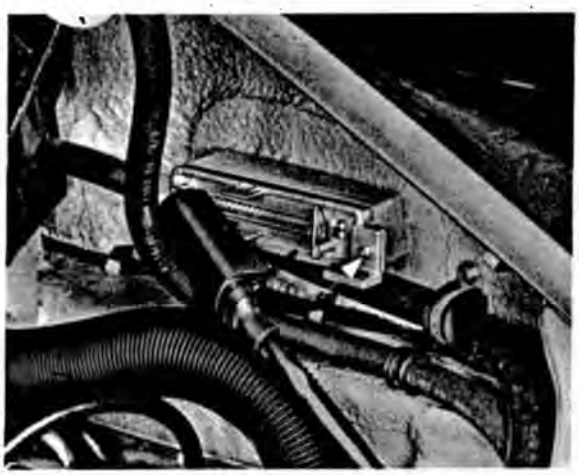
2. Loosen screws and remove throttle valve switch.

REMOVING AND INSTALLING CONTROL UNIT

Removing

1. Disconnect plug at control unit by pushing back spring and pulling out of socket at the same time.

2. Loosen screws and remove control unit.



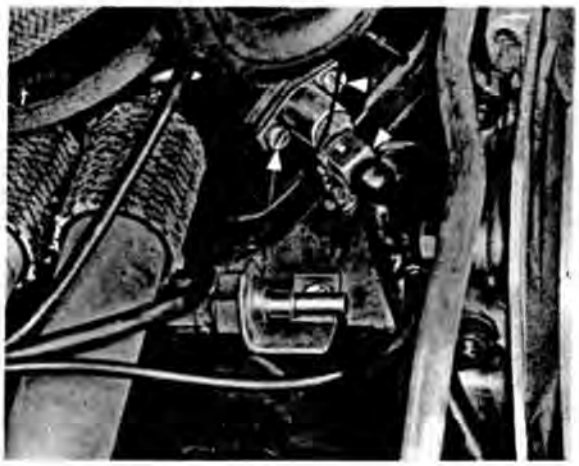
Installing

Connect plug at control unit and press into socket until the spring clip engages with an audible click.

REMOVING AND INSTALLING COLD STARTING VALVE

Removing

Disconnect electrical plug and fuel lines, loosen screws and remove cold starting valve with gasket.



Installing

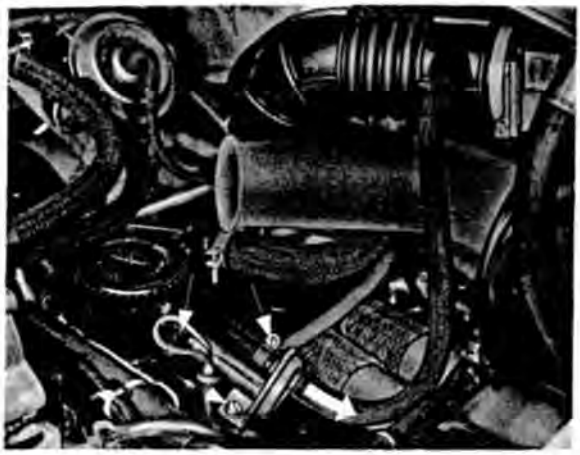
1. Install new gasket.

2. Make electrical connection (blue plug).

REMOVING AND INSTALLING AUXILIARY AIR REGULATOR

Removing

Disconnect hoses and electrical connection, loosen mounting screws and remove auxiliary air regulator.



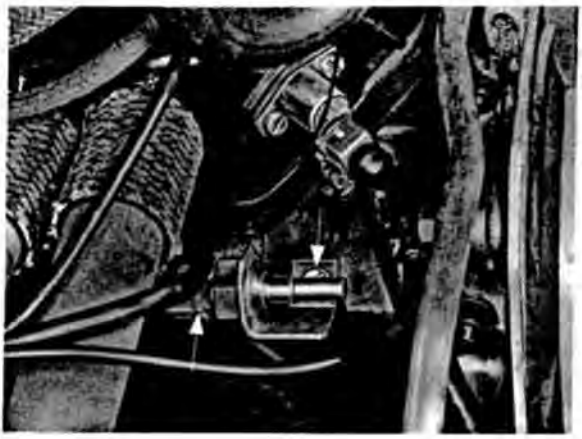
Installing

Make electrical connection (black plug).

REMOVING AND INSTALLING THERMO TIME SWITCH

Removing

Disconnect electrical connection, loosen mounting screw and remove thermo time switch.



Installing

Make electrical connection (brown plug).

REMOVING AND INSTALLING TEMPERATURE SENSOR II

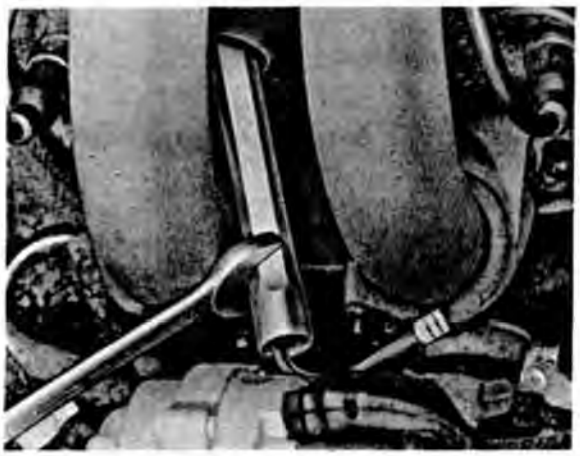
Temperature sensor II is screwed in the cylinder head next to the spark plug for the 3rd cylinder.

Removing

1. Detach line between temperature sensor and wire connector.

2. Remove rubber cover and pull off over connecting wire.

3. Unscrew temperature sensor with aid of socket. US 1054.



Installing

1. Screw in temperature sensor.

   Caution!
   Not too tight.

2. Install rubber cover in proper position.

REMOVING AND INSTALLING PRESSURE REGULATOR

Removing

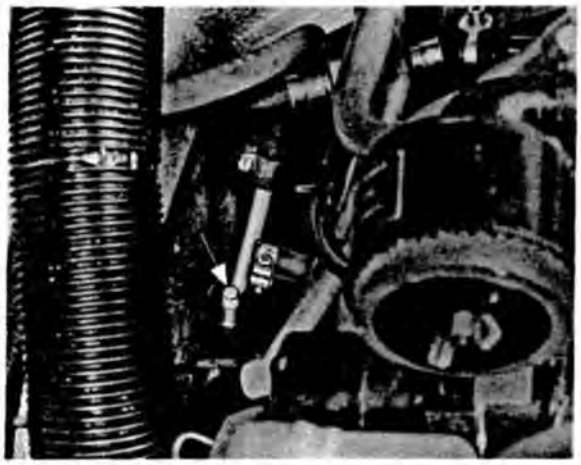
Disconnect fuel hoses and vacuum hose, loosen mounting nuts and take pressure regulator out of holder.

Caution!

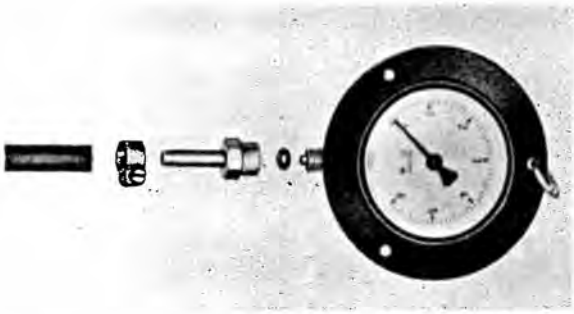
Be careful not to bend holder when loosening or tightening mounting nuts.

CHECKING FUEL PRESSURE

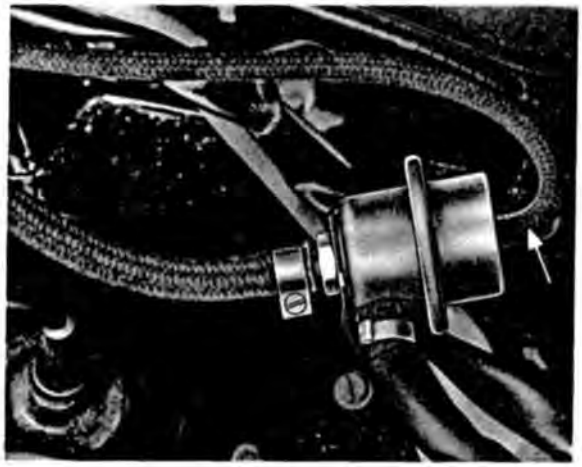
1. Loosen injector supply line plug.



2. Connect the pressure gauge of P 378 with an appropriate adapter or a similar pressure gauge (rated 1, 0) to the injector supply line.



3. Disconnect vacuum hose between air distributor and pressure regulator.



4. Detach hose between throttle housing and intake air sensor at intake air sensor.

5. Turn on ignition.

6. Open stator flap by hand a little until the pump contact makes and then read the fuel pressure at the same time.

Specifications: 2.5 $\pm$ 0.2 atm/35 $\pm$ 1.4 psi
with vacuum hose disconnected.

Replace pressure regulator if specifications are not met.

7. Replace injector supply line plug.

CHECKING INTAKE AIR SENSOR

1. Pull plugs off of intake air sensor.

2. Connect ohmmeter to terminals 6 and 9.
   Specifications: 200 to 400 ohm.

3. Connect ohmmeter to terminals 7 and 8.
   Specifications: 120 to 200 ohm.

4. Connect ohmmeter to terminals 6 and 27 (temperature sensor I).
   Specifications: approx. 2000 ohms at room temperature.

5. Connect ohmmeter to terminals 36 and 39 (fuel pump contacts). When stator flap is moved by hand (pump contacts close), ohmmeter needle should move.

Replace the intake air sensor if specifications are not met.

CHECKING THROTTLE VALVE SWITCH

1. Pull plugs off of throttle valve switch.

2. Connect ohmmeter to terminals 18 and 3.
   Throttle valve closed: continuity
   Throttle valve open: continuity

3. Connect ohmmeter to terminals 18 and 2.
   Throttle valve closed: continuity
   Throttle valve open: no continuity

CHECKING AUXILIARY AIR REGULATOR

1. Remove auxiliary air regulator.

2. Connect ohmmeter to both terminals of auxiliary air regulator and read meter.
   Specifications: approx. 30 ohm.

Replace regulator if necessary.

3. Blow in air.
   Regulator must be open if engine is cold.

4. Connect battery to both terminals of removed auxiliary air regulator. As the heat increases, the opening in the auxiliary air regulator must become smaller.

CHECKING THERMO TIME SWITCH

1. Pull plug off of cold start valve.

2. Connect ohmmeter between both contacts of plug.

3. Both contacts must be connected with each other at an engine temperature less than approx + 35°C/95°F.

4. Above approx + 35°C/95°F the ohmmeter must indicate interruption.

Replace valve if necessary.

CHECKING COLD START VALVE

1. Connect pressure gauge to injector supply line.

2. Disconnect wire from terminal 1 of ignition coil. Operate starter briefly to build up fuel pressure.

3. Pull plug off of cold start valve.

4. Connect B+ and ground to cold star valve.

5. Watch pressure gauge - pressure must drop slowly.

   Replace valve if necessary.

CHECKING COLD START VALVE FOR LEAKS

1. Pull plug off of cold start valve.

2. Take cold start valve off of air distributor, but leave it connected to the injector supply line.

3. Pull wire off of terminal 1 of ignition coil.

4. Operate starter, observing cold start valve for leaks.

   Replace valve if necessary.

CHECKING TEMPERATURE SENSOR II

1. Disconnect plug.

2. Connect ohmmeter between temperature sensor and ground and read meter.

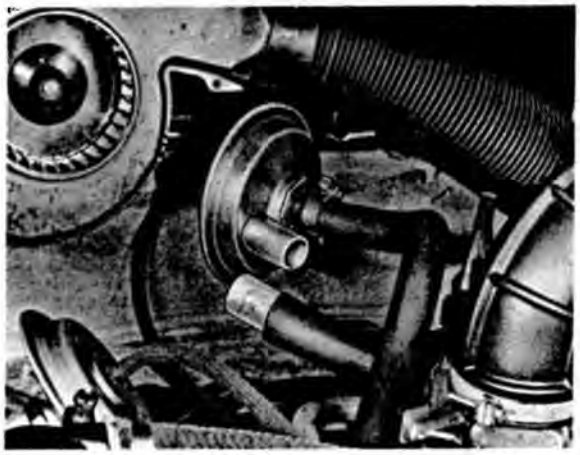
Specifications: 0.5 to 2.5 kohm (dependent on temperature, higher temperatures = less ohm).

Reference value: approx 2.5 kohm at approx 20°C/68°F engine temperature.

Replace sensor if necessary.

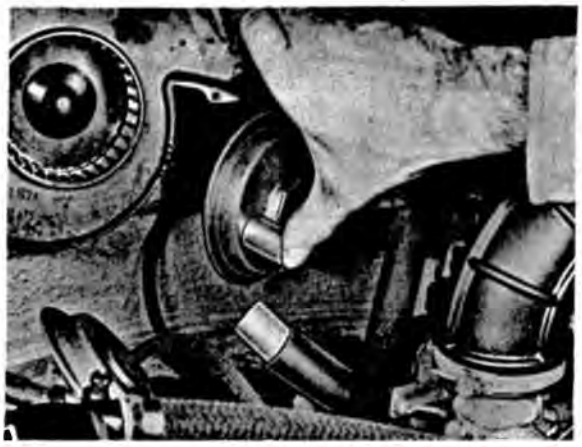
CHECKING OPERATION OF ANTI - BACKFIRE VALVE

1. Disconnect hose between valve and intake air sensor adapter at valve and insert a plug in open end of hose.



2. Start engine. Increase speed briefly to 3000 rpm. Close throttle valve suddenly.

3. Check if air is being sucked in through valve hose connection. Replace valve if suction cannot be felt.

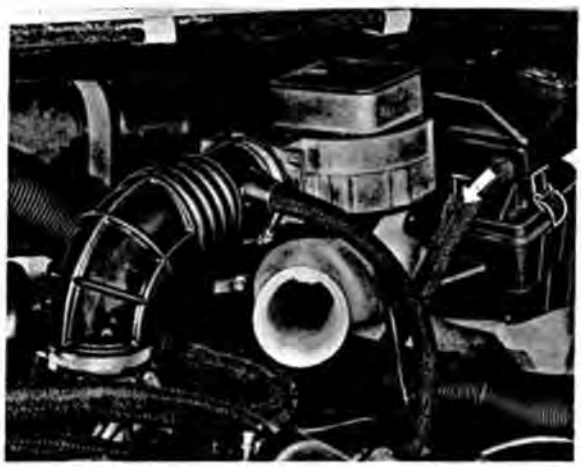


ADJUSTING IDLE

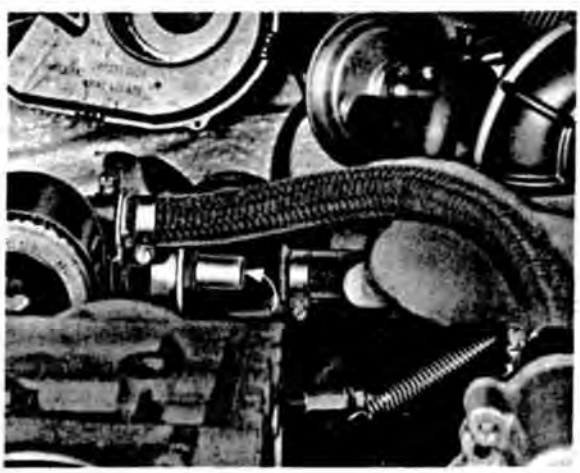
1. Run engine to operating temperature (50 - 70°C/122-158°F).

2. Connect CO tester according to instructions of manufacturer. Use separate tachometers from tester or similar.

3. Disconnect activated charcoal filter hose at air cleaner.



4. Take air injection hose off of check valve and insert an appropriate plug in the check valve opening to give a tight seal.



5. Let engine run at idle and adjust the idle speed on the control screw or bypass screw on the throttle housing to specifications - 925 ± 50 rpm.

6. Measure CO, adjusting if necessary by taking the plug out of the intake air sensor and changing the CO with the adjusting screw. Turning clockwise enriches mixture; counterclockwise leans mixture.
CO Specifications: 0.5 to 1.2 %.

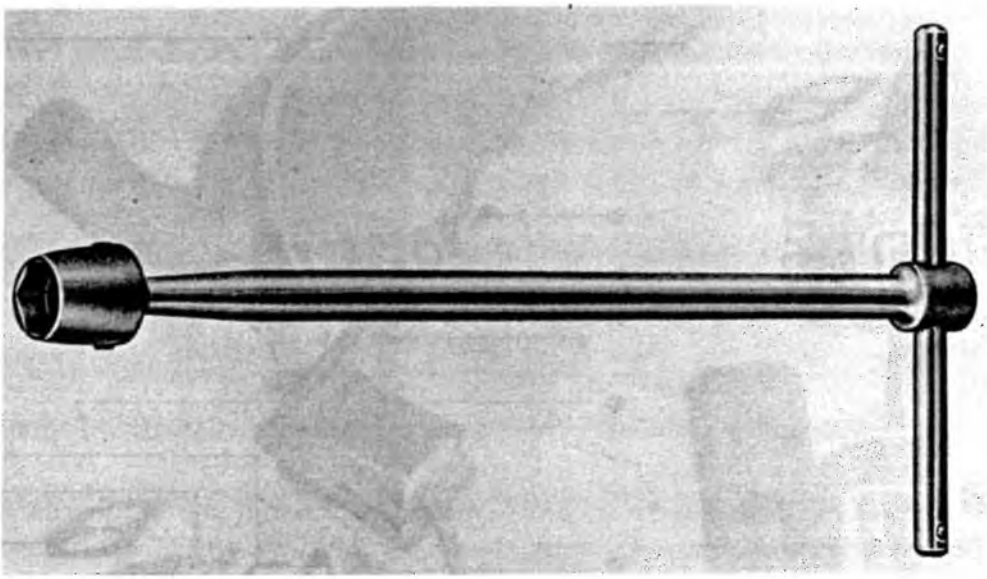
7. Recheck idle speed and correct if necessary.

8. Install plug after adjustments.

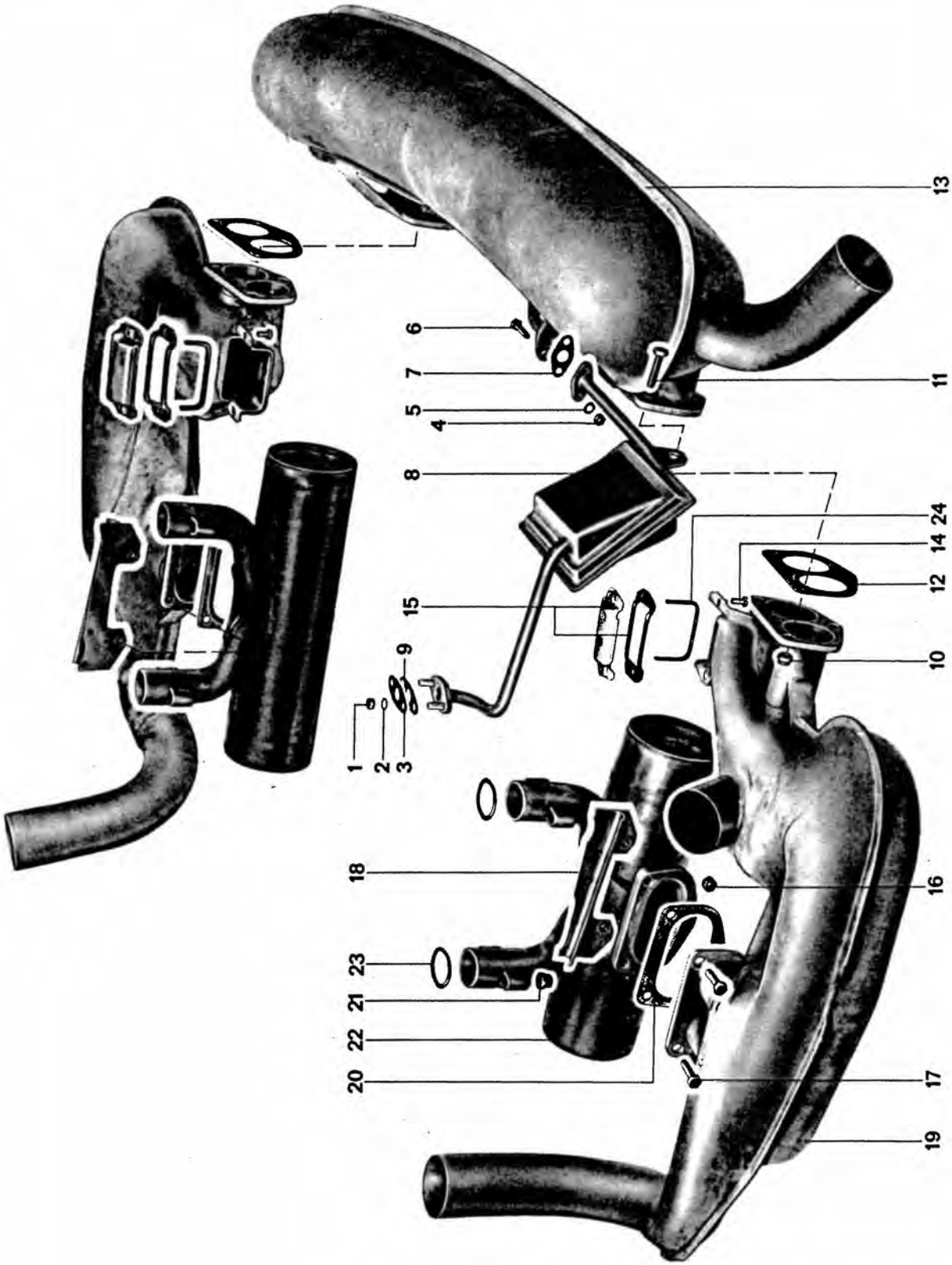
Caution

Make adjustments as quickly as possible to prevent excessive heat in intake lines.

TOOLS



No.	Description	Special Tool	Remarks
1	Universal joint socket wrench 13 mm	P 120 b	


13
6
7
11
5
4
8
24
14
12
15
10
9
1
2
3
18
16
23
21
22
20
17
19

No.	Description	Qty.	Note when Removing	Note when Installing	Remarks
1	Nut	2			
2	Washer	2			
3	Gasket	1		Replace	
4	Nut	2			
5	Washer	2			
6	Bolt	2			
7	Gasket	1		Replace	
8	Exhaust gas filter	1			
9	Gasket	1		Replace	
10	Thermag nut	6		Replace	
11	Bolt	6			
12	Gasket	2		Replace	
13	Muffler	1			
14	Screw	4			
15	Cover with gasket	2		Install correctly.	
16	Thermag nut	2		Replace	
17	Bolt	6			
18	Holder, right and left	2		Replace Install correctly.	
19	Heat exchanger	2			
20	Gasket	2		Replace	
21	Mid grip nut	4		Replace. Coat threads with dry MoS_2. Torque crosswise and evenly to 22 Nm (2.2 kpm).	See page 26 - 4
22	Reactor	2	Mark for reinstallation.	Check parallelism of sealing flange. Smooth flange if necessary.	
24	Gasket	2		Replace.	

INSTALLATION NOTES

Tighten reactor mounting nuts crosswise and evenly. Keep to torque specifications.

CHECKING REACTOR FOR LEAKS

Note

The reactor's operation need not be checked. Only check it for leaks.

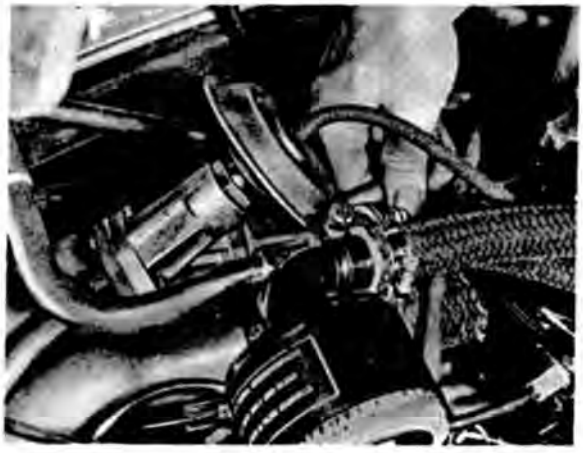
1. Run engine at idle speed.

2. Insert an appropriate plug in the muffler's outlet pipe and check reactor by listening for leaks.
   Replace a reactor which leaks.

CHECKING EXHAUST GAS RECIRCULATION

1. Warm-up engine and then let it run at idle speed. The bypass line between the muffler and EGR valve will be hot, which is necessary to check operation.

2. Increase engine speed to 4000 rpm. Now the exhaust line between the EGR valve and the intake must be hot, too.



If the exhaust line leading to the intake is not hot, the following problems could be causing this.

a) EGR valve defective
b) EGR lines plugged
c) Vacuum bore in throttle housing plugged
d) Vacuum hose plugged or leaks
e) Exhaust filter between muffler and EGR valve contaminated

REMOVING AND INSTALLING EXHAUST GAS RECIRCULATION (EGR) VALVE

Removing

1. Pull off vacuum hose.

2. Remove mounting screws.

3. Take out valve.

Installing

Use new gaskets.

EQUIPMENT CHARTS

Ignition Coil

Type/Model	Version	Remarks
912 E	022 905 115 C	

Distributor

Type/Model	Version	Remarks
912 E	923 602 021 00 (without speed limiter)	Centrifugal and single action vacuum control (retarded)

Spark Plugs

Type/Model	Version *)	Remarks
912 E	Bosch W 175 M 30 Beru 175/14/3 L	M 14 x 1.25 x 19.0 threads 0.7 mm gap

*) Or other spark plugs with the same heat range from other manufacturers as approved by VW.

ADJUSTING IGNITION TIMING

Check the dwell angle before adjusting the ignition timing and, if necessary, correct it to 47 ± 3°.

1. Connect engine to engine tester.

2. The timing is adjusted on a warm engine (oil temperature approx. 60°C/140°F) with a stroboscopic timing light. Pull off vacuum hose at either distributor or throttle housing.

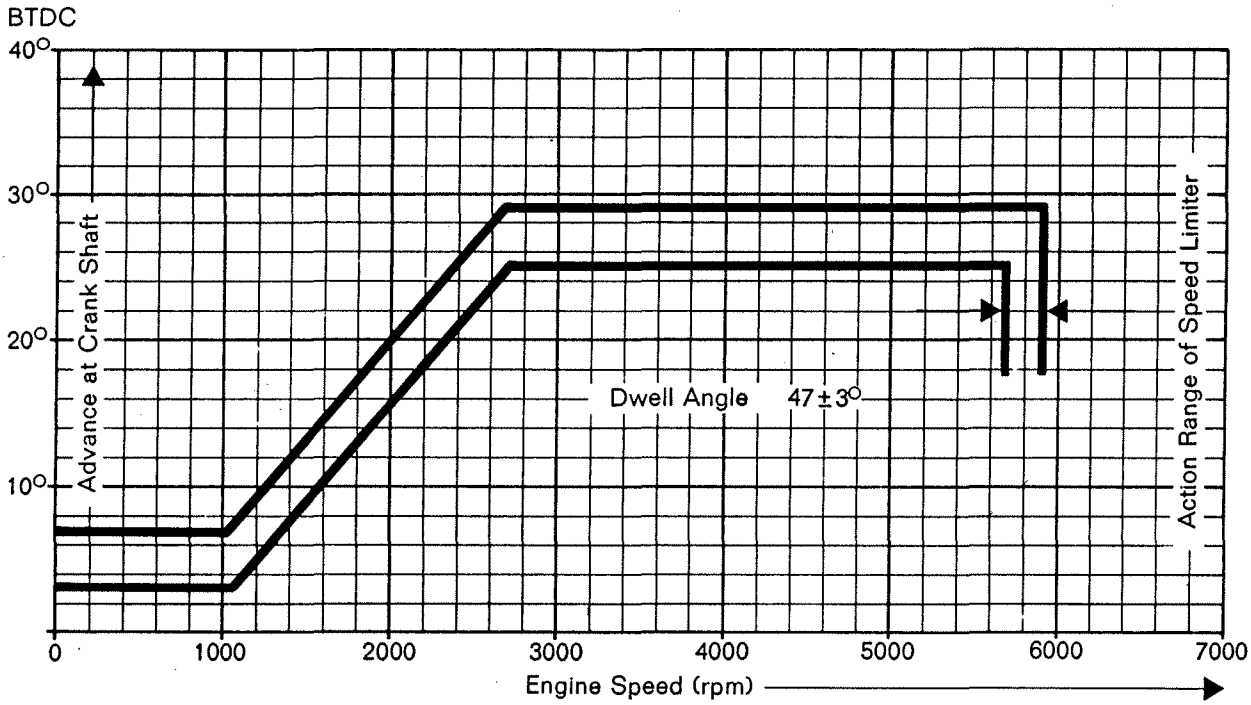
3. At an engine speed of approx. 3500 rpm the white mark on the fan must appear to stop at 27°. To alter the ignition timing loosen the nut on the distributor and turn the distributor.

CHECKING IGNITION TIMING CONTROL IN VEHICLE

1. Adjust ignition timing according to instructions.

2. Disconnect vacuum hose and read ignition angle at 1000 rpm, 2000 rpm and 3000 rpm, and compare with timing curve. The measurements must be within both lines.

Ignition Advance Curve for Distributor — Bosch 0231176060

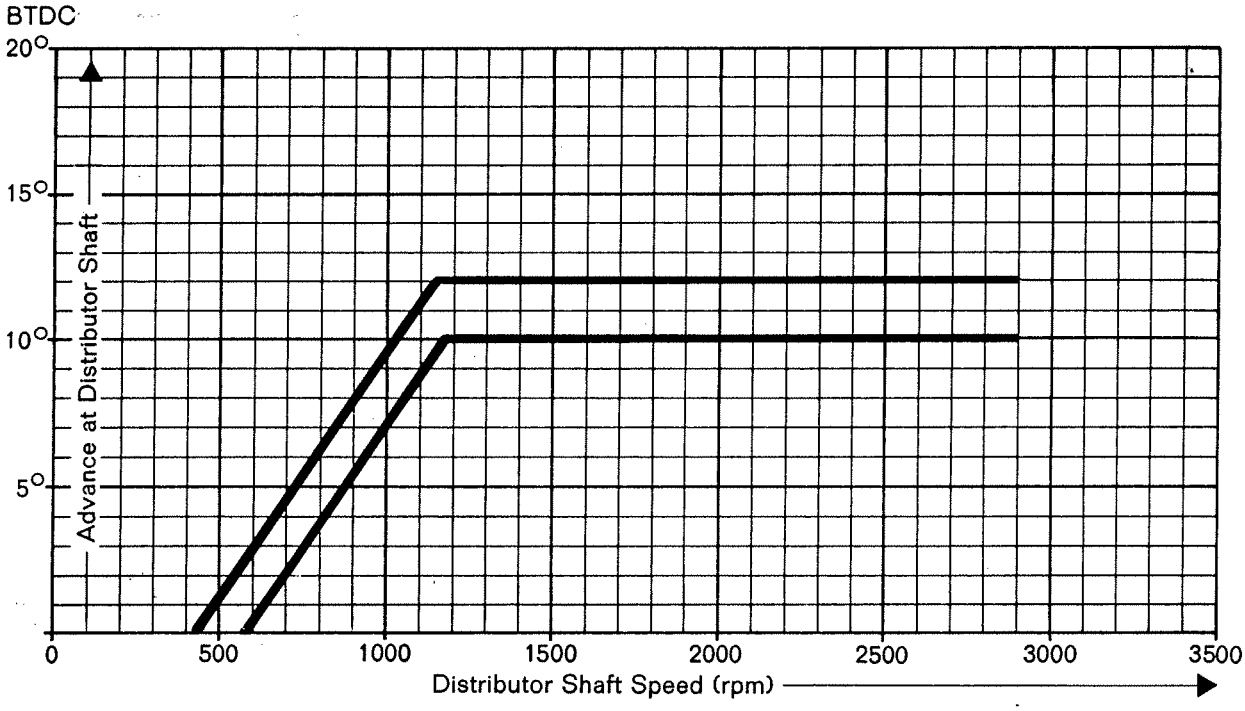


3. Connect vacuum hose for idle speed. The ignition timing must then move about 10° on the crankshaft toward retarded ignition. Use a stroboscopic timing light with a meter for checking timing advance.

CHECKING DISTRIBUTOR IGNITION CURVES ON DISTRIBUTOR TEST STAND

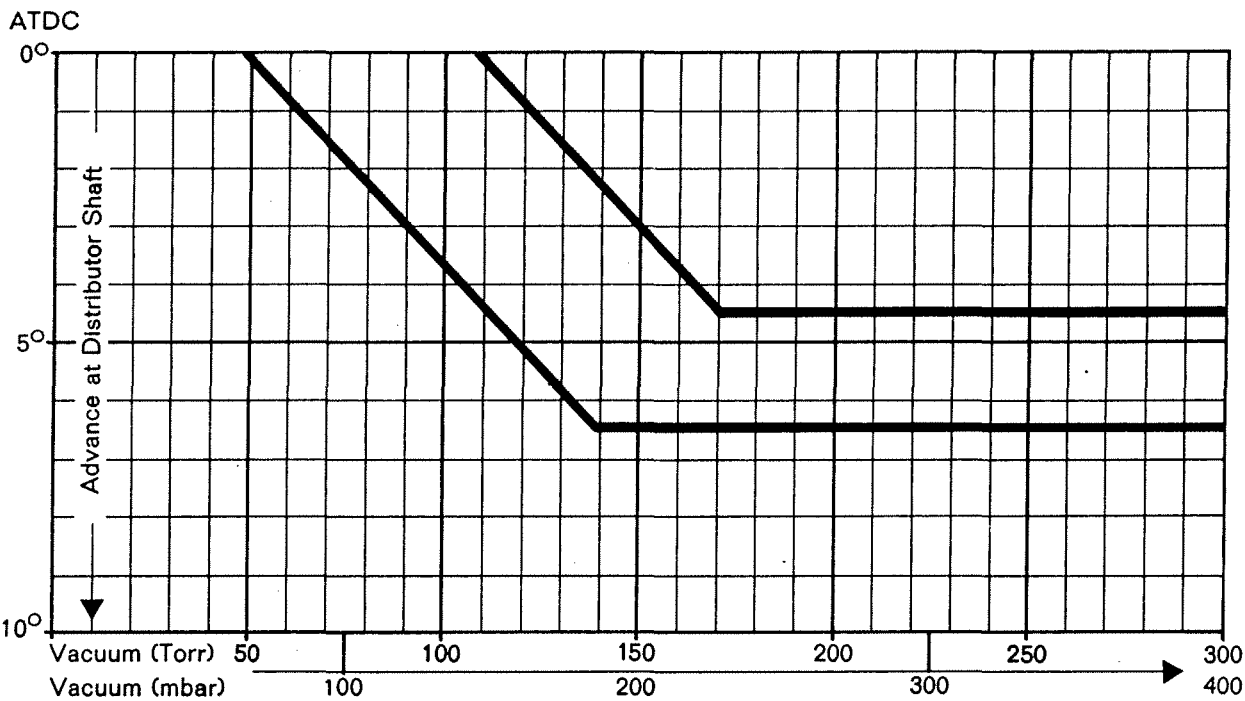
Read ignition angles at various speeds and vacuum values, and compare data with ignition curves. The measurements must be within both lines.

Centrifugal Advance Curve for Distributor — Bosch 0 231 176 060



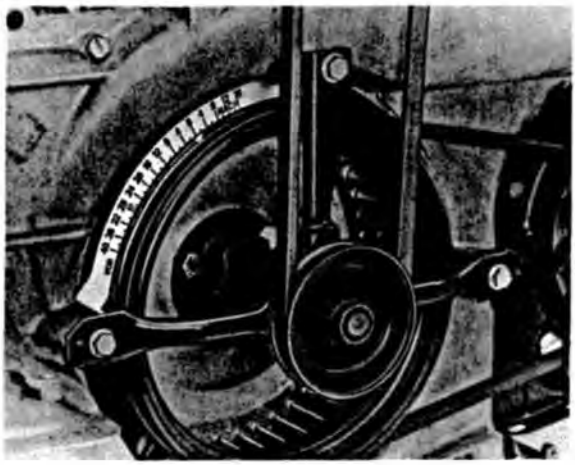
Vacuum Advance Curve for Distributor

Bosch 0231176060



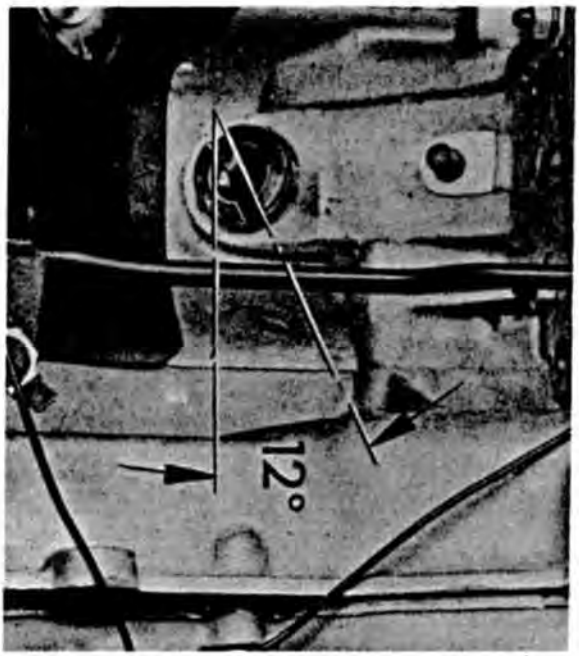
INSTALLING DISTRIBUTOR

1. Move cylinder 1 to TDC.
   The white mark on the fan must be opposite the 0^{o} mark on the timing angle scale.



2. Install distributor so that the distributor rotor faces cylinder 1 mark on the distributor housing.

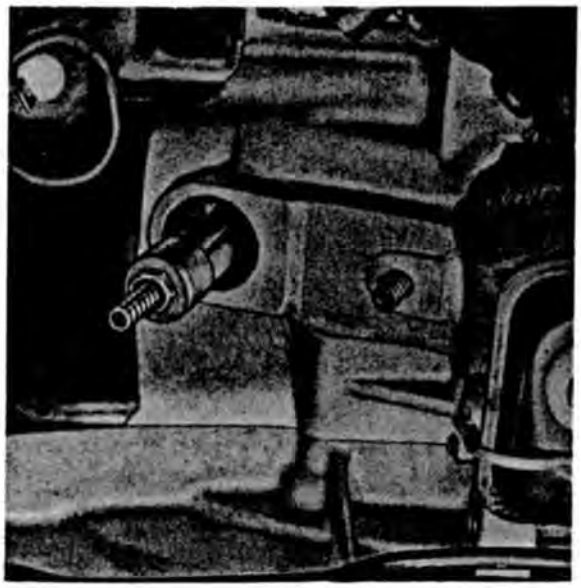
Offset slot in top end of distributor drive shaft should be at an angle of approx. 12^{o} to longitudinal axis of engine. Larger slot segment faces inward.



3. Insert distributor.

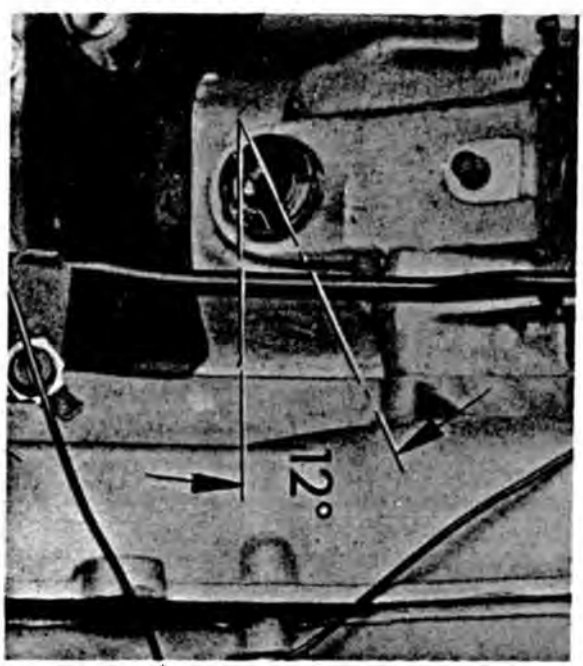
REMOVING AND INSTALLING DISTRIBUTOR DRIVE SHAFT

1. Remove distributor drive shaft with puller.

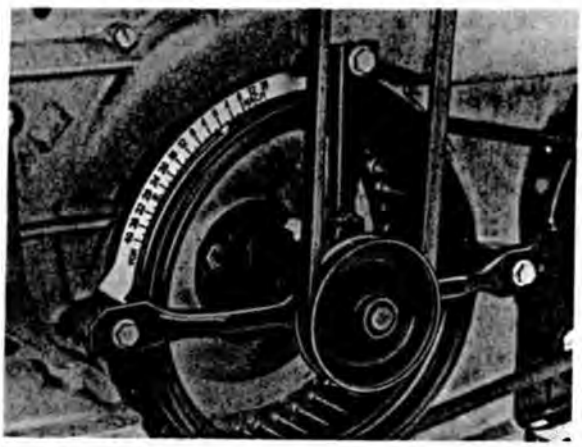


2. Take out washer from under drive shaft.

3. Offset slot in top end of distributor drive shaft should be at an angle of approx. 12° to longitudinal axis of engine. Larger slot segment faces inward.

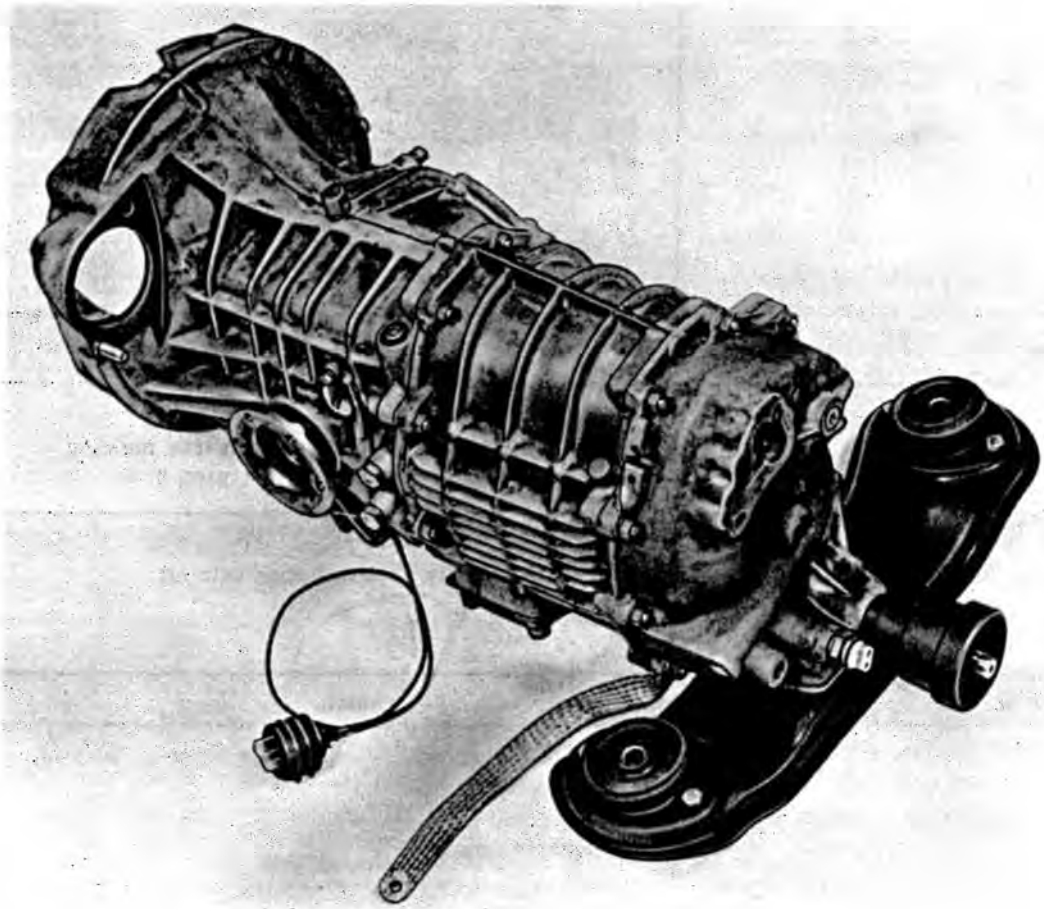


Set cylinder 1 to TDC mark. White mark on fan pulley must be opposite 0° mark on timing scale.



Printed in Germany

MANUAL TRANSMISSION FOR 912 E - 1976 MODEL



A five speed manual transmission is installed in conjunction with the four cylinder engine and only differs from the 1976 model transmissions 915 in a few details.

Clutch guide tube, clutch operation,

input shaft with smaller clutch hub splines,

different ratios.

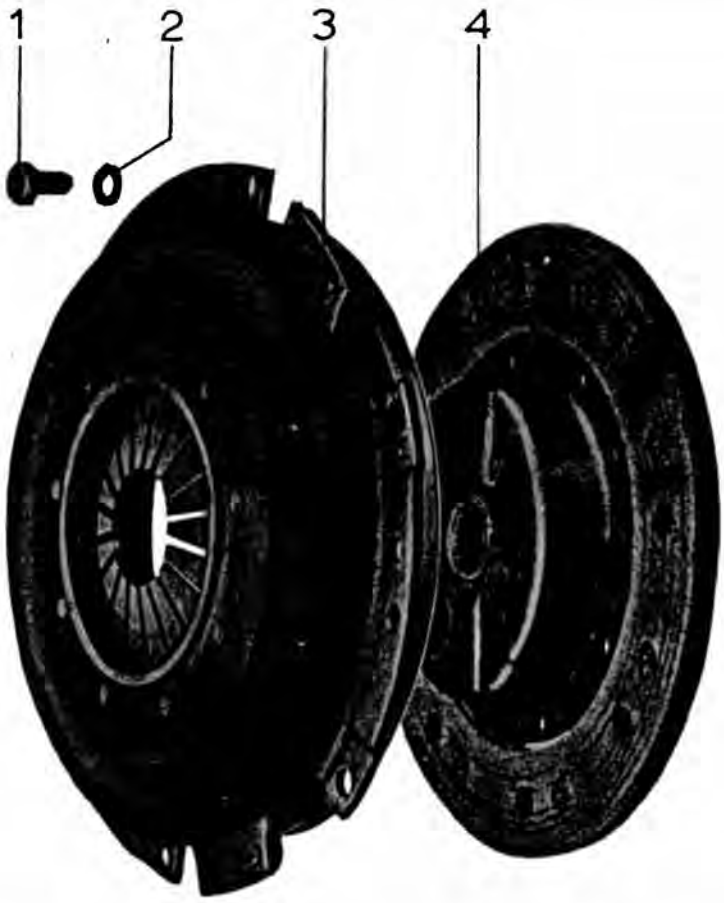
In general transmission 923/02 can be installed in all models.

TECHNICAL DATA

General Data	Manual Transmission 923 (Model 76)		
Ratios		923/02	
1st gear	AZ	11 : 35	3.181
2nd gear	HX	18 : 33	1.833
3rd gear	NT	23 : 29	1.261
4th gear	QP	26 : 25	0.962
5th gear	TL	29 : 21	3.207
Reverse	12 : 21 =	20 : 38	3.324
Final drive		7 : 31	4.429
Capacity	Approx 3 liters/3.2 gt of SAE 90 gear lube meeting Specifications MIL-L 2105 or MIL-L 2105 B		
Transmission weight	56 kp/123 lb ready for installation with oil and starter		
General data	Clutch		
Type	Single disc, dry		
Pressure plate	Diaphragm spring		
Clutch disc	Double spring		

TOOLS

No.	Description	Special Tool	Remarks
1	Steel ruler		Min. length 200 mm
2	Feeler gauge		Commercial item
3	Input shaft		
4	Flywheel lock	VW 215c	

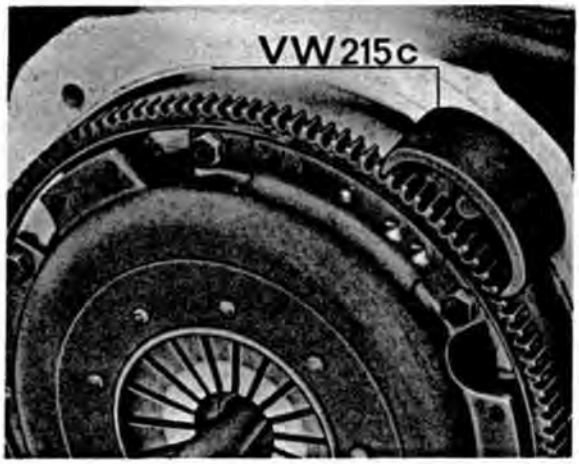


No.	Description	Qty.	Note when Removing	Note when Installing	Remarks
1	Bolt M 8 x 15	6	Loosen alternately 1 to 2 threads crosswise.	Torque crosswise to 23.5 Nm (2.5 mkg).	
2	Washer	6			
3	Diaphragm spring clutch	1	Mark for installation.	Check rivets. Clean bearing surface in flywheel. Check for wear. Remove surface cracks and scoring by grinding or turning.	
4	Clutch disc	1	Check for wear.	Check teeth. Disc must be easy to slide on input shaft without too much radial play. Check rivets. Check lateral runout. Coat input shaft teeth with molybdenum-disulfide powder. Center on input shaft.	

REMOVING AND INSTALLING CLUTCH

1. Insert flywheel lock VW 215c.

2. Loosen bolts on clutch cover.

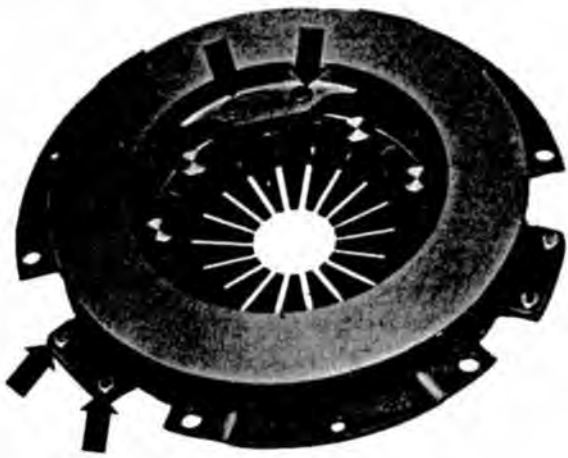


Checking Clutch

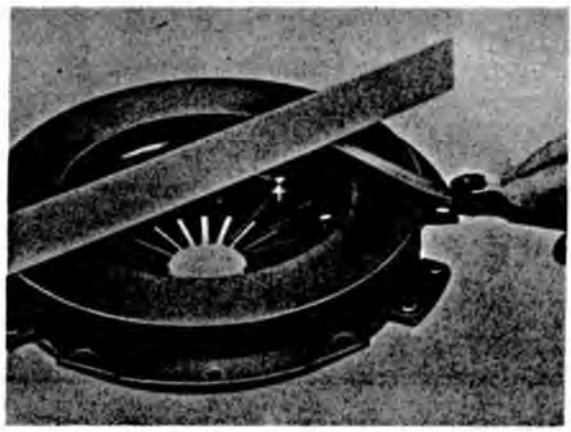
Check ends of diaphragm springs for wear (from clutch release bearing). Scoring up to 0.3 mm deep is not serious.

Check spring connections between pressure plate and cover for cracks. Check tightness of rivets.

Replace clutches which are damaged or have loose rivets.

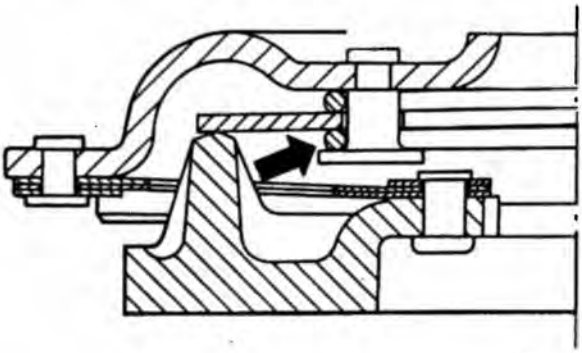


Check bearing surface of pressure plate for cracks, burnt spots and wear. Pressure plates bent inward by up to 0.3 mm are still useable.

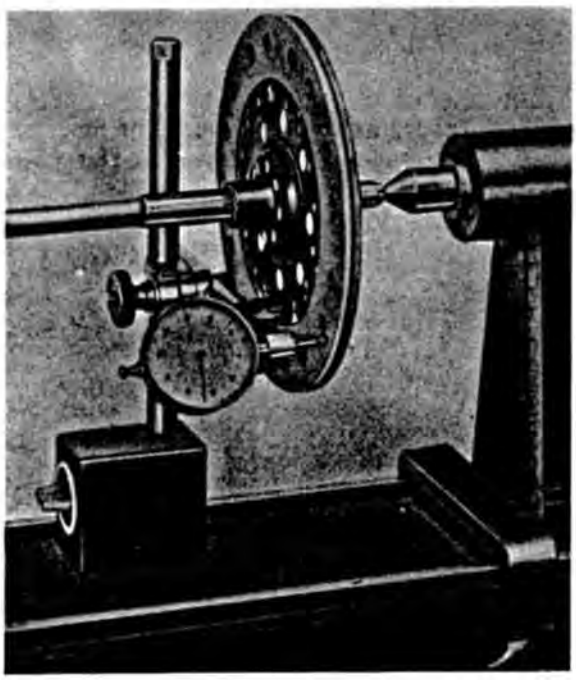


The diaphragm spring is riveted to the cover between two wire rings.

Clutches with visible wear on the rivet head or wire ring must be replaced.



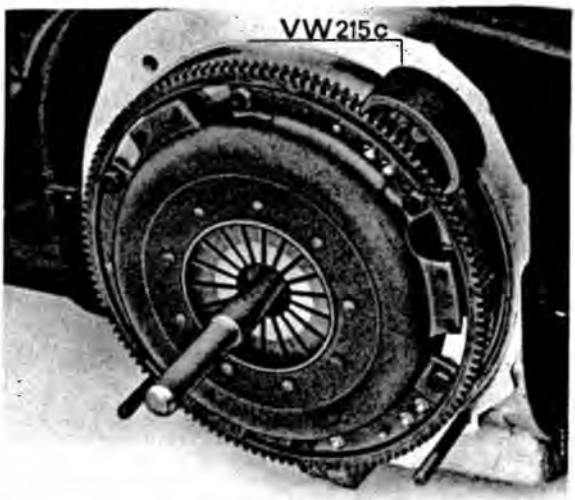
Checking Clutch Disc



Maximum Lateral Runout: 0.5 mm
(measured at 210 mm dia.)

Installing Clutch

1. Center pressure plate on input shaft.
2. Insert flywheel lock VW 215 c.
3. Bolt clutch pressure plate. Torque to 25 Nm (2.5 kpm).



Adjusting Clutch Play

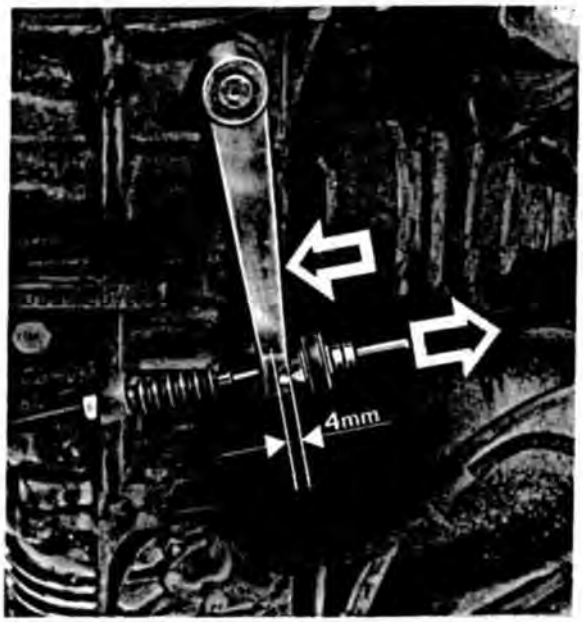
Pull out clutch pedal in direction of arrow to check. The specified play is 20 to 25 mm.

The clutch cable is adjusted by the counternuts on the end of the cable.

1. Press in clutch lever to center rib by hand.
2. Pull out engaging cable with pivot in opposite direction.

There must be about 4 mm of play between the lever and pivot.

To facilitate adjustments, a 4 mm dia. spacer (drill bit) can be placed between the lever and pivot.

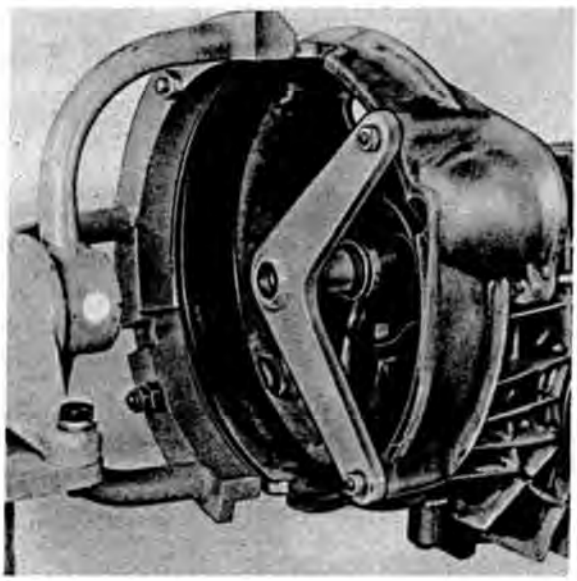


DISASSEMBLING AND ASSEMBLING NOTES

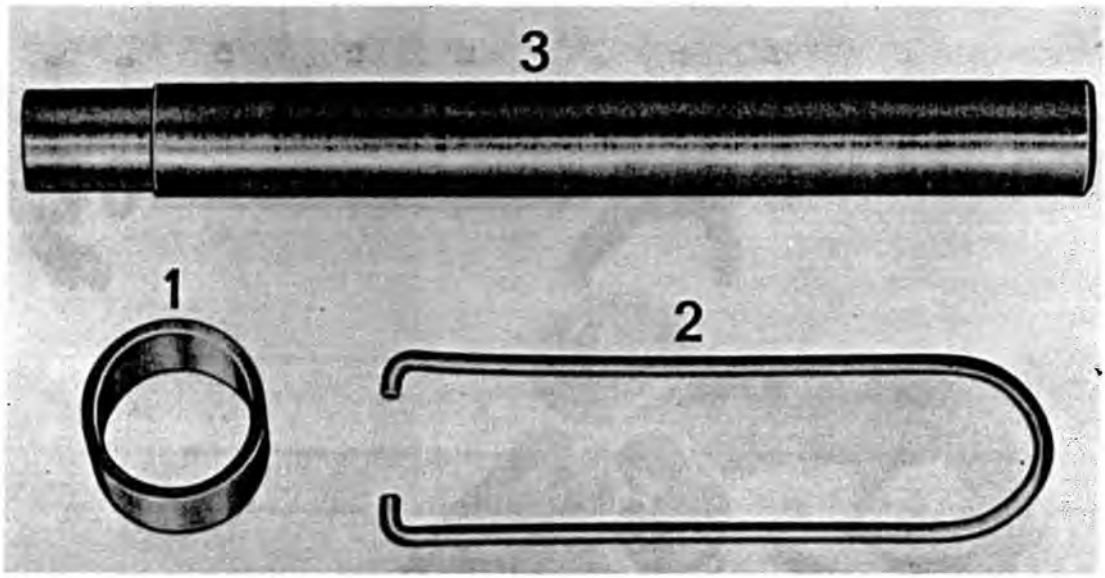
Manual Transmission 923

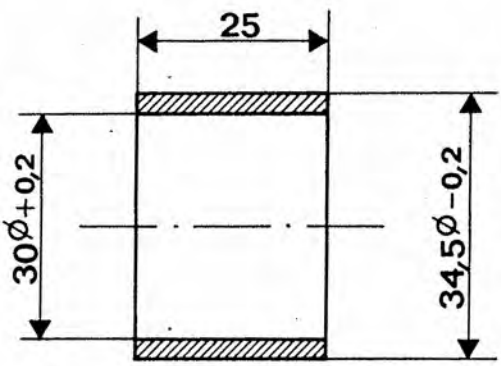
The splines of the input shaft are smaller than that of manual transmission 915. To disassemble, the transmission must be locked with Special Tool P 37 (old transmission 911 and 914).

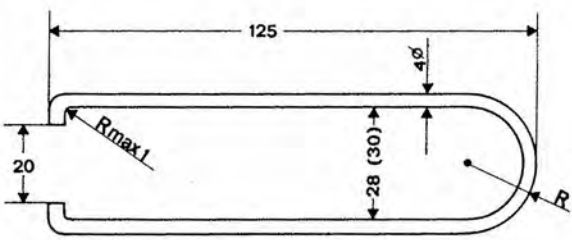
5th gear has to be engaged in addition to the other work.



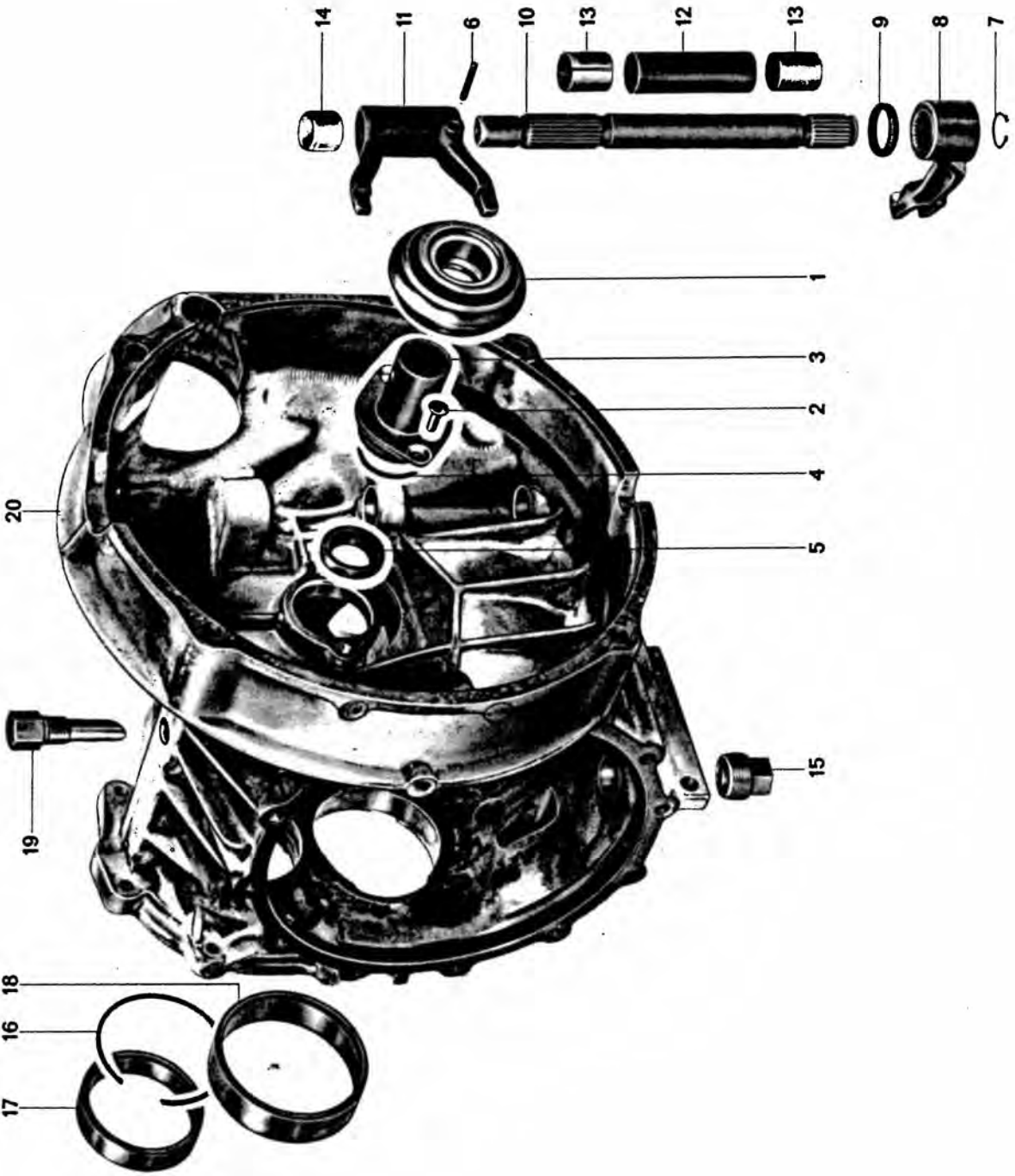
TOOLS







No.	Description	Special Tool	Remarks
1	Sleeve	-	Local manufacture
2	Hook	-	Local manufacture, same as hook for Turbo Carrera
3	Mandrel	P 375	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No.	Description	Qty.	Note		Remarks
			Removing	Installing	
1	Release bearing	1		Do not wash. Just wipe dry. Coat sliding surfaces for guide tube with a MoS_2 all purpose lube.	
2	Phillips screw	2		Torque to specifications.	
3	Guide tube	1	Use hock.	Coat with MoS_2 all purpose lube.	See page 35 - 2
4	O-ring	1		Replace. Lubricate.	
5	Seal, input shaft	1	Use angled screwdriver.	Use local manufactured sleeve.	See page 35 - 2
6	Key	1	Drive out with right size mandrel.	Replace, if necessary.	
7	Circlip	1		Replace, if necessary.	
8	Release lever	1	Mark for installation on lever shaft.	Adjust, if necessary.	
9	Seal	1		Replace, if necessary.	
10	Lever shaft	1		Use MoS_2 all purpose lube.	
11	Release fork	1	Mark for installation on lever shaft.	Adjust, if necessary.	
12	Protective tube	1			
13	Sleeve	2	Drive out with P 375	Drive in properly with P 375	
14	Delrin bearing sleeve	1	Pry out alternately with angled screwdriver.	Replace, if necessary.	
15	Plug	1		Clean and torque to specifications.	
16	Snap ring	1	Use small screwdriver.	Must fit properly.	
17	Bearing outer race	1	Heat case to approx. 120°C/248°F and drive out with US 8050.	Heat case to approx. 120°C/248°F and drive in with US 8050 b.	

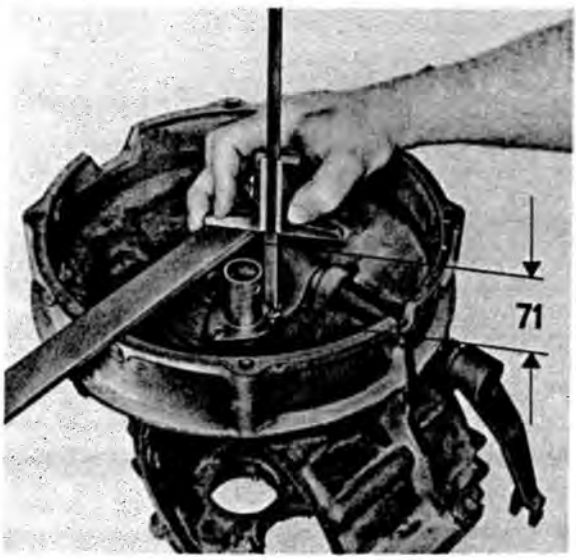
No.	Description	Qty.	Note		Remarks
			Removing	Installing	
18	Bearing outer race	1	Heat case to approx. 120°C/248°F and drive out with US 8050.	Heat case to approx. 120°C/248°F and drive in with US 8050.	
19	Breather	1		Install correctly and torque to specifications.	
20	Transmission case	1		Check for damage.	

DISASSEMBLING AND ASSEMBLING NOTES

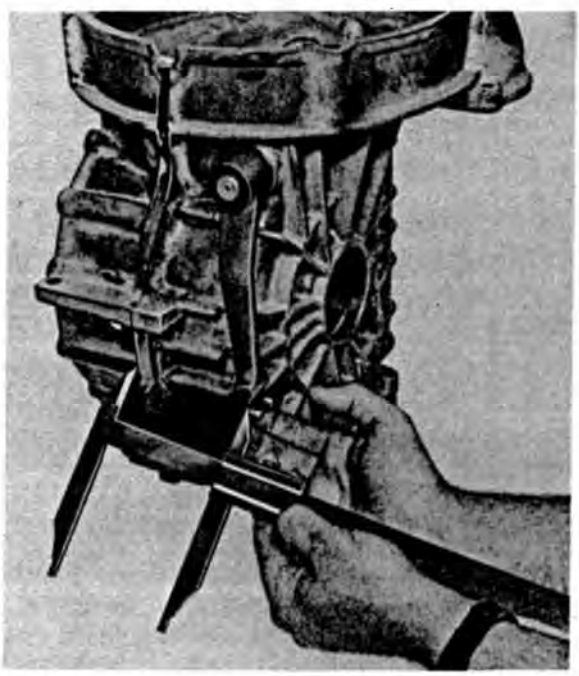
To assure perfect clutching, the release fork and release lever must be matched with each other at the splines of the lever shaft.

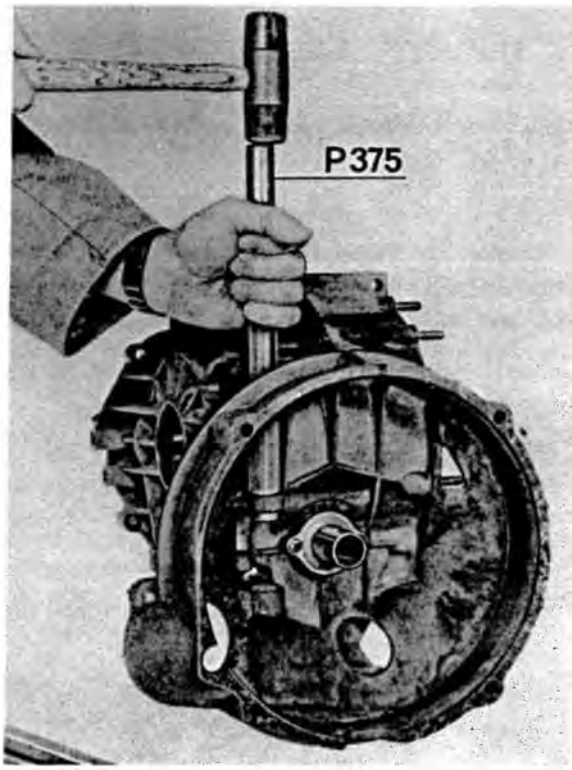
The adjustments are as follows:

About 71 mm on the fork from the clutch bell housing flange surface to the release bearing surface.



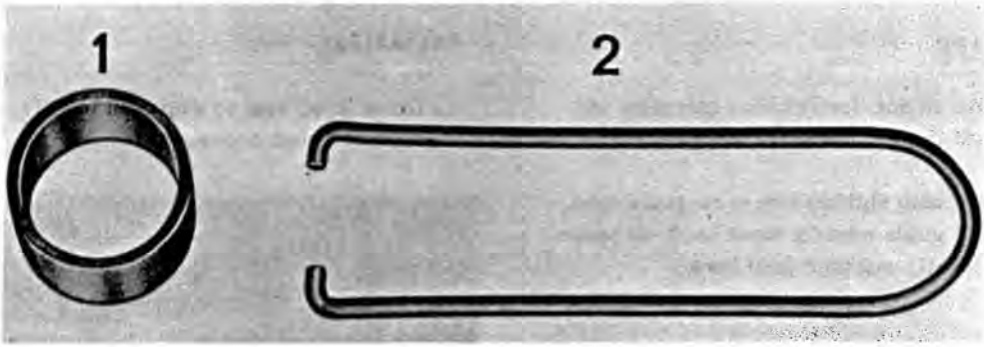
About 101 mm from the depression in the lever to and including the center rib of the transmission.

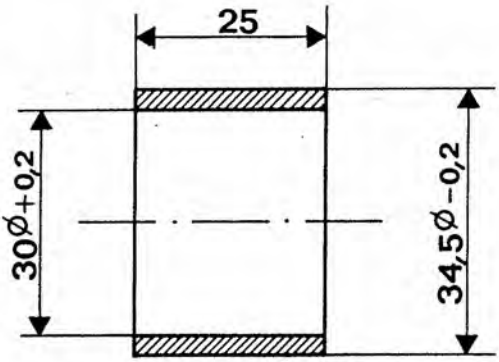


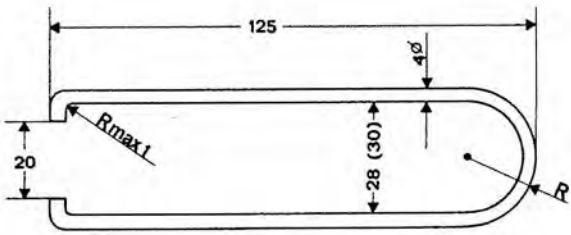


Bushing for lever shaft, driving in and out with P 375.

TOOLS







No.	Description	Special Tool	Remarks
1	Sleeve	-	Local manufacture
2	Hook	-	Local manufacture, same as hook for Turbo Carrera

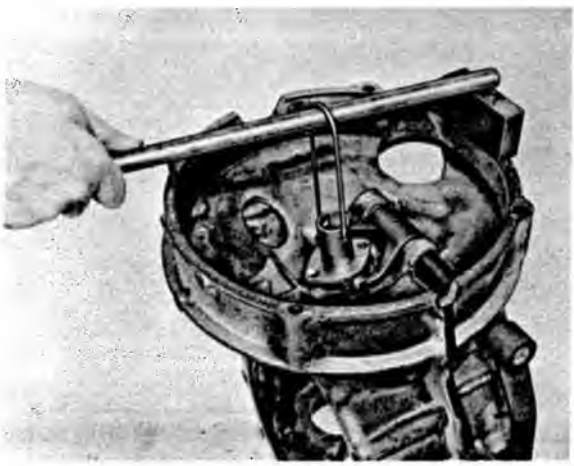
REMOVING AND INSTALLING INPUT SHAFT OIL SEAL

It is very easy to replace the input shaft oil seal of manual transmission 923, without having to disassemble the transmission.

Removing

1. Remove engine/transmission assembly and take off the transmission.

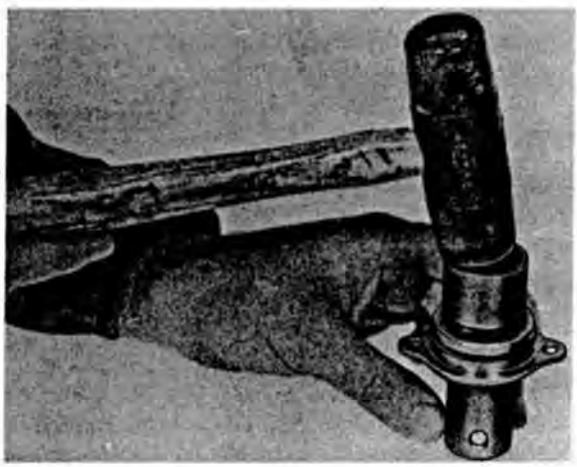
2. Remove both Phillips screws on guide tube. Pull out guide tube for input shaft oil seal with locally manufactured hook.



3. Remove oil seal with an appropriate mandrel or screwdriver.

Installing

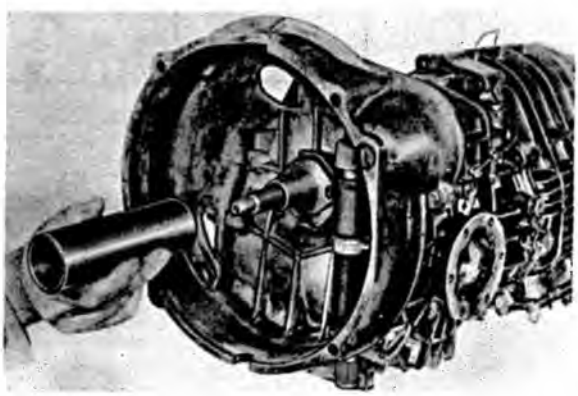
1. Drive in oil seal to stop with locally manufactured sleeve.



2. Place new O-ring on neck of guide tube.

3. Apply a light coat of oil to sealing lip of seal in guide tube and O-ring on guide tube neck.

4. Drive in guide tube so that the mounting screws can be inserted.



5. Insert mounting screws and torque to specifications.

6. Coat release bearing guide tube with MoS_2 paste.

TECHNICAL DATA

Front suspension	Independent, with shock absorber struts and transverse control arms
Springing	One round torsion bar per wheel in driving direction
Torsion bars	18.8 mm dia.
Height setting (at DIN curb weight)	99 $\pm$ 5 mm from center of wheel to center of torsion bar
Difference in height left to right	5 mm
Wheelbase	2271 mm
Track	1360 mm
Shock absorbers	Double action, hydraulic
Make	Boge
Stabilizer	16 mm dia.

TECHNICAL DATA

Rear suspension	Independent, with control arms
Springing	One round torsion bar per wheel transversely mounted
Torsion bars	23 mm dia.
Height setting (at DIN curb weight)	37 mm from center of cross tube to center of wheel
Difference in height left to right	Max. 8 mm
Spring strut angle with air conditioner	40° $40^{\circ}\ 30'$
Shock absorbers	Double action, hydraulic
Make	Boge
Wheelbase (at DIN curb weight)	2271 mm
Track (at DIN curb weight)	1330 mm

AXLE ALIGNMENT DATA

The following data is based on a car at curb weight according to DIN 70020 (car with full fuel tank, spare wheel and tools).

	Specification and tolerances	Max. difference left to right
Front Axle		
Height settings:		
Center of wheel to center of torsion bar	99 ± 5 mm	5 mm
Toe (pressed by 15 kp)	0°	
Track difference angle at 20° lock (toward toe-in)	0° to 30'	Can be altered by exchanging steering arm.
Camber (wheels straight ahead)	0° 30' ± 10'	10'
Caster	6° 5' ± 15'	30'
Rear Axle		
Height settings:		
Center of cross tube to center of wheel	37 ± 5 mm	8 mm
Strut inclination with air conditioner	40° 40° 30'	0,5°
Every 1° change in strut inclination = approx 8 - 9 mm difference in car height		
Toe per wheel	+ 20' -20'	10'
Camber	0° ± 10'	20'

TECHNICAL DATA

Wheels and Tires

Wheels	Steel rims 5 1/2 J x 15
Standard tires, front rear	165 HR 15
Cold tire pressure, front rear	29 psi (2.0 kp/cm^2) 34 psi (2.4 kp/cm^2)
Optional extra tires, front and rear	185 HR 14 on forged light alloy rims 5 1/2 J 14
Cold tire pressure, front rear	29 psi (2.0 kp/cm^2) 34 psi (2.4 kp/cm^2)
Winter tires, front/rear	165 SR 15 MS or 185/70 SR 15 MS on standard rims 5 1/2 J 15
Cold tire pressure	Same as standard tires
Spare wheel	Space Saver tire on steel rim 5 1/2 J 15 with inflator

TECHNICAL DATA

Tandem Brake Master Cylinder

Bore	19.05 mm dia.
Stroke	18/13 mm
Ratio at brake pedal	5.4 : 1
Operating rod/piston play	1 mm

Front Wheel Brakes

Solid disk brake outside dia.	282 mm
Thickness, new	12.7 mm
Min. thickness after machining*)	11.7 mm
Brake disk surface peak-to-valley height after machining	Max. 0.006 mm
Thickness tolerance	Max. 0.03 mm
Brake disk lateral runout	Max. 0.05 mm
Lateral runout after installation	0.2 mm
Caliper piston dia.	48 mm
Pad thickness	10 mm
Wear limit	2.0 mm
Clearance	0.2 mm
Pad surface per wheel	76 cm^2

Rear Wheel Brakes

Solid disk brake outside dia.	290 mm
Thickness, new	10.5 mm
Min. thickness after machining *)	9.5 mm
Thickness tolerance	Max. 0.03 mm
Brake disk lateral runout	Max. 0.05 mm
Lateral runout after installation	Max. 0.2 mm
Brake disk surface peak-to-valley height after machining	Max. 0.006 mm
Caliper piston dia.	38 mm
Pad thickness	10 mm
Wear limit	2.0 mm
Clearance	0.2 mm
Pad surface per wheel	52.5 cm^2

Parking Brakes

Brake drum dia.	180 mm
Brake shoe width	25 mm
Effective braking surface per wheel	85 cm^2

*) Machine brake disks uniformly on both sides.

CHECKING AND MACHINING BRAKE DISKS

The brake disk can be reconditioned if it has certain types of surface damage, excessive lateral runout and excessive thickness tolerances.

Wear can take on the following patterns:

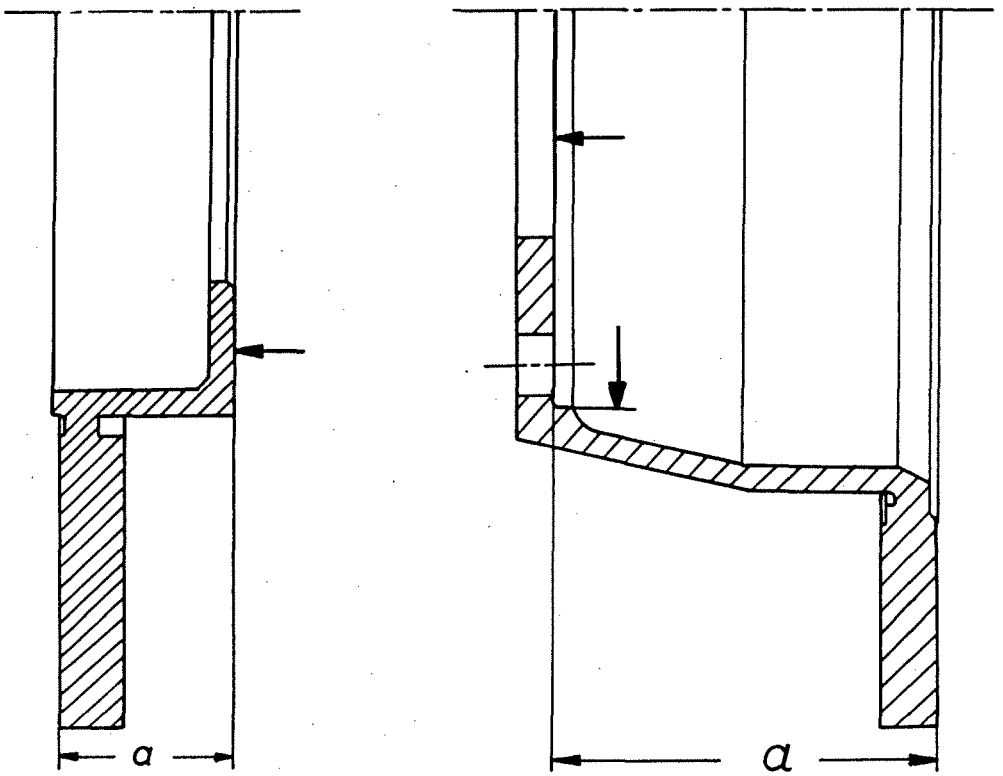
1. Wavy lines in the cross section, as illustrated below, are not serious.

2. Peak scoring, as illustrated below, can be removed by reconditioning.

Refer to the Technical Data on page 44.01 for machining data and limits.

Note
Machine brake disks uniformly on both sides.

Distance "a" is used to check to symmetrical machining of the brake disk and/or to determine the brake disk thickness wear limit.



Arrows indicate the reference and/or take-up surfaces for machining the brake disk.

Distance "a"

Brake Disk Type	Location of Brake Disk	Distance "a" (in reference to new brake disk thickness)	New Brake Disk Thickness
Solid Disk	Front Wheel	35 $\pm$ 0.1 mm	12.7 - 0.2 mm
Solid Disk	Rear Wheel	76 $\pm$ 0.2 mm	10.5 - 0.2 mm

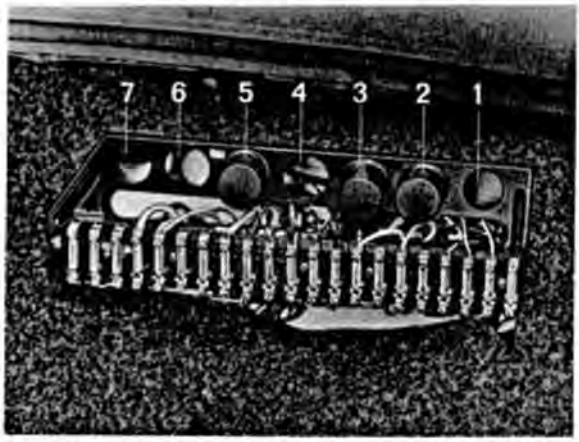
TECHNICAL DATA

Steering

Steering wheel	400 mm dia. (lattice wheel with impact pad)
Steering ratio at center (steering wheel angle to road wheel angle)	17.78 : 1
Turning circle diameter	10.9 m (36 ft)
Track circle diameter	10.35 m (34 ft)
Steering wheel turns from stop to stop	approx. 3.1
Steering frictional torque (measured at steering gear flange, tie rods disconnected)	0.8 to 1.4 Nm (8 - 14 kpcm)

LOCATION OF RELAYS AND FUSES

Up to three relays can be installed in the fusebox located in the luggage compartment.



1 - Open

2 - Foglight relay (optional)

3 - Horn relay

4 - Open

5 - Electric window regulator relay (optional)

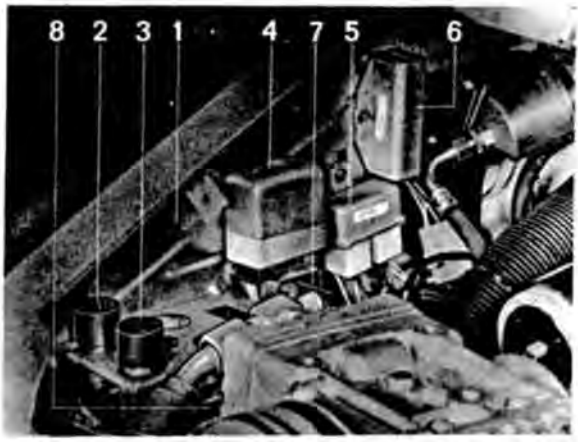
6 - Open

7 - Open

The hazard light relay is on the luggage compartment floor to the left as seen in the driving direction - same as Type 911.

The fusebox holds 18 fuses. They are numbered consecutively on the current flow diagram, whereby the fuse up front as seen in the driving direction is designated S 1.

Relay Plate in Engine Compartment



1 - Relay plate

2 - Rear window defogger unit relay

3 - Heater fan unit relay

4 - Voltage stabilizer

5 - Double relay (fuel pump, power supply for control unit)

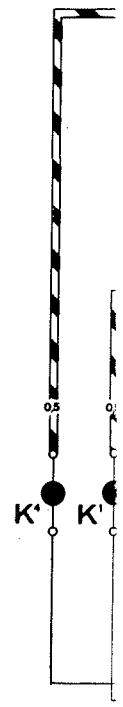
6 - Resistance for fuel injectors

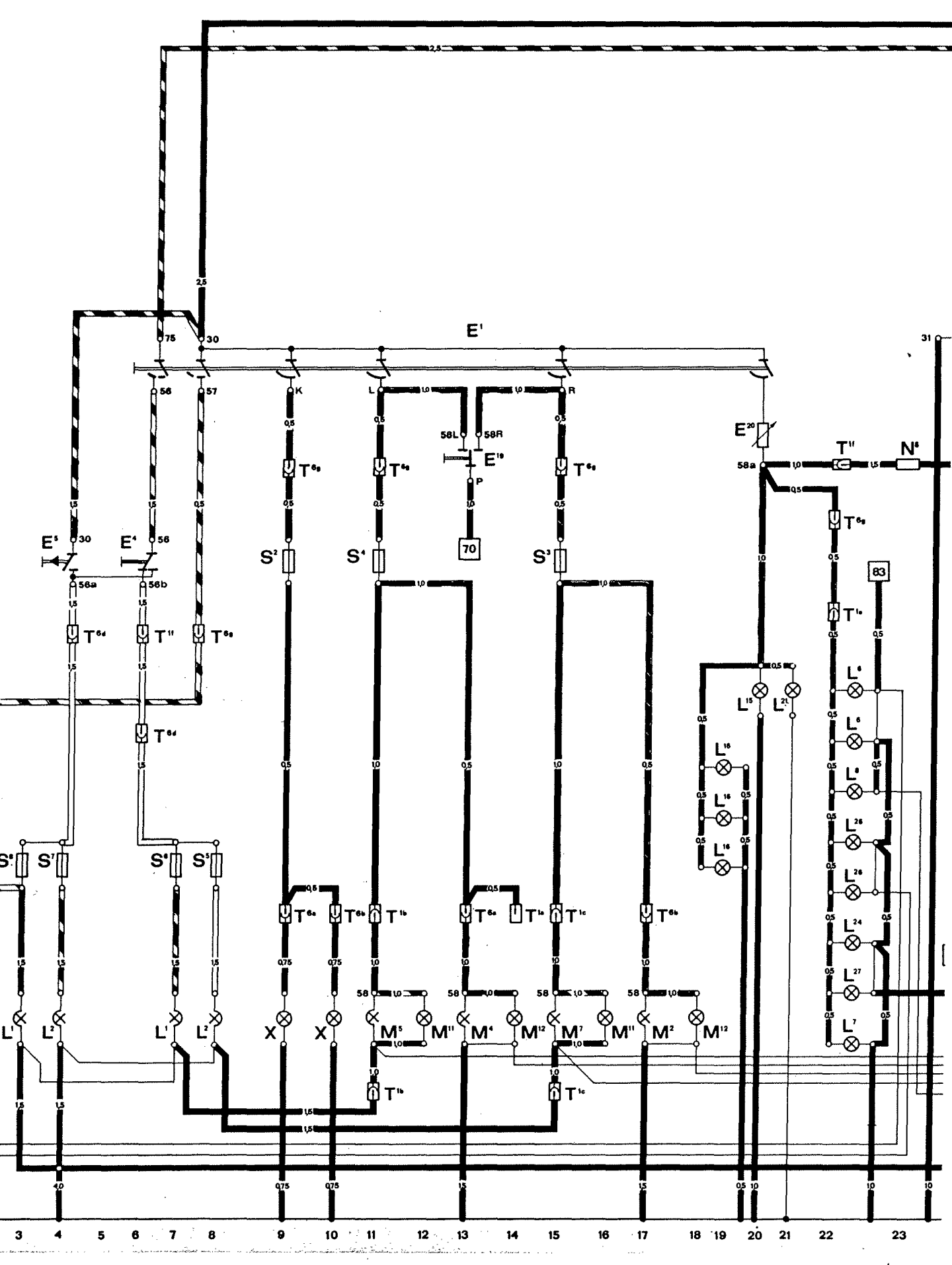
7 - Radio interference suppression

8 - Rear fusebox

Current flow diagram, Type 912 E, Model 76

	Description	Current track
E	— Windshield wiper switch	39, 61, 62, 63
E^{1}	— Headlight switch	6, 8, 9, 11, 15, 20
E^{2}	— Turn signal switch	28
E^{3}	— Emergency flasher switch	24, 25 28, 31, 34
E^{4}	— Dimmer switch	6, 39
E^{5}	— Headlight flasher switch	4
E^{9}	— Fresh air blower switch	57, 58
E^{15}	— Rear window defogger switch	52, 53
E^{19}	— Parking light switch	13
E^{20}	— Instrument panel illumination potentiometer	20
E^{26}	— Switch for glove compartment light	41
F	— Stop light switch	50
F^{2}	— Left door switch	45
F^{3}	— Right door switch	46
F^{4}	— Back-up light switch	48
F^{5}	— Switch for luggage compartment light	42
H	— Horn switch	39
H^{2}	— Horns	36, 38
H^{6}	— Key warning buzzer contact	43
J^{1}	— Hazard/turn signal flasher	33, 34, 35
J^{4}	— Horn relay	36, 37
J^{9}	— Rear window defogger relay	53, 54
J^{27}	— Diode for seat belt warning system	46
K^{1}	— High beam indicator light	2
K^{4}	— Parking lights indicator light	1
K^{5}	— Turn signal indicator light	27, 29
K^{6}	— Hazard flasher indicator light	24
K^{8}	— Blower indicator light	58
K^{10}	— Rear window defogger indicator light	52
L^{1}	— Sealed beam unit, left headlight	3, 7
L^{2}	— Sealed beam unit, right headlight	4, 8
L^{6}	— Speedometer illumination light	22
L^{7}	— Fuel gauge illumination light	22
L^{8}	— Clock illumination light	22
L^{15}	— Ashtray illumination light	20
L^{16}	— Heater control assembly illumination light	19
L^{21}	— Temperature control lever illumination light	21
L^{24}	— Oil temperature indicator illumination light	22
L^{26}	— Tachometer illumination light	22
L^{27}	— Oil pressure indicator illumination light	22
M^{2}	— Right stop / rear light	17, 50
M^{4}	— Left stop / rear light	13, 51
M^{5}	— Left front turn signal / parking light	11, 25
M^{6}	— Left rear turn signal	26
M^{7}	— Right front turn signal / parking light	15, 31
M^{8}	— Right rear turn signal	30
M^{11}	— Front side marker light	12, 16
M^{12}	— Rear side marker light	14, 18
M^{16}	— Left back-up light	48
M^{17}	— Right back-up light	49
N^{6}	— Resistor	23
S^{2}	— Fuses	9, 15, 11, 8, 7
to	— on	4, 3, 31, 25, 48
S^{15}	— the	52, 61, 59, 58
S^{17}	— fuse	34
S^{18}	— box	40
S^{24}	— Fuse on the rear fuse box	54
T^{1}	— Cable connector, single	
	a — near regulator panel	14, 53, 54, 55
	b — behind sealed beam unit, left	11, 25
	c — behind sealed beam unit, right	15, 31
	d — behind fuse box	37, 63
	e — on luggage compartment floor	22, 42, 44, 45, 46, 56
	f — behind instrument panel	6, 22, 24, 28, 55, 56, 57
	h — near left rear lights	24
T^{6}	— Cable connector, sixfold	
	a — in engine compartment, rear left	9, 13, 24, 26, 48, 51
	b — in engine compartment, rear right	10, 17, 30, 49, 50
	c — below instrument panel	61, 62, 63
	d — below instrument panel	4, 6, 26, 30, 39
	e — below instrument panel	25, 31, 32, 34
	g — below instrument panel	8, 9, 11, 15, 22
	h — below instrument panel	41, 56, 57, 58
T^{14}	— Cable connector, fourteenfold on regulator panel	48
U^{1}	— Cigar lighter	59
V	— Windshield wiper motor	61, 62
V^{2}	— Blower motor	56, 57
V^{5}	— Washer pump	63
W	— Interior light	45, 47
W^{3}	— Luggage compartment light	42
W^{6}	— Glove compartment light	41
X	— License plate light	9, 10
Y	— Clock	40
Z^{1}	— Rear window defogger	54

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58L
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E20
58a
T11
N5
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E4
56
56a
56b
S2
S4
S3
T6g
T6d
T11
T6a
T6b
T1b
T6c
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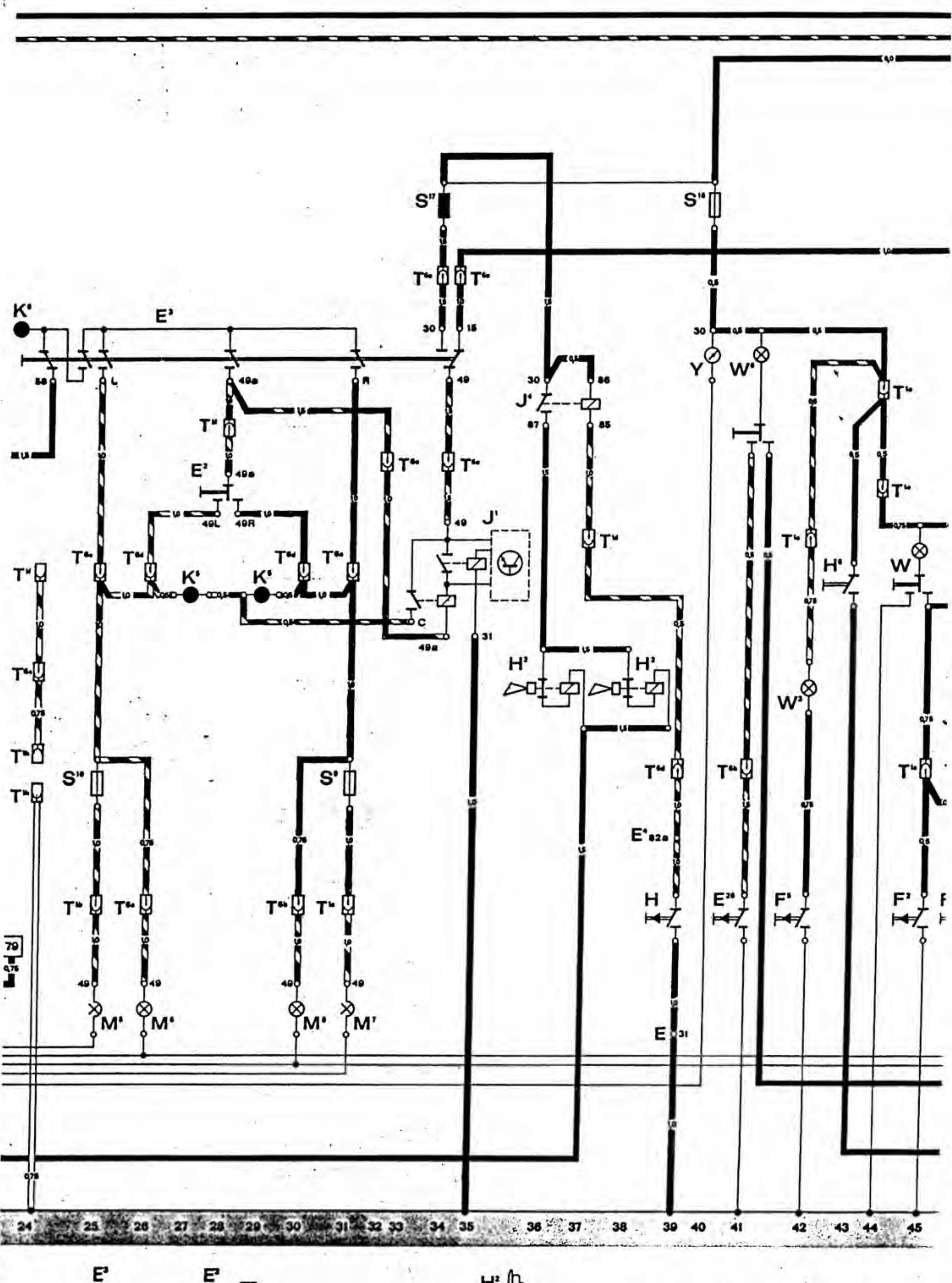
K⁶
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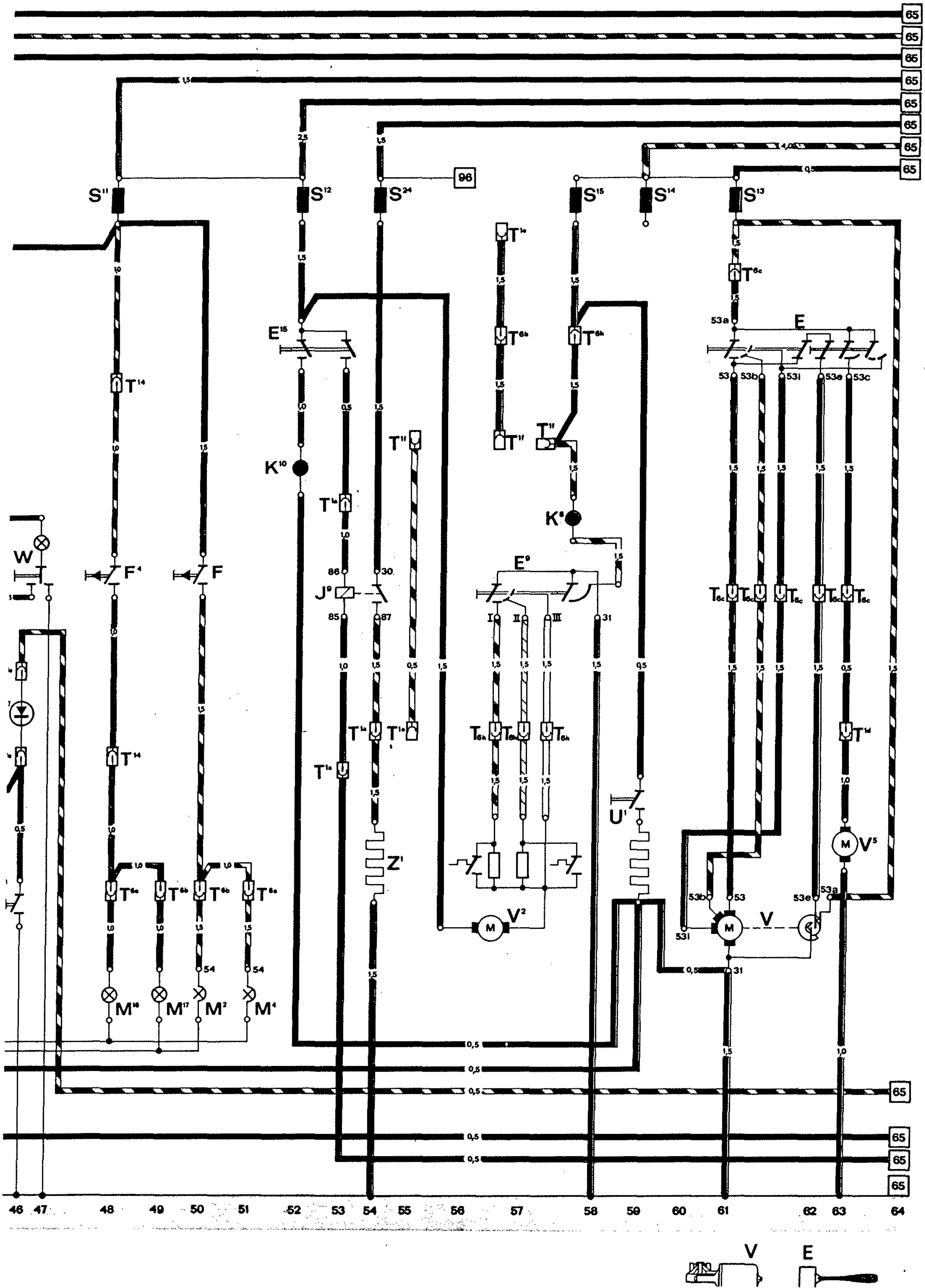
S¹⁶
T⁶ᵃ
J⁴
J¹
E²
K⁵
H²
Y
W⁶
W³
H⁶
W
T¹⁴
S¹⁰
S⁹
M⁵
M⁶
M⁸
M⁷
E⁴ 82a
H
E²⁶
F⁵
F²
E 31
24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45

E³
E²
H²


S11
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S24
S15
S14
S13
96
E15
K10
T14
F4
F
W
J9
86
85
30
87
Z1
T1a
T1f
T6h
K8
E9
V2
U1
E
53a
53
53b
53i
53e
53c
T6c
T1d
V5
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M16
M17
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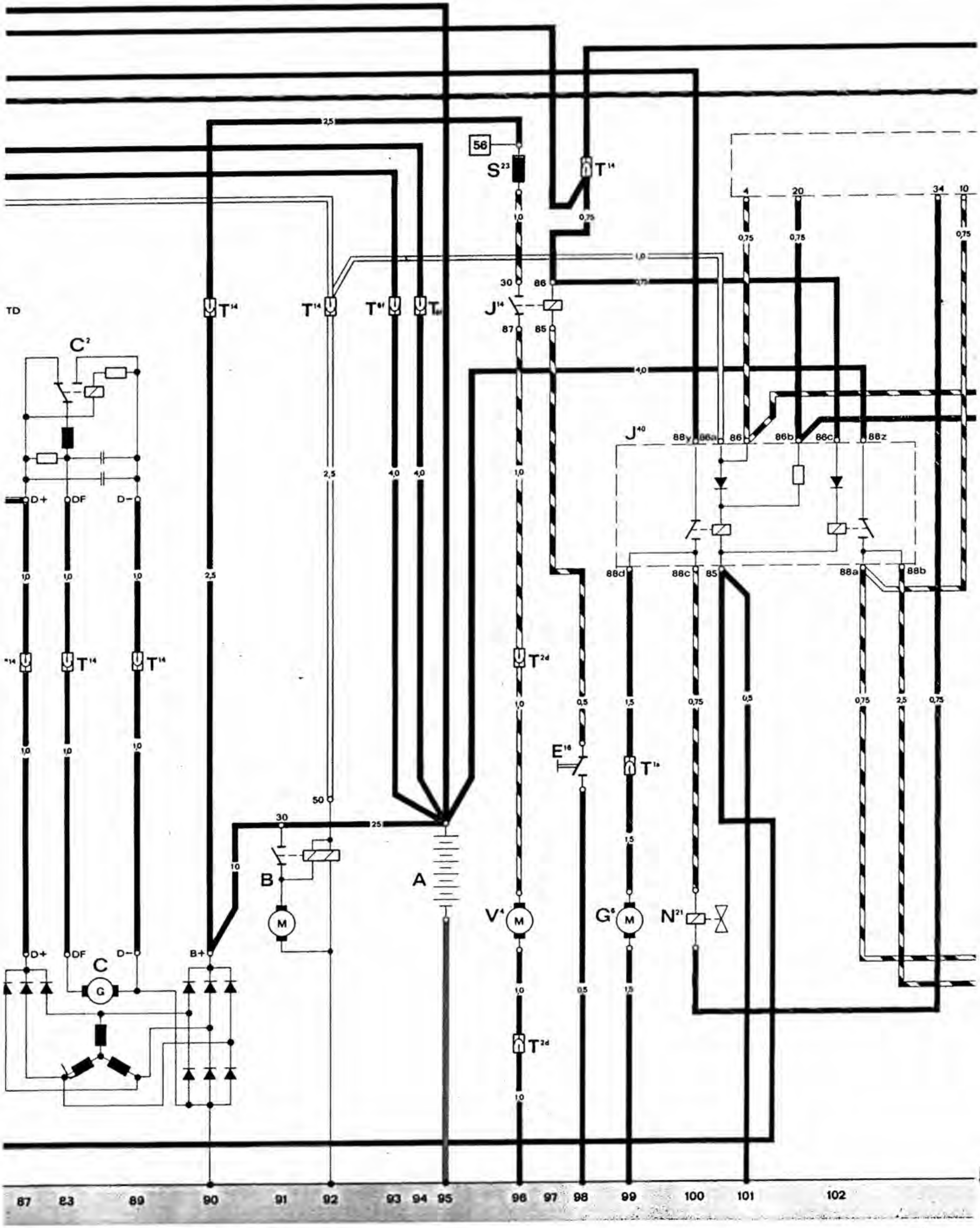
Current flow diagram, Type 912 E, Model 76

Current flow diagram, Type 912 E, Model 76

	Description	Current track
A	— Battery	95
B	— Starter	91, 92
C	— Generator	87, 88, 89, 90
C^{2}	— Voltage regulator	87, 88, 89
C^{6}	— Ignition condenser	116
D	— Ingnition / starter switch	68, 69, 70, 71, 72
E^{16}	— Heater blower switch	98
E^{24}	— Left seat belt switch	71
F^{1}	— Oil pressure switch	85
F^{6}	— Brake warning switch	77
F^{9}	— Parking brake switch	78
F^{25}	— Throttle valve switch	115
F^{26}	— Thermo — switch for cold start valve	103, 104
F^{27}	— Mileage counter switch (EGR)	75, 76, 78
G	— Fuel sender unit	82
G^{1}	— Fuel gauge	81
G^{5}	— Tachometer	86
G^{6}	— Fuel pump	99
G^{8}	— Oil temperature sender unit	84
G^{9}	— Oil temperature indicator	84
G^{17}	— Temperature sensor I	106
G^{18}	— Temperature sensor II	113
G^{19}	— Air flow meter	106, 107, 108
G^{21}	— Speedometer	75
G^{22}	— Speedometer sensor	83
J^{14}	— Relay for heater blower	96, 97
J^{21}	— Electronic fuel injection unit	101—118
J^{34}	— Seat belt warning system relay with integrated buzzer	69, 72, 74
J^{40}	— Double relay	99, 100, 101, 102
K^{2}	— Generator charge indicator light	75
K^{3}	— Oil pressure indicator light	85
K^{7}	— Parking brake / brake warning indicator light	76
K^{16}	— Low fuel warning light	83
K^{19}	— Seat belt warning light	75
K^{22}	— EGR warning light	80
N	— Ignition coil	118
N^{6}	— Resistor	109, 110, 111, 112
N^{17}	— Cold start valve	104
N^{19}	— Injection valves cyl. 1 and 4	109, 110
N^{20}	— Injection valves cyl. 2 and 3	111, 112
N^{21}	— Supplementary air valve	100
O	— Distributor	117, 119, 120
P	— Spark plug connector	118, 119, 120, 121
Q	— Spark plug	118, 119, 120, 121
S^{23}	— Fuse on rear fuse box	96
T^{1}	— Cable connector, single	
	a — near regulator panel	84, 99
	e — on luggage compartment floor	74
	f — behind instrument panel	70, 71, 77, 78
T^{2}	— Cable connector, double	
	c — near left seat	71, 72
	d — in engine compartment	96
	i — in tunnel, rear	83
$T^{6}f$	— Cable connector, sixfold below instrument panel	66, 67, 74, 93, 94
T^{14}	— Cable connector, fourteenfold on regulator panel	84, 85, 87, 88, 89, 90, 92, 98, 120
V^{4}	— Heater blower	96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S²³
J¹⁴
J⁴⁰
E¹⁶
V⁴
G⁶
N²¹
T¹⁴
T²ᵈ
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56
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DF
D−
B+
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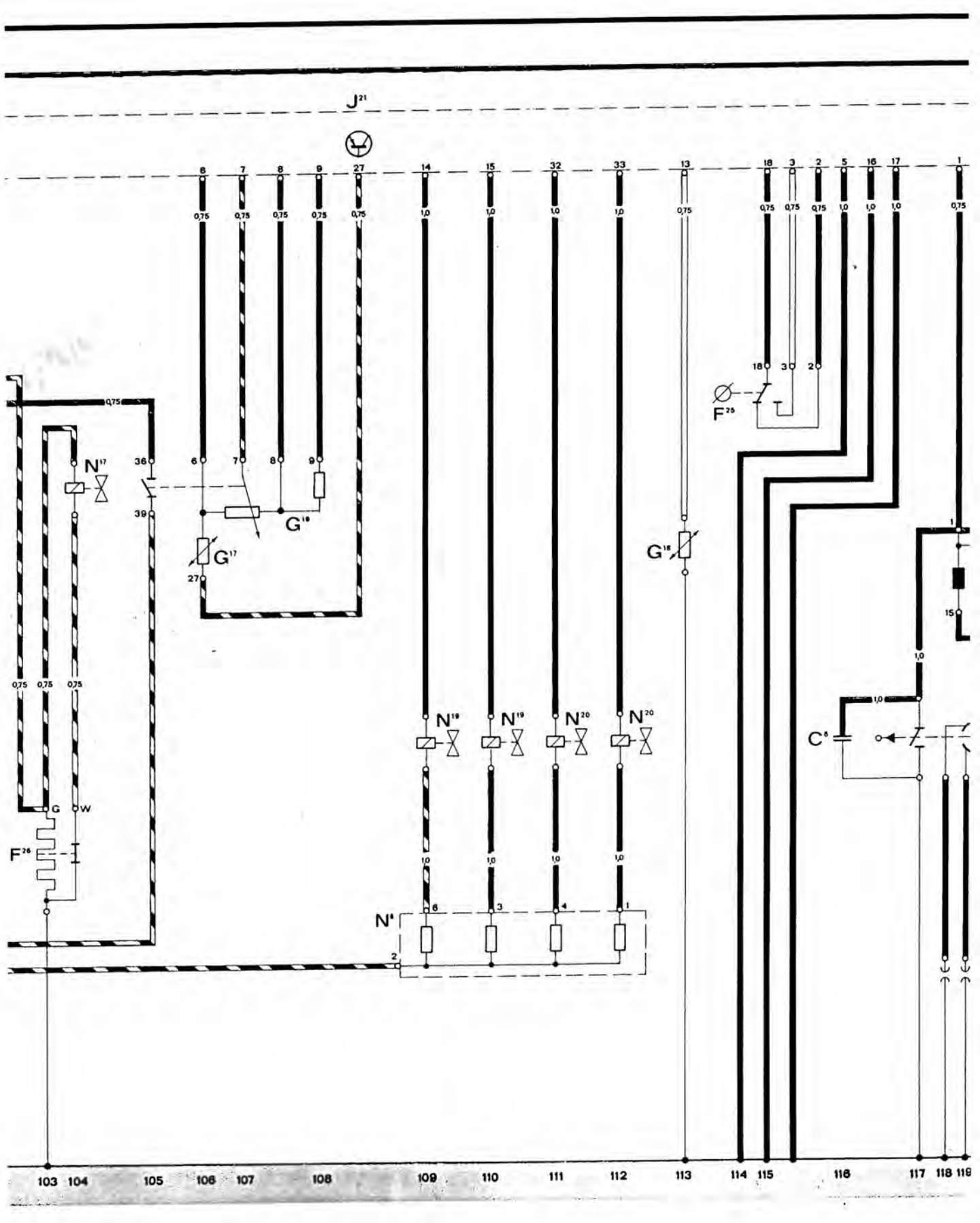
J21
N17
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F26
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G16
N19
N19
N20
N20
N4
C6
103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119