Service Manual
Models 180 to 220 SE

Mercedes-Benz
service

MERCEDES-BENZ OF NORTH AMERICA, INC.

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PREFACE

This manual was developed as a supplementary manual to the Workshop Manual Model 190 to extend the coverage to Models 180, 180a, 180b, 180c, 180D, 180Db, 180Dc, 190D, 190Db, 190SL, 220a, 219, 220S and 220SE.

The individual repair procedures are described in detail only if they do not correspond to those of Model 190. When there is no difference, reference is made to the basic Model 190 Workshop Manual. This means that for a complete description of various repair procedures, both manuals, the Workshop Manual Model 190 and the Workshop Manual 180 to 220SE, must be available.

Not covered are the side-valve engine of model 180, diesel engines OM 636 OM 621 of models 180D, 180Db, 180Dc, 190D and 190Db, the fuel injection system of Model 220SE, the hydraulic-automatic transmission, and the doublejointed rear axle of model 180 and 180D. These units are covered in other workshop manuals.

The entire contents of this Workshop Manual are arranged by groups. The group index serves to locate any particular group. Each group is preceded by a comprehensive listing of its contents.

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

The information contained in this special publication was originally issued by Daimler-Benz AG in conjunction with supplementary service literature only to its authorized dealers. The various repair and maintenance procedures outlined herein are procedures to be used by trained Mercedes-Benz service and repair station personnel. Supplementary service literature is no longer available for this publication.

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

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Location of Model Plate, Engine, Chassis, and Body Numbers

Apart from exceptions listed below, the location of the Model Plate and the Plates giving the Engine, Chassis, and Body Numbers and the Type of Car Finish, is, for Models 180 to 220 SE, the same as on Model 190.

On Models 180 and 180 D the Engine Number Plate is located on top of the timing gear cover. On Model 190 SL the Chassis Number Plate and the Plate giving the Type of Car Finish are located at the top of the fire wall behind the battery. On Model 220a there is as yet no plate indicating the type of Car Finish.

To ensure prompt and correct execution of your orders and attention to your inquiries, please let us have the following details:

1. Complete Chassis Number
2. Complete Engine Number
3. Complete Body Number
4. Mileage covered

Location of Unit Numbers

In your inquiries and orders referring to specific car units such as front axle, steering gear, transmission, and rear axle, please quote the Unit Numbers as well. For Models 180 to 220 SE these Numbers can be found in the same place as on Model 190.

Group Index

Index

Notes

General

Technical Specifications

*Change: Models 180c and 190 Dc added, changes at **

I. Models 180, 180a, 180b, 180c and 190 SL

Models

Car model	180	180a	180b	180c	190 SL
Chassis type	120.01	120.01	120.01	120.01	121.04
Engine model	M 136 VII	M 121 B.IV	M 121 B.IV b	M 121 B.V II	M 121 B.II[1] M 121 B.IX[2]*
Engine type	136.925	121.920	121.920	121.927	121.921[1] 121.928[2]*

Engine

	180	180a	180b	180c	190 SL
Operation	4-cycle carburetor				
No. of cylinders	4				
Bore/Stroke (mm)	75/100	85/83.6			
Total eff. piston displacement (cm³)	1767	1897			
Compression ratio ε	6.7:1	6.8:1	7.0:1		8.8:1[3]
Firing order	1–3–4–2				
Max. speed (rpm)	4500	6000			
Engine performance in metric HP at rpm acc. to DIN*) in gr. HP/rpm acc. to SAE	52/4000 58/4000	65/4500 74/4700	68/4400 78/4500		105/5700 120/5800
Max. torque mkg/rpm acc. to DIN mkg/rpm acc. to SAE	11.4/1800 11.7/1800	13.0/2200 14.4/2800	13.2/2500 14.8/2500		14.5/3200 15.8/3800
Crankshaft bearings	3 Babbit metal plain bearings with steel-backed shells	3 compound plain bearings with steel-backed shells			
Connecting rod bearings	compound plain bearings with steel-backed shells				
Valve arrangement	side	overhead			
Camshaft location	lateral	overhead			
Oil cooling	—	Oil-water heat exchanger			
Cooling system	Water circulation through pump, thermostat with by-pass pipe and fan				
Lubrication	Forced-feed lubrication by means of gear-type pump				

*) The HP output stated is actually available for the car at the clutch, since the power used by the engine accessories has already been deducted.
1) Up to end of further developed valve controls.
2) As from start of further developed valve controls.
3) Up to engine No. [illegible] compression ratio ε = 8.5 : 1

Model	180	180 a	180 b	180 c	190 SL

Electric Equipment

Battery Voltage (V) / Capacity (Ah)	6 / 84	12 / 56		12 / 52	12 / 56

Dimensions

Wheel track (mm) front / rear	1420 / 1460¹)		1440²) / 1485³)	1440 / 1495	1440²) / 1485²)³)
Wheel lock, inner / outer	37° / 30°				
Min. turning circle (m)	approx. 11		approx. 10.7		approx. 11
Wheel base (mm)	2650				2400
Length of vehicle (mm)	4460	4485	4500		4290
Width of vehicle (mm)	1740				1760
Height of vehicle, ready for driving (mm)	approx. 1560				app. 1320
Ground clearance, vehicle with 2 persons (mm)	approx. 195				app. 155

Weights

Dry weight of vehicle without fuel, spare wheel and tools (kg)	1070	1085			1075⁴)
Unladen weight of vehicle, ready for driving, with full fuel tank, spare wheel and tools (kg)	1150	1165			1160⁵)
Perm. total weight (kg)	1150	1615			1440
Perm. axle load (kg) front/rear	720/880	735/880			690/750

Capacities

Cool. system with heating (ltr.) Water	9	10			
Fuel tank / fuel reserve (ltr.) Fuel	56/5				65/6
Crankcase (ltr.) Engine oil max/min.	4/2.5				
Oil filter (ltr.) Engine oil	0.5				
Water pump (cm³) Hypoid oil SAE 90	10				
Transmission (ltr.) Automatic Transmission Fluid	4				
Rear axle (ltr.) Hypoid oil SAE 90	2.25⁶)				
Steering (ltr.) Hypoid oil SAE 90	0.3				
Brake system (ltr.) ATE blue brake fluid	0.5				
Wheel hub front (g) Anti-friction bearing grease	65				

¹) On model 180 with two-jointed rear axle [illegible] mm.
²) For rim size 5 JK × 13 B (2nd type), for rim size 4½ K × 13.0 (1st type) wheel track front 1430, rear 1475.
³) Previously 1470 mm.
⁴) Applies to roadster, for coupe 1095 kg.
⁵) Applies to roadster, for coupe 1180 kg.
⁶) On model 180 with 2-jointed rear axle 1.6 ltr.

Model	180	180 a	180 b	180 c	190 SL

Speeds, Consumption Figures and Operating Conditions

		180	180 a	180 b	180 c	190 SL
At rear axle ratio of i =		1:3.69	1:3.90			1:3.90[4])
Max. speed for individual gears (km/h) timed	1st gear	34	42			50
	2nd gear	58	74			76
	3rd gear	90	117			120
	4th gear	approx. 126	approx. 135			approx. 175
Climbing ability (%)	1st gear	43	54			50
	2nd gear	23	27.5			30
	3rd gear	13	15.5			17
	4th gear	8	6.9			9.5
Acceleration time in 4th gear from 20–100 km/h[1]) (sec)		38	33	32		25[5])
Engine speed at 100 km/h in 4th gear (rpm)		3390	3370	3350		3380
Fuel consumption for average high-way travel (ltr./100 km)		–	8–12	7.5–11.5		9.2–12.3
Fuel consumption acc. to DIN 70030[2]) (ltr./100 km)		[6])	10.9 at 101 km/h			10.9 at 110 km/h
Engine oil consumption (ltr./100 km)		0.15				
Cool. Water working temperature (° C)		70–95				
Fuel		regular fuel				premium[7]) (super)
Anti-Knock rating (Octane rating min. ROZ)	for optimal efficiency[3])	82	86			96
	with max. retardation of ignition and corresponding drop in output	80				90

[1]) Vehicle with 2 persons.
[2]) Measured at ¾ of max. speed 130 km/h + 10 %.
[3]) Gasoline engines are set for optimal output in the factory using commercial fuels. If exceptional cases for a short period demand the use of fuels having an octane rating below that stated for optimum output, ignition should in all cases be retarded correspondingly.
[4]) For gear ratio 2nd type: for gear ratio 1st type and
rear axle ratio i = 1 : 3.89 SL i = 1 : 3.70
Max. speed 50/80/140/approx. 175 54/82/148/approx. 175
Hill climbing ability 46/26/15/9.0 45/25/15/8.5
[5]) Acceleration period in 4th gear from 20 to 100 km/h in sec.
[6]) Standard fuel consumption 8.7 ltr/100 km; measured at ¾ of max. speed, 80 km/h + 10%.
[7]) Gasoline-benzene mixture, respectively.

II. Models 180 D, 180 Db, 180 Dc, 190 D and 190 Db

Models

Car Model	180 D	180 Db	180 Dc	190 D	190 Db
Chassis Type	120.11	120.11	120.11	121.11	121.11
Engine Model	OM 636.VII	OM 636.VII	OM 621.IV	OM 621.I	OM 621.I
Engine Type	636.930	636.930	621.914	621.910	621.910

Engine

Operation	4-cycle diesel Daimler-Benz constant flow principle precombustion chamber		
Number of cylinders	4		
Bore/Stroke (mm)	75/100	87/83.6	85/83.6
Total effective piston displacement (cm³)	1767	1988	1897
Compression ratio ε	19:1	21:1	
Injection order	1–3–4–2		
Max. speed (rpm)	3600	3800	4000
Engine performance in metric HP at rpm acc. to DIN¹) in gr. HP at rpm acc. to SAE	43/3500 48/3500	48/3800 52.4/3800	50/4000 55/4000
Torque max. in mkg/rpm acc. to DIN in mkg/rpm acc. to SAE	10.3/2000 10.6/2000	11/2200 11.4/2200	11/2200 11.5/2200
Crankshaft bearings	3 compound plain bearings with steel-backed shells		
Connecting rod bearings	compound plain bearings with steel-backed shells		
Valve arrangement	overhead		
Camshaft location	lateral	overhead	
Oil cooling	—	Oil-water heat exchanger	
Cooling system	Water circulation by means of pump, thermostat with by-pass pipe, fan		
Lubrication	Forced-feed lubrication by means of gear-type pump		

¹) The metric horsepower specified is actually available at the clutch, since the power used by the engine accessories has already been deducted.

Model	180 D	180 Db	180 Dc	190 D	190 Db

Electrical Equipment

	180 D	180 Db	180 Dc	190 D	190 Db
Battery Voltage (V) Capacity (Ah)	12 84		12 66	12 84	

Dimensions

	180 D	180 Db	180 Dc	190 D	190 Db
Wheel track (mm) front rear	1420 1460*)	1430 1475	1440 1485	1420 1460	1430 1475
Wheel lock inner outer	39° 33°				
Min. turning circle (m)	approx. 11	approx. 10.7			
Wheel base (mm)	2650				
Length of vehicle (mm)	4485	4500		4485	4500
Width of vehicle (mm)	1740				
Height of vehicle, ready for driving (mm)	approx. 1560				
Ground clearance, carrying 2 persons (mm)	approx. 195				

Weights

	180 D	180 Db	180 Dc	190 D	190 Db
Dry weight of vehicle (kg) without fuel, spare wheel and tools	1130	1140			
Unladen weight of vehicle, ready for driving, with full fuel tank, spare wheel, tools (kg)	1210				
Perm. total weight (kg)	1650	1660			
Perm. axle load (kg) front/rear	770/880	780/980			

Capacities

	180 D	180 Db	180 Dc	190 D	190 Db
Cool. System with heating (ltr.) Water	9		10.3		
Fuel tank / fuel reserve (ltr.) Fuel	56/5				
Crankcase (ltr.) Engine oil max./min	4/2.5				
Oil filter (ltr.) Engine oil	0.5				
Water pump (cm³) Hypoid oil SAE 90	10				
Transmission (ltr.) Autom. Transm. Fluid	1.4				
Rear axle (ltr.) Hypoid oil SAE 90	2.25¹)				
Steering (ltr.) Hypoid oil SEA 90	0.3				
Brake system (ltr.) ATE blue brake fluid	0.5				
Wheel hub front (g) antifriction bearing grease	65 each				

*) For vehicles with two-jointed rear axle 1450 mm ¹) On Model 190 D with two-jointed rear axle 1.6 ltr.

Model	180 D	180 Db	180 Dc	190 D	190 Db

Speeds, Consumption Figures and Operating Conditions

	180 D / 180 Db	180 Dc	190 D / 190 Db
At rear axle ratio of i =	1:3.70	1:3.90	1:3.70
Max speed in the individual gears (km/h) timed 1st gear 2nd gear 3rd gear 4th gear	28 48 75 approx. 110[3])		30 53 84 approx. 120[4])
Climbing ability (%) 1st gear 2nd gear 3rd gear 4th gear	35 19 11 6	38 20 12 6.5	36 19 11 6
Acceleration time in 4th gear from 40–100 km/h[1]) (sec)	39	36	32
Engine speed at 100 km/h in 4th gear (rpm)	3220	3350	3220
Fuel consumption for average highway travel (ltr/100 km)	5.7–7.8	6.0–8.0	5.7–8.0
Fuel consumption acc. to DIN 70030[2]) (ltr/100 km)	6.8 at 82.5 km/h	7.3 at 82.5 km/h	7.1 at 90 km/h
Engine oil consumption (ltr./100 km)	0.15		
Cooling water working temperature (°C)	70–95		
Fuel	Diesel fuel acc. to DIN 51601		

[1]) Vehicle carrying 2 persons.
[2]) Determined at ¾ of max. speed (110 km/h + 10%).
[3]) For Model 180 Dc a max. speed of 117 km/h must on no account be exceeded on down grades.
[4]) On down grades a max. speed of 130 km/h must on no account be exceeded.

III. Models 220 a, 219, 220 S, and 220 SE

Car model	220 a	219		220 S		220 SE
Chassis type	180.010	105.010		180.010[2]		128.010[3]
Engine model	M 180 II	M 180 II		M 180 III		M 127 III
Engine model	180.921	180.921		180.924		127.980
A. Engine						
Operation	Four-cycle carburetor					Four-cycle gasoline injection
Number of cylinders	6					
Bore/stroke (mm)	80:72.8					
Total effective piston displacement (cc)	2195					
Compression ratio ε	7.6:1	7.6:1	8.7:1	7.6:1	8.7:1	8.7:1
Firing or injection order	1—5—3—6—2—4					
Maximum R.P.M.	6000					
Engine performance in metric HP at R.P.M. according to DIN[1]	85/4800	85/4800	90/4800	100/4800	106/5000	115/4800
in gr HP at R.P.M. according to SAE	92/4000	92/4000	100/5000	112/5000	120/5200	130/5000
Maximum torque in mkg at R.P.M., DIN rating	16.0/2400	16.0/2400	17.0/2400	16.3/3500	17.5/3500	19.0/3800
in mkg at R.P.M., SAE rating	16.5/2500	16.5/2500	18.0/2700	17.8/3800	19.0/3600	20.2/3800
Crankshaft bearings	4 Compound plain bearings with steel-backed shells					
Connecting rod bearings	Compound plain bearings with steel-backed shells					
Valve arrangement	Overhead					
Camshaft location	Top					
Oil cooling	Oil-water heat exchanger					
Cooling system	Water circulation through pump, thermostat with by-pass pipe and fan					
Lubrication	Force-feed lubrication by means of gear-type pump					

[1] The metric horsepower specified is actually available at the clutch, since the power used by the engine accessories has already been deducted.
[2] Chassis type for Convertible A 180.030 and Coupé A 180.037.
[3] Chassis type for Convertible A 128.030 and Coupé A 128.037.

Model		220 b	219	220 S	220 SE

B. Electrical Equipment

Battery	voltage (V) capacity (Ah)	12 56			

C. Dimensions

Track (mm)	front rear	1430 1470			
Wheel lock	inner outer	33° 30°	39° 35°		
Minimum turning circle (m)		appr. 11			
Wheel base (mm)		2820	2750	Sedan 2820	Convertible and Coupé 2700
Length of vehicle (mm)		4715	4680	4750	4700
Width of vehicle (mm)		1740		1740	1790
Height of vehicle curb condition (mm)		appr. 1560		appr. 1560	appr. 1530
Ground clearance carrying 2 persons (mm)		appr. 215	appr. 205	appr. 215	

D. Weights

Dry weight of vehicle (kg) without fuel, spare wheel and tools		1180	mech. clutch 1170 autom. clutch 1165	Sed. Conv. Coupé 1230 1270 1255 1245 1305 1270	Sed. Conv. Coupé 1250 1310 1275 1265 1325 1290
Unladen weight of vehicle, with full fuel tank, spare wheel and tools (kg)		1280	mech. clutch 1260 autom. clutch 1275	1325 1365 1350 1340 1400 1365	1345 1405 1370 1360 1420 1385
Load capacity (kg)		450	mech. clutch 465 autom. clutch 450	465 405 440 450 390 425	465 405 440 450 390 425
Permissible total weight (kg) Permissible axle load (kg) front rear		1730 810 920	1725 825 900	1790 840 950	1810 860 950

E. Capacities

Cooling system with heating (ltr)	11.3			
Fuel tank / fuel reserve (ltr)	64/5.5	56/5	64/5.5	80/5.5
Crankcase (ltr) Engine oil max./min	6/3.5			
Oil filter (ltr) Engine oil	0.5			
Water pump (cc) Hypoid oil SAE 90	10			
Transmission (ltr) Automatic transmission fluid	1.4			
Rear axle (ltr) Hypoid oil SAE 90	2.25			
Steering (ltr) Hypoid oil SAE 90	0.3			
Brake system (ltr) ATE blue brake fluid	0.5			
Wheel hub front (g) Anti-friction bearing grease	65 each			

Model	220 a	219	220 S	220 SE

F. Speeds, Consumption Figures, and Operating Conditions

At rear axle ratio i =	1:4.11/4.10	1:4.10 1:3.70	1:4.10	1:4.10
Maximum speeds in the individual gears (km/h) timed 1st gear 2nd gear 3rd gear 4th gear	 44 68 110 appr. 130	 40 42 69 74 110 117 appr. appr. 149 164	 49 76 119 appr. 160	 49 76 119 appr. 160
Climbing ability (%) 1st gear 2nd gear 3rd gear 4th gear	 52 30 18 10	 52 55 30 31.5 18 18.5 10.5 10.6	ε=7.6:1 ε=8.7:1 52 55 30 31.5 18 18.5 10.5 10.6	 60 34 19 10.7
Acceleration time in 4th gear from 20 to 100 km/h (sec)	27	ε=7.6:1 ε=8.7:1 27 26	ε=7.6:1 ε=8.7:1 27 25	23
Engine speed at 100 km/h in 4th gear (rpm)	3470	3580 3370	3470	3470
Fuel consumption Fuel consumption for average highway travel (ltr/100 km)	—	ε=8.7:1 mech. cl. 9.0—12.5 aut. cl. 9.3—13.0	ε=8.7:1 9.0—12.0 9.3—12.5	8.7—12 9.0—12
Fuel consumption according to DIN 70030[1] (ltr/100 km)	—	ε=8.7:1 mech. cl. 11.2 at 110 km/h aut. cl. 11.4 at 110 km/h	ε=8.7:1 mech. cl. 10.7 at 110 km/h aut. cl. 10.9 at 110 km/h	mech. cl. 10.7 at 110 km/h aut. cl. 10.9 at 110 km/h
Rated fuel consumption[2] (ltr/100 km)	9.8	ε=7.6:1 9.8	ε=7.6:1 9.6	—
Engine oil consumption (ltr./100 km)	0.15			
Cooling water working temperature (°C)	70—95			
Fuel	Premium or benzol-gasoline fuel			
Anti-knock rating (octane rating ROZ)[3]	—	ε=7.6:1 ε=8.7:1 — 95—99	ε=7.6:1 ε=8.7:1 — 95—99	— 96—99
Minimum anti-knock rating ROZ[4]	82	87 90	87 90	93

[1] Determined at ¾ of the maximum speed, at a maximum of 110 km/h with a 10% increase

[2] Determined at ¾ of the maximum speed, at a maximum of 90 km/h with a 10% increase

[3] The gasoline engines are adjusted at our works with commercial fuels of the anti-knock rating given above (measured in accordance with the research method, ROZ). When fuels of a lower octane rating are used the ignition must be adjusted accordingly.

[4] In Models 219 and 220 S with a compression ratio of ε = 6.8:1 (optional extra, see Job-No. 01-3/3, Section B) the minimum octane rating ROZ is 80.

Measuring Runs

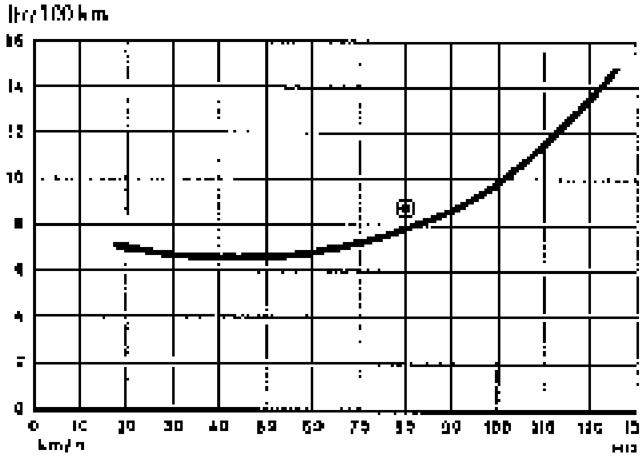
Job No
00-4

The directions given in the Model 190 Workshop Manual for measuring fuel consumption, oil consumption, acceleration, and maximum speed, apply, with the necessary modifications, also to Models 180 to 220 SE.

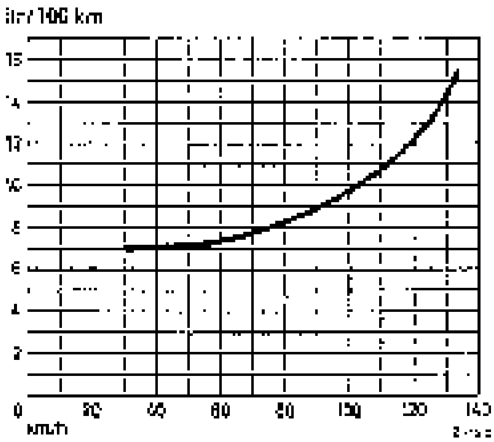
The prescribed weights (unladen weight and total weight of vehicle) of these Models are listed in the Section "Technical Specifications" (see Job No. 00-1), and the values for partial-load fuel consumption and for acceleration are given in the graphs on the following pages 00-4/2 to 00-4/6.

A. Partial Load Fuel Consumption Curves

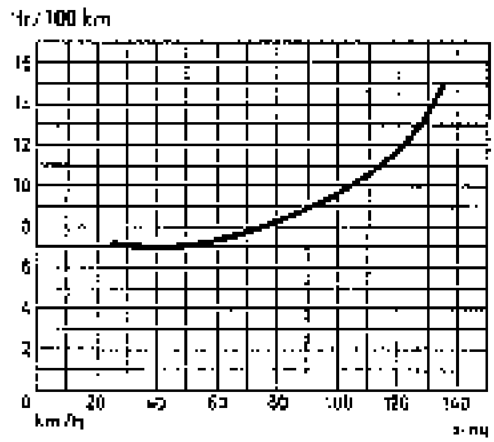
Load: Two persons and full fuel tank



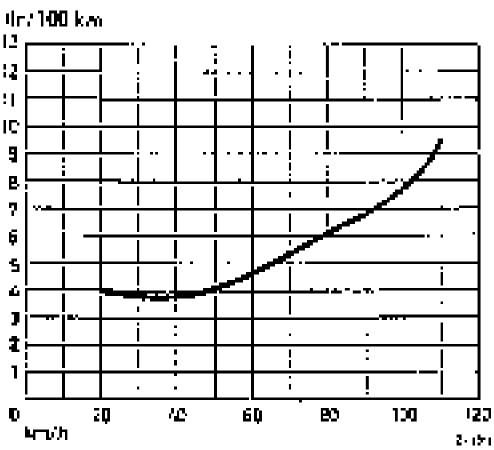
Model 180



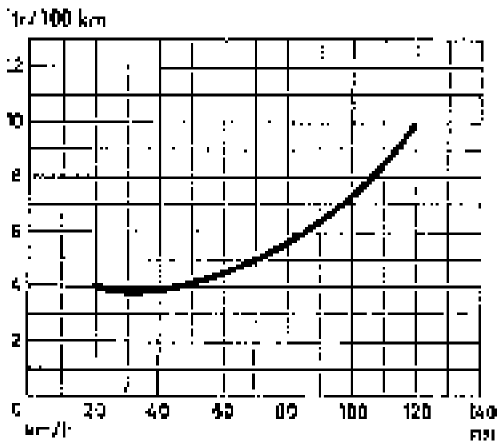
Model 180 a



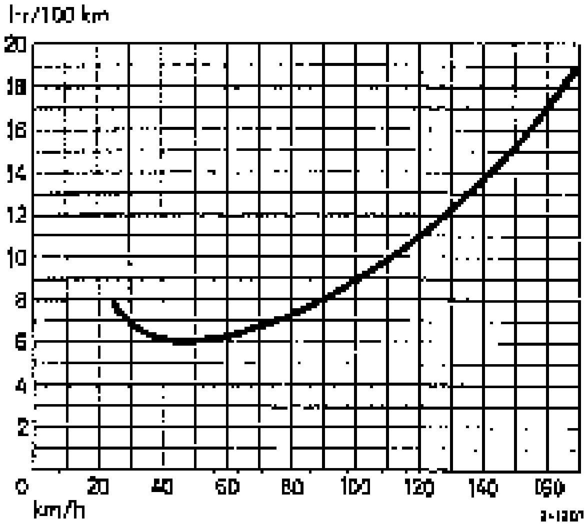
Model 180 b



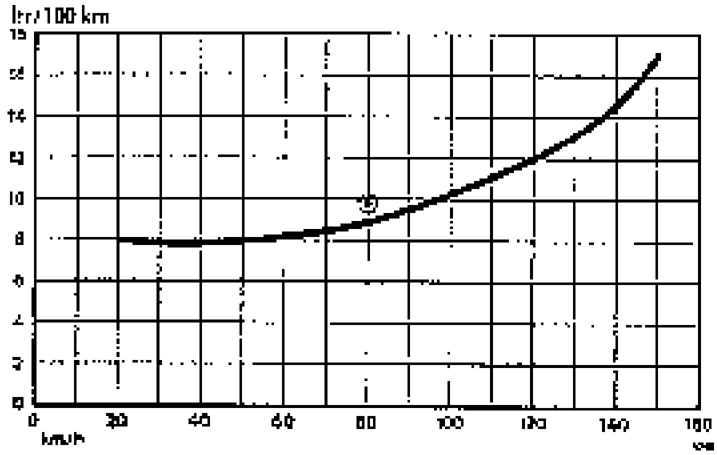
Models 180 D and 180 Db



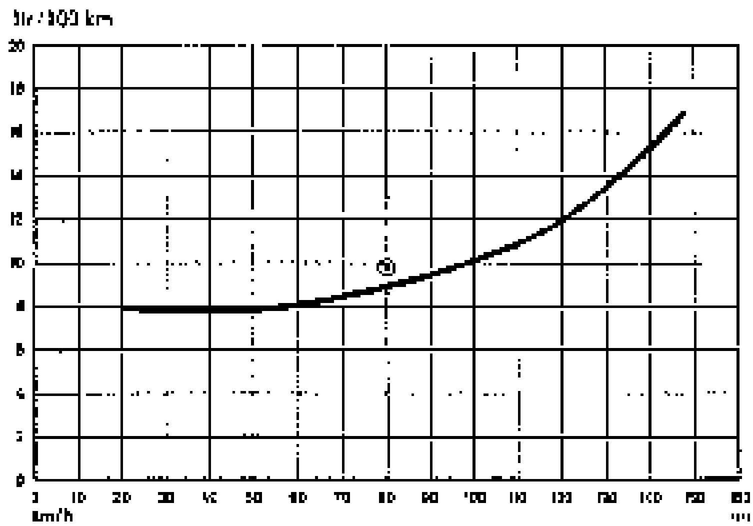
Models 190 D and 190 Db



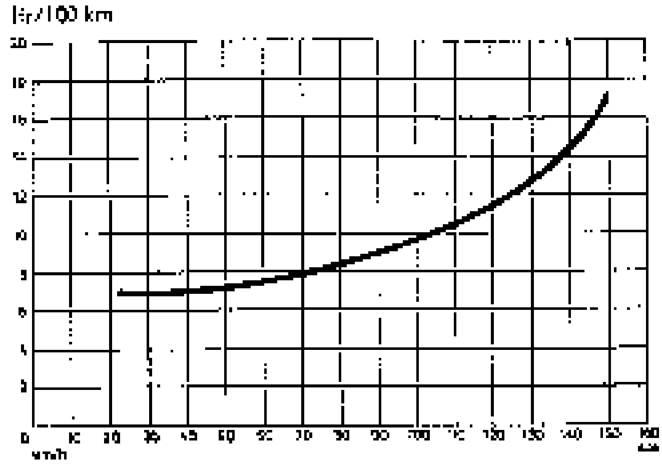
Model 190 SL



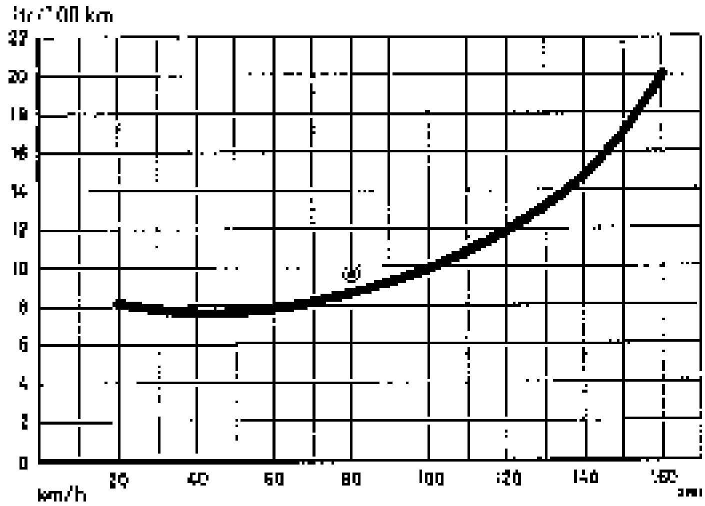
Model 220 a



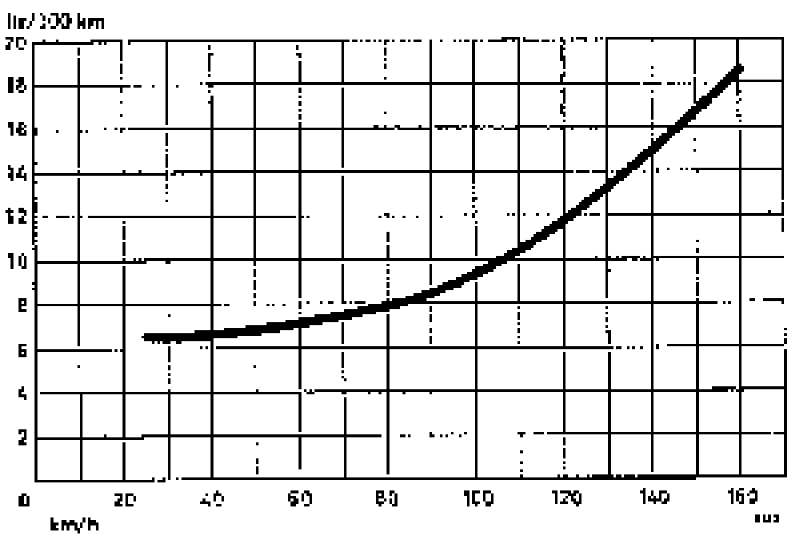
Model 219 with compression ratio ε = 7,6:1



Model 219 with compression ratio ε = 8.7:1



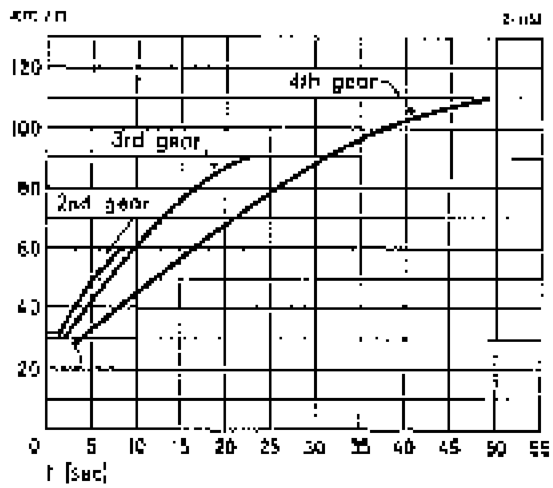
Model 220 S with compression ratio ε = 7.6:1



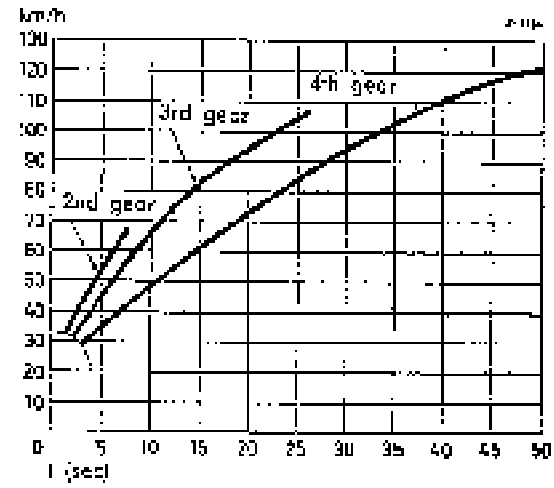
Model 220 S with compression ratio ε = 8.7:1 and Model 220 SE

B. Acceleration Curves

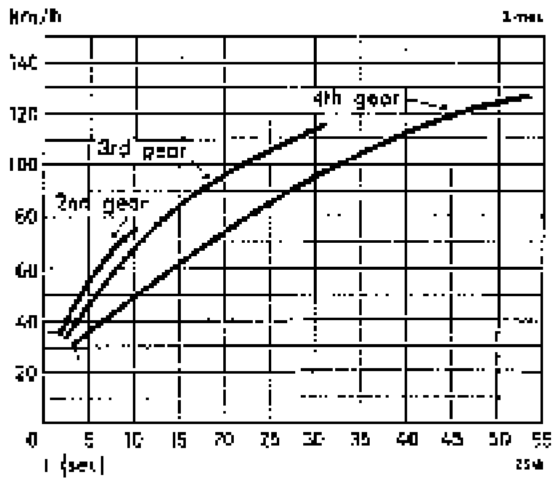
Load: Two persons and full fuel tank



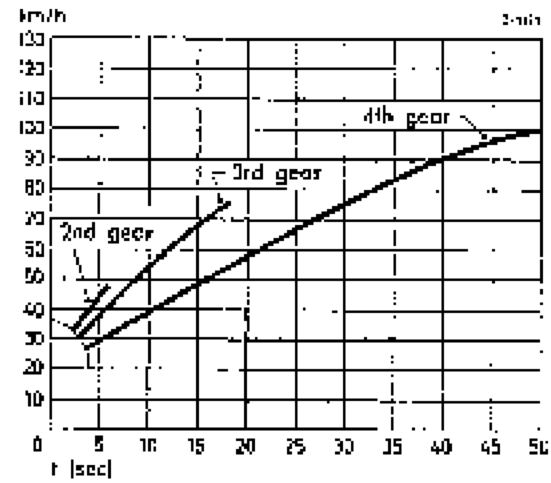
Model 180



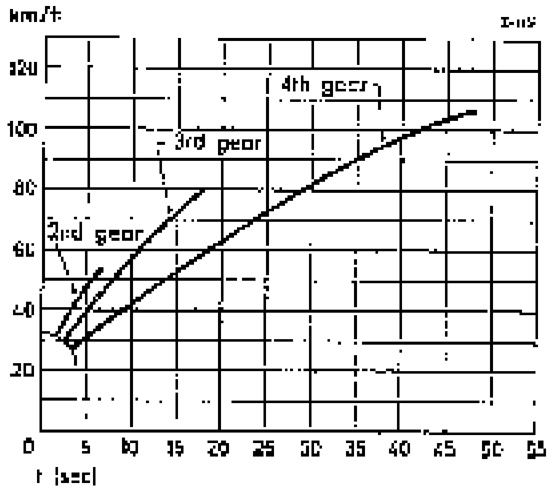
Model 180 a



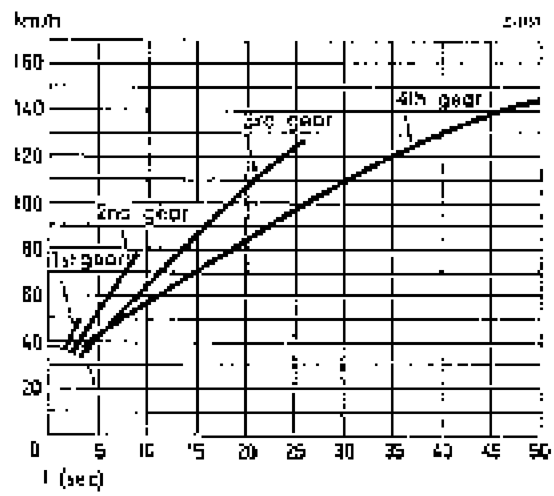
Model 180 b



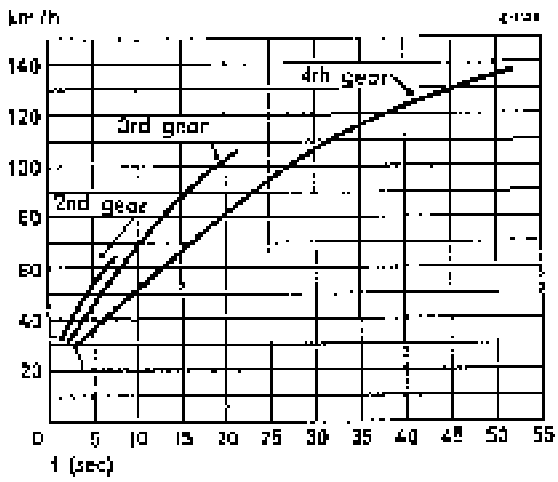
Model 180 D



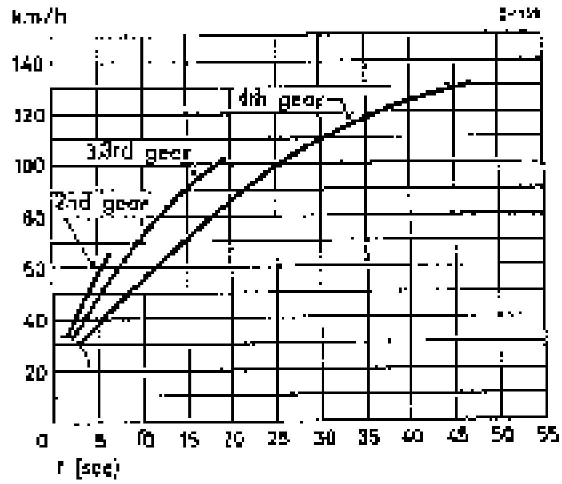
Model 190 D



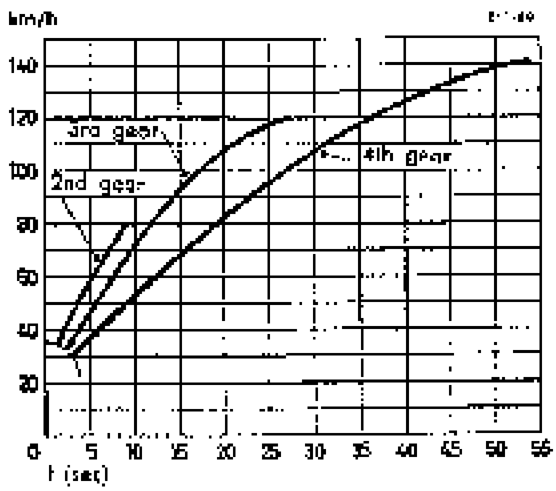
Model 190 SL



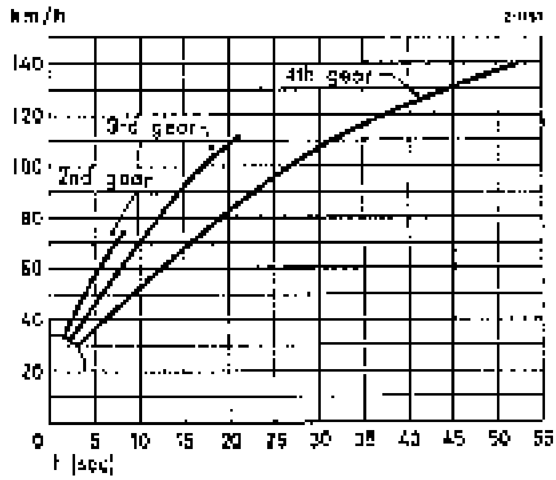
Model 220 a



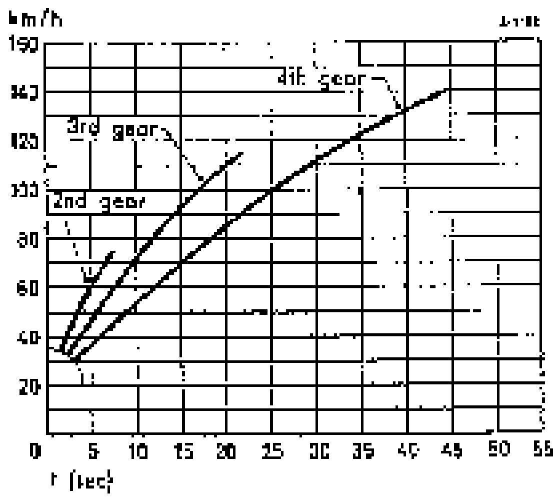
Model 219 (ε = 7.6:1)



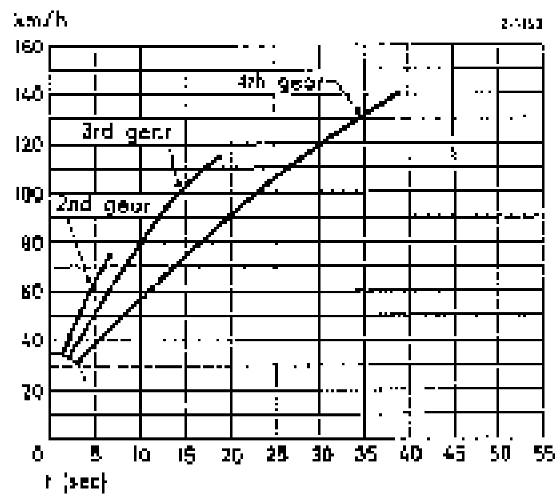
Model 219 (ε = 8.7:1)



Model 220 S (ε = 7.6:1)



Model 220 S (ε = 8.7:1)



Model 220 SE

Running-In Instructions for New and Replacement Engines

Job No.
00-7

Strict adherence to the running-in instructions is of vital importance for the reliable operation, service life, and economical running of every engine.

New and completely overhauled engines (replacement engines) are given their initial running-in in our works before they are installed in a vehicle or are shipped to a repair shop.

We recommend, therefore, that engines which have been repaired, e. g. by installing new bearings or new pistons, should be run in for a short period of time before they are installed in the vehicle. Since in most cases, however, a test stand and brake will not be available, the following short instructions show how engines can be run in on an ordinary test bench with outside cooling and without a braking system. Water temperature (appr. 80° C) and oil pressure must be checked at regular intervals.

Running-in Instructions

Engine speed rpm	Running-in period (minutes)		
	Models 180, 180 a, 180 b, 190, 190 b	Models 190 SL, 220 a, 219, 220 S	Model 220 SE
1500 *)	30	30	30
1800—2000	20	20	30
1800	10	20	30
2000	10	20	20
2500	5	5	20
2500—3000	5	5	20

*) When the engine has been run in at 1500 rpm, the cylinder head screws should be retightened according to our instructions, and in addition all screws and nuts for fastening the intake pipe, the carburetor, the exhaust manifold, the starter, and the generator should be retightened.

Running-in has the additional advantage that the engine, while removed from the car, can be checked for leakage, oil pressure, quiet operation, and idle.

Furthermore it is advisable to make an oil change directly after running in the engine and to clean the air filter at the same time. It is a common experience that very many impurities are left in the corners and cavities of the housing even if the engine components are carefully cleaned before assembly; these impurities are loosened by the splashing oil when the engine is being run in and are removed when the oil is drained off.

When the engine is installed in the car, the running-in instructions given in the Owner's Manual should be followed.

Engine and Engine Suspension

Engine and Engine Suspension Groups 01-24

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Removal and Installation of Engine together with Transmission

Job No. 01-1

On Models 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE the removal and installation operations for the engine together with the transmission are basically the same as for Model 190. In addition, the following points require attention for the various Models:

I. Model 190 SL

(See also Section II)

a) Engine Hood

Before removing the hood, mark the position of the hinge bearing on the left side and unscrew the hinge bearing. Then push the engine hood toward the left and remove it.

When reinstalling the engine hood, make sure that the hood is properly seated and pay attention to the marks on the hinge bearing made during removal.

b) Air Intake Silencer

Detach the flexible hose from the air intake pipe and the rubber hose from the vent tube, and remove the cover of the air intake silencer together with the flexible hose. Then loosen the three hexagon screws at the bottom of the silencer base. When lifting the air intake silencer, check the damping plate between the cowl and the air intake silencer. Damaged damping plates should be replaced.

The flexible hose between the air intake silencer and the air intake pipe must not be kinked after it has been installed.

c) Fuel Overflow Line

Disconnect the rubber hose between the fuel overflow line and the pipe at the air scoop bracket on the cowl.

On installation align the two pipes; the rubber hose must not be kinked.

In addition, make sure that the pipe on the air scoop bracket is fastened in such a way that the distance between the lower end of the pipe and the drain funnel is appr. 10 mm.

d) Hot-Start Mechanism

Disconnect the control cable for the hot start mechanism from the rear carburetor.

Connection and disconnection of the control cable are described in Job No. 30-6.

e) Speedometer Drive

Disconnect the flexible speedometer drive at the front of the engine.

When connecting the drive, make sure that the shaft is not kinked.

f) Oil Filter

Unscrew the oil filter housing from the crankcase. In order to prevent dirt from getting into the oil passages, close the openings in the crankcase by means of wooden plugs or cover them with textile tape.

Use a new gasket when reinstalling the oil filter.

g) Gear Shift Mechanism

Removal:

1. Fold the rubber mat on the transmission tunnel over to the left. After unscrewing the hexagon tappet screws from the tunnel, remove the cover plate for the gear shift linkage.
2. Engage 1st gear and loosen the hexagon nut of the clamping screw on the yoke end of the shifting shaft.
3. By engaging 2nd gear push the shifting shaft forward and retain it by holding the yoke end in position. Then pull out the shift tube toward the rear from the splines in the yoke end.

Installation:

4. Move the shifting shaft against the reverse gear stop, put the gear shift lever vertical (seen in the direction of travel) and insert it in the splines of the shifting shaft yoke end. In this position the gear shift lever must be absolutely vertical (seen in the direction of travel and at right angles to it).

   Then tighten the hexagon nut of the clamping screw on the yoke end.

Note: To gain better access to the hexagon nut, it is advisable to engage 1st gear without, however, displacing the shift tube in the yoke end.

5. Check the gear shift mechanism. To do this, engage the various gears and check whether, when the gear is engaged, there is sufficient clearance between the shift lever and the upper shift lever bearing. The shift lever must on no account butt against the shift lever bearing, since this may cause the gear to slip out. Always declutch when shifting the individual gears.

6. Screw on the cover plate for the gear shift linkage and put on the rubber mat.

II. Models 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE

(For Model 220 SE see also Section III)

a) Cylinder Head Cover

On Models 219 and 220 S with hydraulic automatic clutch it is advisable to remove the cylinder head cover before lifting out the engine. This makes it much easier to remove the engine together with the transmission, since the engine can be lifted higher at the front end.

b) Clutch Actuating Mechanism

Models 190 SL and 220 a have three different versions of the clutch actuating mechanism, whereas Models 180 a, 180 b, 219, 220 S, and 220 SE have only the latest version, which is also installed in Model 190.

The installation and removal procedures for the clutch actuating mechanism are different for the different versions. For details see Job No. 21-1.

c) Reversing Light Switch

On the first cars of Model 220 a the reversing light switch was mounted in the bearing block for the steering wheel shift mechanism, so that it was not necessary to disconnect the cables. On later cars, as also on Models 180 a, 180 b, 190, 190 SL, 219, 220 S, and 220 SE, the switch was mounted on the transmission case cover. For that reason the cables of the reversing light switch must be disconnected and reconnected at the cable connector fastened to the bearing block for the steering wheel gear shift mechanism whenever the transmission is removed or installed.

On the first cars of Models 190 SL and 220 a the cables were directly connected to the switch without any cable connector. Since in this version the terminals are not easily accessible, the cables must be cut off and must be connected by a cable connector when the transmission has been reinstalled.

d) Rear Engine Suspension

Models 180 a, 180 b, 190 SL, 220 a, and 219 with Three-Point Engine Suspension

Before the engine together with the transmission is removed from the car, the rear rubber mounting must be disconnected from the chassis base panel. Procedures are as follows:

Removal:

1. Slightly raise the engine at the transmission by means of a car jack. Loosen the two hexagon screws fastening the rear rubber mounting to the chassis base panel and remove them, paying attention to the washers between rubber mounting and chassis base panel (see para 3).

2. Lower the engine together with the transmission and support it under the oil pan, taking care, however, that the oil pan does not rest on the center thread of the steering shock-absorber. Further removal procedures are the same as in cars with four-point engine suspension.

Installation:

3. After reinstalling the engine together with the transmission, raise the engine and fasten the rear rubber mounting to the chassis base panel, but do not yet tighten the nuts.

   When inserting the hexagon screws, make sure that the same washers are installed

between rubber mounting and chassis base panel as were installed originally. This applies in particular to Model 190 SL. On this Model a 30 mm washer must be installed between chassis base panel and rubber mounting (see also Job No. 24-1).
On older cars, on which the hexagon screws for the rear rubber mounting were secured by lock nuts, only Self-Locking Nuts M 10 AGGN 14 440 should be installed.

4. Allow the engine to settle in the rubber mountings. This is necessary in order to ensure that the engine is seated without forcing. When this has been achieved, tighten the two nuts on the rear rubber mounting.

Models 190 SL, 219, 220 S, and 220 SE with Four-Point Engine Suspension

On Models 190 SL (as from chassis end no. 65 00 376), 219 with hydraulic automatic clutch, 220 S, and 220 SE the rear rubber mountings are provided with a limit stop as on Model 190.

On Model 190 SL, from chassis end nos. 65 00 173 to 65 00 375, the rear rubber mountings have no limit stop.

III. Model 220 SE

(See also Section II)

Before removing the engine together with the transmission, it is advisable to remove the right engine compartment panel, the battery behind it, and the horn on the left fork bracket, in order to prevent damage to these parts. The same applies to the installation procedure. In addition, particular care should be taken to ensure that **the ropes around the engine do not touch and bend the lines, the control linkage, or the control levers. Bent rods and levers change the adjustment of the control linkage and consequently the fuel-to-airratio.** For this reason the control linkage should always be checked after the engine has been reinstalled in the car (see Workshop Manual Passenger Car Models starting August 1959, Job No. 00-16).

Engine Tune-Up

Change: Model 180 c and modified valve timing gear have been added.

In general it is sufficient to carry out the checking and adjustment operations described in the procedures A–K below for gasoline engines and in the procedures A–G and M–P for fuel injection engines.

It is usually unnecessary to check the valve timing settings; this should only be done in special cases.

An accurate adjustment of the tappets is not possible when the engine is warm and should therefore never be undertaken. For this reason the tappet clearance data always refer to the cold engine.

If it should be necessary to begin adjustment operations with the engine at working temperature, procedures B etc. should be carried out first and, when the engine is cold, the tappet clearance should be adjusted and finally, after the engine has warmed up again, the idle should be adjusted. In the case of the injection engine for model 220 SE the control linkage can only be adjusted after the tappet clearance has been checked.

Operations should be carried out in the following order:

A. Tappet clearance adjustment
B. Compression measurement
C. Cleaning and testing of spark plugs
D. Measurement and adjustment of distributor contact gaps and angle of closure
E. Ignition setting
F. Checking camshaft adjustment
G. Measurement and adjustment of pressure of fuel feed pump
H. Measurement and adjustment of fuel level and injection amount of gasoline engines
I. Trouble-shooting hints on carburetor system
K. Adjustment of carburetor linkage and idle
L. Testing valve timing
M. Measurement of intake pipe vacuum
N. Exhaust gas test values
O. Engine testing on the roller test stand
P. Adjustment of gasoline injection pump in model 220 SE
Q. Checking gasoline injection system of model 220 SE
R. Trouble-shooting hints on gasoline injection system of model 220 SE
S. Adjustment of control linkage, idle adjustment, and readjustment of speed build-up of gasoline injection engine in model 220 SE

A. Tappet Clearance Adjustment

Tappet clearance should only be checked or adjusted with the engine cold!

On models 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE the tappet clearance is adjusted and checked as described for model 190, with the difference, however, that on model 220 SE not only the cylinder head cover, but also the air filter and the venturi control unit must be removed (see Job No. 01–4, Section A), and that the adjustment of the control linkage must always be checked after the tappet clearance has been checked and after previously removed parts have been reinstalled (see Workshop Manual Passenger Car Models starting August 1959, Job No. 00–16).

Tappet Clearance

Models	220 a	180 a, 180 b, 190, 190 SL	180 c 190 SL[1]	219, 220 S, 220 SE
Inlet	0.09	0.10	0.09	0.12
Exhaust	0.20	0.20	0.15	0.20

During adjustments be sure that the gage (tolerance feeler band) requires a firm pull. For setting tappet clearance use only the special Wrench Combination 000 589 11 07 or the short Wrench Combination 000 587 64 09. Using any other tool may prevent full tightening of the hexagon nut on the adjusting screw and the nut may come loose. Also, use of an unsuitable wrench may damage the hex nut during the tightening. Be sure to replace any damaged nuts.

[1] On the new, further modified valve timing (Fig. 01–3/2a) the tappet clearance is measured between the slide surface of the rocker arm the cam base circle of the camshaft.

If models 180 c and 190 SL with the new valve timing require a correction of their tappet clearance, adjustments are made by turning the upper portion of the ball pin at the hexagon portion (SW 14) with the adapter 111 589 03 63 (1) and a torque wrench (0–6 mkg) (2) Fig. 01–3/1). Too small a tappet clearance is increased by screwing ball pin top down, too large a tappet clearance is decreased by screwing the ball pin top out. When turning the ball pin top (2) in its socket (1) the adjusting torque should be at least 1.5 mkg (Fig. 01–3/2b). If the adjusting torque is less, either the ball pin top (2) or the ball pin socket (1) or both parts should be replaced. If the tappet clearance is too small and the ball pin top cannot be further adjusted (turned down) by means of the hexagon SW 14 into the ball pin socket, a thinner thrust piece (7) may be inserted into valve spring retainer (9) (Fig. 01–3/2a). Normally, the thrust plates are 4.5 mm thick, they are also available 3.5 mm and 2.5 mm thick. Replacement of a thrust plate requires disassembly of the rocker arm (refer to Job No. 05–1).

Valve Arrangement

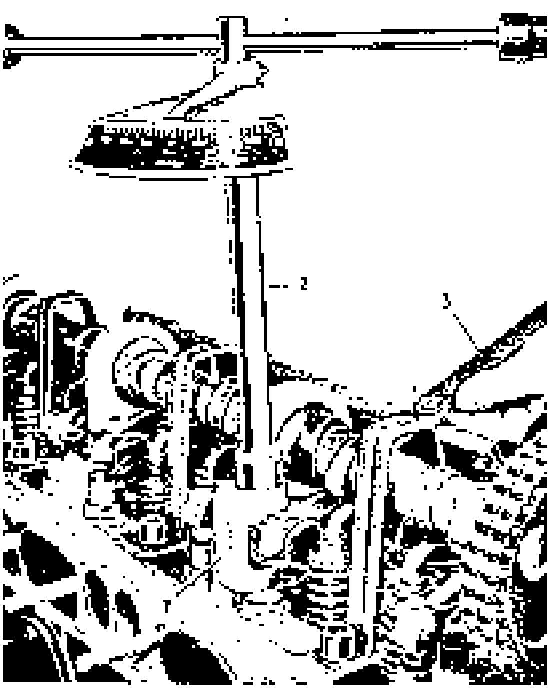


Fig. 01–3/1

1 Adapter for adjustment of tappet clearance 111 589 03 63
2 Torque spanner
3 Gage with tolerance feeler band 0.08 mm and 0.15 mm

Note: The camshaft with Code No. 33 used in models 219 and 220 S with a compression ratio of $\varepsilon = 8.7:1$ is also available as a replacement for models 220 a, 219 and 220 S with a compression ratio of $\varepsilon = 7.6:1$. When using the camshaft with Code No. 33 for type 220 a inlet tappet clearance should also be set to 0.12 mm. When installing a camshaft with Code No. 33 sodium-filled exhaust valves should be included in the installation.

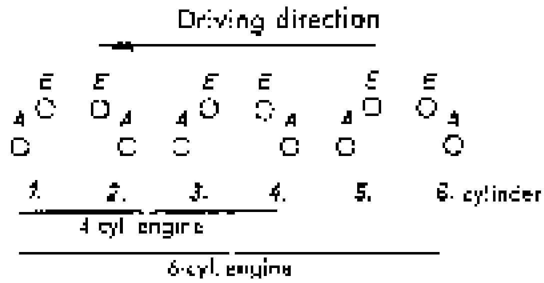


Fig. 01–3/2

B. Compression Measurement

The compression pressure should always be measured (by means of the Compression Recorder 000 589 18 21) **with the engine at working temperature and the throttle valves fully opened** (see Model 190 Workshop Manual).

The compression values are listed in the Table below. They apply only when Compression Recorder 000 589 18 21 is used. When judging the compression pressure, not so much importance should be attached to the absolute figure as to the equality of the figures for the individual cylinders. The figures obtained for the individual cylinders **must not vary by more than 1.5 atmospheres.**

Compression Ratio, Capacity of Compression Chamber, and Compression Pressure

Model	180 a 190 [1]	180 b	180 a [2] 180 b [2] 190	220 a [3] 219 [3] 220 S [3]	220 a 219 [4] 220 S [4]	219 [5] 220 S [5] 220 SE	190 SL [6]	190 SL [7]
Compression ratio ε Maximum permissible Normal Minimum permissible	 7.0:1 6.8:1 6.6:1	 7.25:1 7.0:1 6.8:1	 7.8:1 7.5:1 7.25:1	 7.1:1 6.8:1 6.5:1	 7.8:1 7.6:1 7.35:1	 9.0:1 8.7:1 8.4:1	 8.8:1 8.5:1 8.25:1	 9.2:1 8.8:1 8.45:1
Total capacity of compression chamber with cylinder head fitted (cc)	70.5—81.5	76—82	69.0—75.0	60.5—65.5	53.5—57.5	45.5—49.5	60.3—66.3	57.8—63.8
Capacity of compression chamber in cylinder head with valves fitted and spark plugs screwed in (cc)	70.3—71.3	68.5—69.5	62.3—63.3	50.0—51.0	44.5—45.5	36.4—37.4	51.7—53.7	49.3—51.3
Compression pressure in new engines (atmospheres)	7.5—8.0	7.5—8.0	9.0—9.5	7.5—8.0	8.0—8.5	9.0—10.0	9.0—9.5	9.0—10.0
Minimum compression pressure in used engines (atmospheres appr.)	6	6	7	6	7	8	8	8

[1]) Engine with lower compression as optional extra for Model 190 according to SA 10250.

[2]) Engine with higher compression for countries with altitudes above 2000 meters as optional extra for Models 180 a and 180 b according to SA 10331.

[3]) Engines with lower compression as optional extra for Models 220 a and 219 according to SA 10337, and Model 220 S according to SA 10197.

[4]) 1st Version on Model 219 up to engine end no. 75 06347, on Model 220 S up to engine end no. 75 09383.

[5]) 2nd Version on Model 219 with standard clutch as from engine end no. N 75 04348, with hydraulic automatic clutch as from engine end no. Z 75 00002, on Model 220 S with standard clutch as from engine end no. N 75 09084, with hydraulic automatic clutch as from engine end no. Z 75 00008.

[6]) 1st Version up to engine end no. 65 03803.

[7]) 2nd Version as from engine end no. 65 03804.

On previous Models the compression ratio was stamped on the left rear part of the cylinder head; on recent Models it is cast in the cylinder head on the left-hand side above the threaded union for the water pipe connection (Fig. 01-3/3).

Compression ratio markings on cylinder head
now previously

Fig. 01-3/3

C. Cleaning and Testing of Spark Plugs

For testing and cleaning the spark plugs and for the interpretation of spark plug appearance in Models 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE see the details given in the Model 190 Workshop Manual.

Approved Spark Plugs

The approved spark plugs are listed in our Service Bulletins and Spark Plug Tables and are also contained in our Workshop Tables.

Thread Length of Spark Plugs

The thread lengths differ on different types of spark plugs. It is necessary therefore to ensure that only spark plugs of the type approved for the individual engines are installed.

Wrong spark plugs may cause engine trouble and may even damage the engine.

The following list gives the thread length of the spark plugs for the various engines. The Table is based on thread length "H_2" (Fig. 01-3/4a).

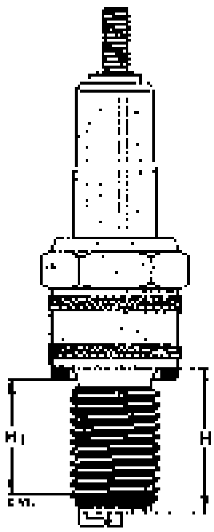


Fig. 01-3/4 a

H_1 = free thread length
H_2 = thread length (standard length)

Thread Length of Spark Plugs

Model	Thread length "H_2"
180 a, 180 b, 190, 220 a, 219, 220 S all with the exception of ε = 8.7:1	12
190 SL with ε = 8.5:1	18
190 SL with ε = 8.8:1	19 *)
219, 220 S with ε = 8.7:1	19 *)
220 SE	19

*) The cylinder heads for Models 190 SL (ε = 8.8:1) and 219, 220 S (ε = 8.7:1) formerly had a plug thread for spark plugs with a thread 18 mm long, and now have a plug thread for spark plugs with a 19 mm thread. To distinguish the two types, cylinder heads with a plug thread for 19 mm spark plugs are marked "19" beside the compression ratio marking.

On Champion spark plugs the beginning of the thread is not chamfered, so that the free thread length "H_1" is slightly longer than that of Bosch and Beru spark plugs. For this reason it is necessary to install a second sealing ring of a minimum thickness of 1 mm when Champion spark plugs are used. This is necessary, since otherwise part of the plug thread would project into the combustion chamber and may accumulate carbon deposits, which, under certain circumstances, may damage the thread in the cylinder head when the plugs are unscrewed.

Installation of Spark Plugs

Spark plugs should only be slackened and tightened by means of the Articulated Spark Plug Wrench 000 581 00 67. Great care is necessary when this wrench is used to screw in the spark plugs, as a certain amount of experience is necessary to insert the spark plug correctly. In order to avoid damage to the plugs and to the thread in the cylinder head, Spark Plug Holder 198 580 00 65 should be used for screwing in the spark plugs (Fig. 01-3/4b).

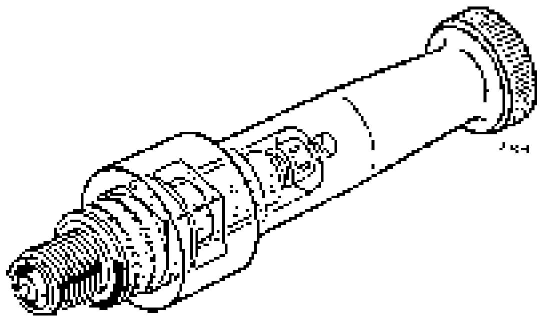


Fig. 01-3/4b

The Rubber Socket 000 581 00 86 pressed into the Articulated Spark Plug Wrench and the Socket 000 581 00 56 screwed into the Spark Plug Holder are replaceable.

D. Measurement and Adjustment of Distributor Contact Gaps and Angles of Closure

Measurement and adjustment on Models 180 a, 190 b, 190 SL, 220 a, 219, 220 S, and 220 SE are carried out in the same way as on Model 190. **We should like to point out again that whenever the angle of closure has been corrected, it is absolutely necessary to check whether the contact gap is still satisfactory.**

When the contact gaps have been adjusted, it is always necessary to check and if necessary to readjust the ignition setting.

Distributor Contact Gaps and Angles of Closure

Model	180 a, 180 b, 190, 190 b, 190 SL	220 a, 219, 220 S, 220 SE
Distributor contact gap (mm)	0.4—0.5	0.3—0.4
Angle of closure *)	50° ± 2°	36° ± 2°

*) When measuring the angle of closure please note that at higher engine speeds it may be lower by a maximum of 3°.

E. Ignition Setting

For the ignition setting in Models 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE see the details given in the Model 190 Workshop Manual.
Ignition adjustment should always be made by means of a flash stroboscope, and a timing light should only be used in exceptional circumstances.
The adjustment data are listed in the Table overleaf.

Ignition Setting

Model	Compression ratio	Distributor Bosch designation	Basic setting and stroboscope value at starter speed	Stroboscope values at engine speed (rpm): 800, with automatic vacuum control	800, without	1500, without	3000, without	4500, without	4500, with
180 a 4) 190	6.8:1	VJU 4 BR 14 VJU 4 BR 22 VJUR 4 BR 27	8° ± 1° BTDC	15°—23° 12°—19°	26°—32° 12°—19°	27°—33°	32°—39°	41°—47°	47°—53°
180 b 4)	7.0:1	VJUR 4 BR 28	4° ± 1° BTDC	0°—10°	0°—10°	19°—25°	37°—43°	44°—52°	52°—62°
220 a 219	6.8:1 7.6:1	VJU 6 BR 24 VJUR 6 BR 24 VJUR 6 BR 36	5° ± 1° BTDC	10°—19°	10°—19°	23°—30°	28°—34°	34°—41°	47°—53° 1)
219	8.7:1	VJUR 6 BR 38	1° ± 1° ATDC	4°—13°	4°—13°	17°—24°	22°—28°	28°—35°	36°—47° 1)
220 S	6.8:1 7.6:1	VJUR 6 BR 24 VJUR 6 BR 38	9° ± 1° BTDC	13°—22°	13°—22°	26°—33°	31°—37°	37°—43°	45°—56° 1)
220 S	8.7:1	VJU 6 BR 38	2° ± 1° BTDC	7°—16°	7°—16°	20°—27°	25°—31°	31°—38°	39°—50° 1)
220 SE	8.7:1	VJUR 6 BR 32	2° ± 1° BTDC 2)	0°—6°	0°—6°	13°—17°	24°—28°	28° 3)	36°—40°
190 SL	8.5:1 8.8:1	VJUR 4 BR 11 VJ 4 BR 12	1° ± 1° BTDC	—	—	—	35°—45°	—	—
		VJ 4 BR 17 VJR 4 BR 24	3° ± 1° BTDC	—	—		35°—41°	—	—

1) In the case of the 2nd version distributor VJUR 6 BR 38 the vacuum control is 10±2° on the crankshaft, as compared with 20±2° on distributors VJUR 6 BR 38, 1st version, VJUR 6 BR 24, and VJU 6 BR 24. The values given in the above table apply to distributor VJUR 6 BR 38, 2nd version; the corresponding values for the 1st version and for the two distributors VJUR 6 BR 24 and VJU 6 BR 24 are 10° higher (e. g. 52°—63° instead of 42°—53°).

2) The basic setting only applies to the assembly setting. For the final ignition setting see the values given for a speed of n = 4500 rpm without automatic vacuum control.

3) In the case of distributor VJUR 6 BR 32 T, whose centrifugal governor advance curve is near the upper limit of the tolerance range, the centrifugal governor control already starts at a speed of n = 650 rpm. For this reason the ignition setting with a distributor VJUR 6 BR 32 T should also be checked at idling speed. At this speed the ignition setting must not be earlier than 4° BTDC. If the value is smaller, ignition can be retarded up to 26° BTDC at a speed of n = 4500 rpm.

If in exceptional cases a fuel with an octane rating lower than 96—99 ROZ (F—1) has to be used, ignition must be retarded in order to adapt it to the octane number of the fuel used. This setting should be carried out only within certain limits set out below.

Fuel with ROZ	Stroboscope value at n = 4500 rpm
93	26° BTDC
90	22° BTDC
88	20° BTDC

Ignition should be retarded at the distributor bearing by means of the hand lever. Adjustment by one graduation changes the ignition by 2° on the crankshaft. As soon as premium gasoline is being used, the hand lever should be moved back to its full advance position (28° BTDC at n = 4500 rpm).

If in engines which have run for a considerable time, the ignition is found to have moved in the "advance" direction, check the end play of the idling gear shaft, which should be 0.05—0.12 mm. If the end play exceeds 0.20 mm, the wear parts must be replaced.

4) Ignition setting on Models 180 a and 190 b with a compression ratio ε = 7.5:1 for countries with altitudes above 2000 meters: 3° BTDC.

Note: The distributor named first with each model indicates the present standard design.
On model 190 SL the distributors VJ 4 BR 12, VJ 4 BR 11 and VJR 4 BR 24 have no vacuum control. Though the distributor VJUR 4 BR 11 is provided with a vacuum box, it is not connected. Compared with the two other distributors the VJ 4 BR 11 and VJR 4 BR 24 have a different movement curve. Therefore, care must be taken, that the various distributors are not mixed up when the ignition is adjusted.

Measurement of Ignition Vacuum Control

If the initial operation of the vacuum control and the amount of the vacuum should ever require an inspection, the following table shows the required values. However, the vacuum at the distributor should not be confused with the vacuum at the testing connection of the intake pipe. For this reason a Tee-piece should be inserted on the distributor when measuring the vacuum.

Initial Operation of Vacuum Control and Amount of Vacuum

Model	Distributor	Begins to operate at Engine Speed without Load rpm	Vacuum at Distributor mm Hg
180 a, 190	VJU 4 BR 14 VJU 4 BR 22 VJUR 4 BR 27	1000–1200	90–120
180 b, 180 c	VJUR 4 BR 26	1000–1200	90–130
220 a, 219	VJU 6 BR 24 VJUR 6 BR 24	1400–1600	90–120
[illegible]	VJUR 6 BR 33	1400–1600*)	90–160
220 S	VJUR 6 BR 24	1800–2000	90–120
220 S	VJUR 6 BR 33	1000–2000	90–160
220 SE	VJUR 6 BR 32	800–1000	90–140

*) For carburetors with by-pass bores (as from No. 3003560) vacuum control at engine speed n = 3500–3800 rpm

F. Checking Camshaft Adjustment

The camshaft adjustment for models 180 a, 180 b, 180 c, 190 SL, 220 a, 219, 220 S and 220 SE is tested in the same workshop way as described in the manual for model 190.

Contrary to the above and contrary to the more recent models the earlier 220 a and the early 190 SL models have no marks at the front of the counterweight on the crankshaft. On these engines the graduation on the flywheel should be used, which is exposed at bottom of clutch housing after removing cover plate.

G. Measurement and Adjustment of Pressure of Fuel Feed Pump

I. Models 180 a, 180 b, 180 c, 190 SL, 220 a, 219 and 220 S

The fuel feed pump, the location of the pump on the engine, its drive, as well as measuring and adjusting of delivery pressure, are the same as for Model 190.

Note: When reassembling the pump make sure that prior to tightening the upper part of the pump the diaphragm spring is pre-stressed up to stop by means of hand lever, because otherwise the diaphragm will either tear or warp during operation.

Test Values of Fuel Feed Pump

Delivery Pressure		Vacuum at Suction Side
At Starter Speed	At Idling Speed	
0.12–0.16 atm.	0.15–0.20 atm.	0.28–0.38 atm.

II. Model 220 SE

For description and test procedure of electric fuel feed pump refer to Workshop Manual Passenger Car Models starting August 1959, Job. No. 00–15.

H. Measurement and Adjustment of Fuel Level and Injection Amount in Carburetor Engines

Fuel Level and Injection Amount

Model	180 a	180 b	180 c	190 SL	220 a, 219	220 S
Fuel Level mm	16–20	16–18	16–18	*)	13–15	19–21
Injection quantity cm³/stroke	0.9–1.2	1.0–1.2	0.7–1.0	0.4–0.6	1.3–1.5	1.1–1.3

*) Distance from separating surface of carburetor cover with gasket to upper edge of vertical float wall. For die-cast carburetors 36–38 mm, for sand-cast carburetors 39–42 mm.

Note: The injection amounts named in the table for models 220 a and 219 refer to the total injected by both injection tubes.

After measuring the injection amount, check whether injection tubes are aligned in such a manner that the injection jet hits the edge of the closed throttle valve. If this is not the case, speed build-up faults may result.

I. Measurement and Adjustment of Fuel Level

a) **Models 180 a, 180 b, 180 c, 220 a and 219**
For the downdraft carburetor of models 180 a and 180 b, 180 c, and the double-downdraft carburetor for models 220 a and 219 measuring and adjustment procedures are substantially the same as for the compound downdraft carburetor of model 190. The fuel level is measured as usual on the wall which faces the suction canal (Fig. 01–3/5).

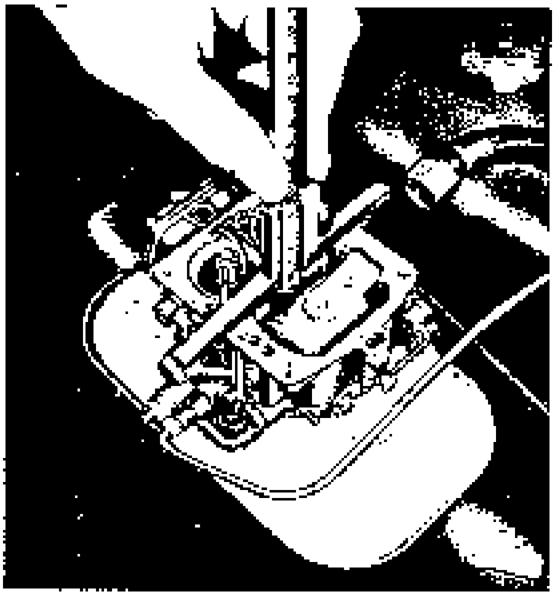


Fig. 01-3/5

For correcting the fuel level in downdraft carburetors, copper sealing rings are available for the float needle valve in the following thicknesses:

Part No. 000 997 81 40
0.5 mm thick

Part No. 000 997 28 40
1.0 mm thick (standard)

Part No. 000 997 82 40
1.5 mm thick

Part No. 000 997 83 40
2.0 mm thick

The fuel level can thus be corrected quite simply. An alteration of 0.5 mm in the thickness of the sealing ring is equivalent to an alteration in fuel level of appr. 1 mm.

b) **Model 220 S**

In the case of the compound downdraft carburetor for Model 220 S the fuel level measuring procedure is exactly the same as in the case of the compound downdraft carburetor for Model 190.

c) **Model 190 SL**

In the case of the cross-draft compound carburetor for Model 190 SL a different method is used to measure the fuel level. When the carburetor cover is removed, the float is removed with it. This means that instead of the float level, the position of the float in relation to the carburetor cover has to be measured (Fig. 01-3/8).

To do this, disconnect the fuel line, the support of the fuel overflow line at the hot-start mechanism, and the hose connections at the carburetor covers. Then unscrew the four fixing screws from the carburetor covers and carefully remove the carburetor covers, taking care not to bend the float arms (Figs. 01-3/6 and 01-3/7).

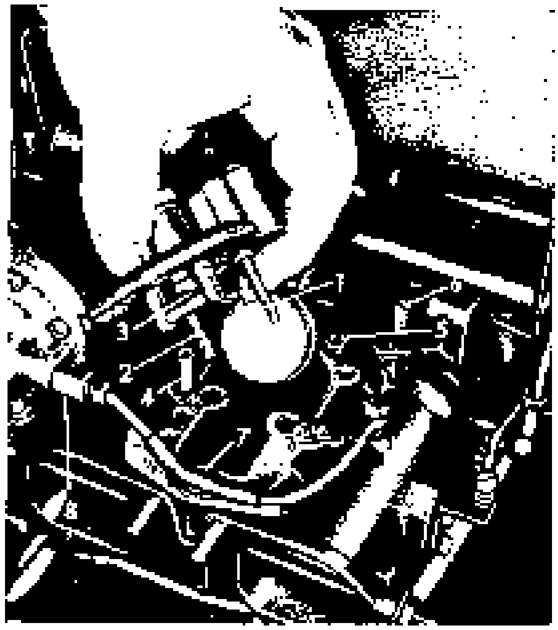


Fig. 01-3/6

Die-cast carburetor

1 Mixing tube of Stage I
2 Mixing tube of Stage II
3 Float needle valve
4 Mixture outlet tube
5 Idle fuel jet of Stage I
6 Idle mixture adjustment screw of Stage I
7 Pump jet with injection tube
8 Unit valve (safety valve) on the vacuum side

Note: On sand-cast carburetors the fuel overflow line is connected to the carburetor covers by means of a cap nut.
To check the float adjustment, measure the position of the float in relation to the separating surface of the carburetor cover. The distance "h" from the separating surface (with gasket) to the upper edge of the vertical front wall should be:

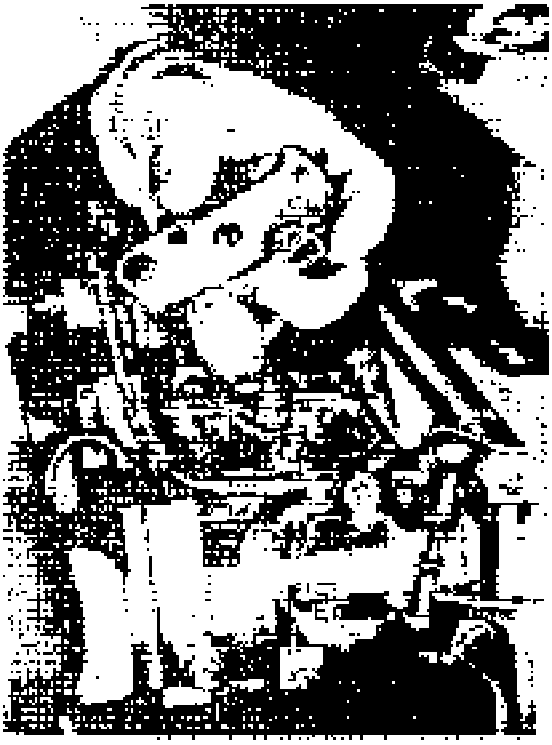


Fig. 01-3/7

Sand cast carburetor

h = 37–38 mm for die-cast carburetors
h = 39–40 mm for sand-cast carburetors
(Fig. 01-3/8)

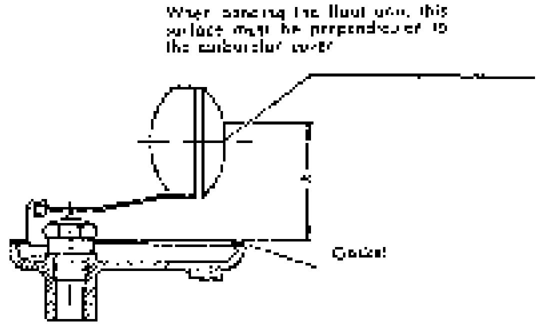


Fig. 01-3/8

II. Measurement and Adjustment of Injection Amount

Note: To measure the injection amount of the accelerating pump, use measuring tubes that have been bent to the correct shape. **On no account must the injection tubes of the carburetors be used** for this purpose, since there is a danger that the tubes will leak in the holder. The gaskets for the holder of the injection tubes should always be replaced.

It is advisable always to measure the fuel amount produced by five strokes in order to achieve the required degree of accuracy.

a) Models 180 a, 180 b, 220 a, and 219

In the case of the downdraft carburetor for Models 180 a and 180 b and the double downdraft carburetor for Models 220 a and 219 measuring and adjustment procedures are basically the same as in the case of the compound downdraft carburetor for Model 190.

Unlike other carburetor models, the connecting rod to the accelerating pump in the downdraft carburetor for Models 180 a and 180 b is provided with three cotter-pin holes instead of an adjusting nut. The adjustment can be slightly changed by adding washers between the pump arm and the cotter pin (see also Job No. 07-0, Sections E and F).

When measuring the injection amount on the double downdraft carburetor for Models 220 a and 219 the two injection tubes must be considered as a unit (Fig. 01-3/9a).

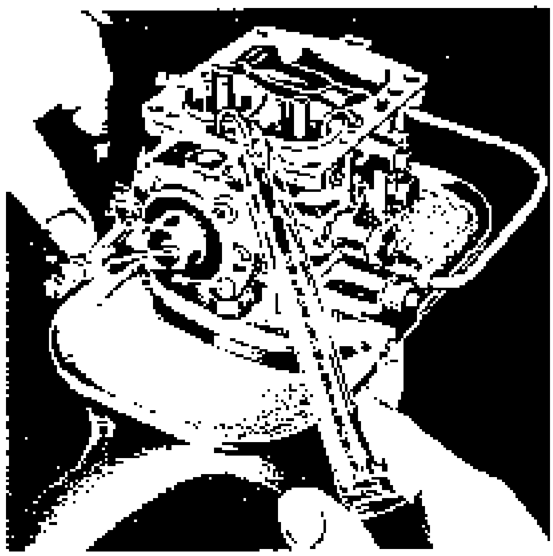


Fig. 01-3/9a

The injection amounts given in the Table always refer to the two injection tubes together.

When the injection amount has been adjusted, the two injection tubes must be so positioned that the injection jet is directed toward the edge of the closed throttle valve.

If there are any doubts, check the height of the injection tube for the 1st version carburetor for Model 180 a and of the injection tubes of the double downdraft carburetor for Models 220 a and 219. Measure the distance "a" from the separating surface of the carburetor housing to the lower end of the injection tube (Fig. 01-3/9b).

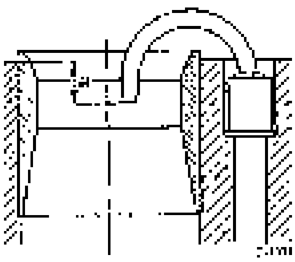


Fig. 01-3/9b
a = 9.0 ± 1.0 mm for Model 180 a
a = 5.0 ± 1.0 mm for Models 220 a and 219

b) **Model 220 S**

In the case of the compound carburetor for Model 220 S the procedures for measuring and adjusting the injection amount are exactly the same as in the case of the compound carburetor for Model 190.

c) **Model 190 SL**

On Model 190 SL the measuring procedure is different for die-cast carburetors and sand-cast carburetors.

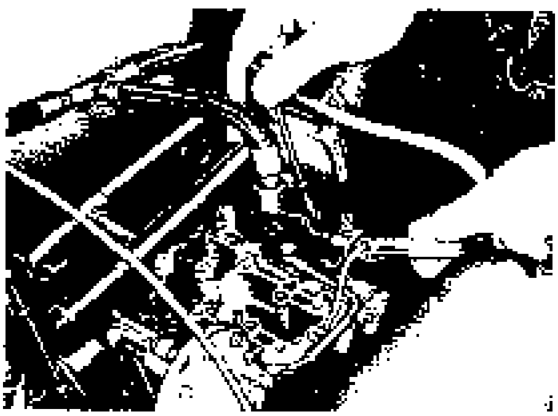


Fig. 01-3/10

Measurement on a die-cast front carburetor

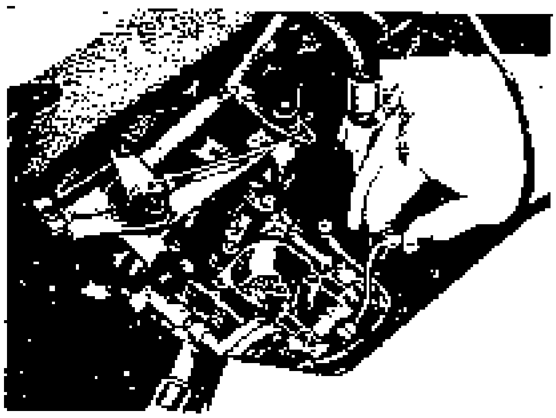


Fig. 01-3/11

Measurement on a die-cast rear carburetor

On the die-cast carburetors the carburetor covers are removed and the injection tubes are replaced by two Measuring Tubes 000 589 51 21 (Figs. 01-3/10 and 01-3/11).

If it is necessary to correct the injection amount, it is advisable to remove the air suction tube, which makes it much easier to adjust the connecting rods on the accelerating pumps, particularly on the rear carburetor.

Note: In order to ensure that during future measuring operations the choke control need not be disconnected when the air suction tube is removed, it is advisable to cut a slot as shown in Fig. 01-3/12a into the fixing eye for the choke control sleeve. If that is done, the air suction tube can be removed by simply loosening the clamping screw for the control sleeve.

Section A B

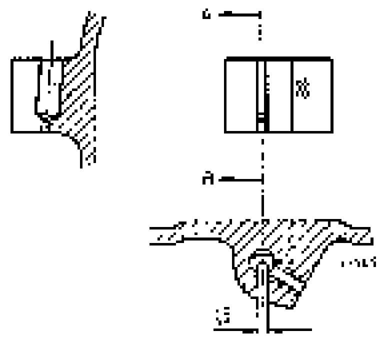


Fig. 01-3/12a

In the case of sand-cast carburetors, the air suction tube and the choke valve housings

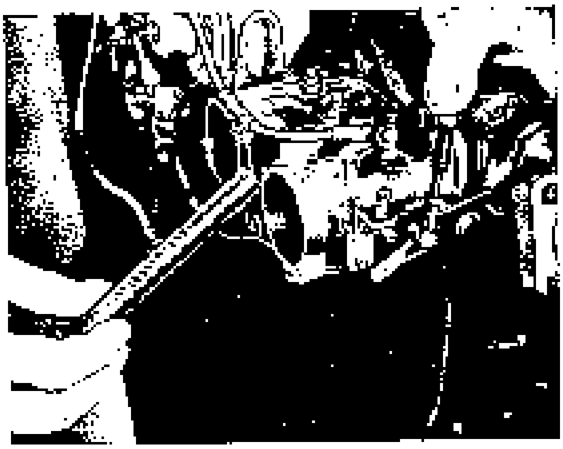


Fig. 01-3/12b

Measurement on a sand-cast front carburetor

must be removed. Then unscrew the injection tubes and install them upside down (Fig. 01-3/12b).

When screwing the choke valve housings and the air suction tube to sand-cast carburetors, make sure that the gaskets are absolutely flat and are not damaged during the operation. It is advisable to glue them to the flange surfaces with grease. Damaged gaskets should always be replaced.

The cylinder head screws used to fasten the choke valve housings must be well tightened to ensure that they cannot work loose.

III. Checking the Beginning of Enrichment via the Pump System on Carburetors for Model 180 a

1. Disconnect the push rod (10) from the angle lever of the carburetor linkage (Fig. 01-3/13a). Back out the idle adjustment screw (7) at the throttle valve lever until the throttle valve is completely closed.

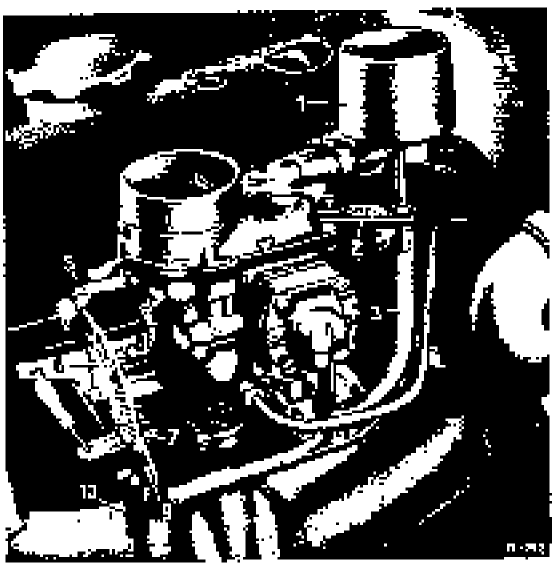


Fig. 01-3/13a

1 Container with outlet pipe
2 Holder
3 Hose length
4 Pipe union
5 Metal pointer
6 Graduated disk
7 Idle adjustment screw
8 Aperture limiting screw
9 Throttle valve lever
10 Push rod

2. Clamp a metal pointer (5) into position by means of the rear square screw for fastening the carburetor cover.

3. Fasten a suitable graduated disk (6) to the throttle valve shaft by means of an M 8 X 1 hexagon nut and adjust it so that, **when the throttle valve is completely closed**, the pointer points to 0° on the graduated disk.

4. Screw out the ball valve on the lower part of the carburetor housing and replace it by a pipe union (4) consisting of a pierced ball valve and a soldered pipe length.

5. Fasten a suitable small container (1) to the carburetor cover; the container must have an outlet pipe and a holder. Then connect the container to the pipe connection by means of a suitable hose length (3) and fill up with fuel.

Note: The outlet pipe of the container must not be too short, since otherwise the head will be insufficient to provide the necessary fuel flow.
The hose length must be of fuel-resistant material.

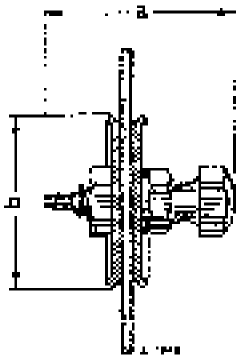


Fig. 01-3/13b

6. The enrichment delivery point differs according to the design of the pump diaphragm (see Table). The type of diaphragm used in any given carburetor can only be determined by removing the diaphragm.

In addition, check the position of the cotter pins in the connecting rod.

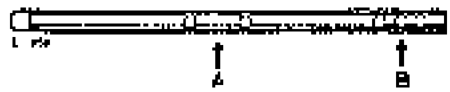


Fig. 01-3/13c

Enrichment Delivery Point

Pump diaphragm	Bolt length "a"	19	20.5	
	Plate dia. "b"	16	16	22
Enrichment delivery point		55°—60°	40°—44°	36°—40°
Cotter pin "A"		right pin hole	left pin hole	
Cotter pin "B"		center pin hole		
Washer between pump arm and cotter pin "B"		-	1 mm	—

7. Now move the throttle valve lever a few times. In order to check the enrichment delivery point, slowly open the throttle valve until fuel emerges from the injection tube. This is the enrichment delivery point.

Repeat the process several times in order to obtain accurate values. Just before the delivery point is reached, the throttle valve lever should be moved very slowly.

If there is a constant dripping of fuel from the injection tube, the ball valve in the accelerating pump is leaking. In that case remove and clean the valve after detaching the accelerating pump.

If fuel enrichment delivery occurs too early, the pin of the pump diaphragm can be slightly shortened. If the delivery point is far beyond the specified value, the pump diaphragm must be replaced.

I. Trouble-Shooting Hints on Carburetor System

Engine trouble is often ascribed to the carburetor system although it may very well be due to other causes.

Before beginning any work on the carburetor system, the following points should be checked:

The spark plugs (electrode gaps – the appearance of the plugs may also give useful hints), the distributor (appearance and gap of distributor contacts – distributor rotor – distributor plate), the ignition cable harness and ignition lead plugs, the ignition setting, the tappet clearance, the compression pressure, the air filter, and the fuel pre-filter (dirt), the fuel line connections and the fuel pre-filter (leaks), and the fuel feed pump pressure.

Also check all parts supplied with interference suppressors, in particular the distributor rotor, the ignition lead plugs, and the spark plugs; the easiest way of checking these parts is to replace them by non-suppressed parts.

If carburetor faults develop during running, these are usually caused by dirt, gum deposits, dried-up or faulty seals and gaskets. In such cases it will usually suffice to thoroughly clean the float chamber, all jets, valves, injection tubes, bores, and canals, to blow them out with compressed air and to replace defective seals and gaskets. When this has been done, the carburetor will usually be in perfect working order. If normal cleaning fails to remove the faults, it is advisable to disassemble the carburetor completely and to clean and examine all parts. It is often impossible to determine with certainty the exact cause of a fault without checking all parts, since the same fault can have various causes. To assist in trouble-shooting, some possible faults and their causes are listed below.

Cause	Remedy
Engine difficult to start when cold	
Models 180 a, 180 b, 220 a, 219, and 220 S	
Starter fuel jet blocked	Clean starter fuel jet
Air leakage caused by loose starter housing	Check start mechanism
Control cable for start mechanism wrongly connected	Check adjustment of control cable (see Job No. 30-6).
Model 190 SL	
Choke valve not closing	Check adjustment of start mechanism (see Job No. 07-0, IV. Compound cross-draft carburetor for Model 190 SL, Section C)
Failure of throttle valves of Stage 1 to open	Check functioning of throttle valves
Choke valve sticking	Free up
Throttle valves of Stage 2 not closing completely	Check adjustment of throttle valves and, if necessary, readjust (see Job No. 01-3, Section K)

Cause	Remedy
Engine uneven after cold start	
Models 180 a, 180 b, 220 a, 219, and 220 S	
Failure of starter air valve to open, and in consequence, start mixture too rich	Check starter air valve, blow out vacuum canal and, if necessary, replace sealing ring
Model 220 S	
Mechanical throttle valve of Stage 2 not closing	Free up
Model 190 SL	
Wrong adjustment of clearance between the relay lever and the throttle valve lever of Stage 1 on the rear carburetor	Adjust clearance after having adjusted the idle (see Job. No. 01-3, Section K)
Engine difficult to start when hot	
Models 180 a, 180 b, 190 SL, 220 a, 219, and 220 S	
Fuel level too high	Correct fuel level, clean or, if necessary, replace float needle valve, replace sealing ring, correct pressure of fuel feed pump
Model 190 SL	
Hot-start mechanism sticking	Free up hot-start mechanism, if necessary, replace return spring
Bowden cable of hot-start mechanism catching or wrongly adjusted	Free up Bowden cable or readjust
Fuel retained in suction canal of Stage 1 and 2	Check fuel suction pipe of Stage 2 and Fuel outlet pipe of Stage 1
Poor idling **Note:** The idle can only be adjusted when the engine is at normal working temperature.	
Models 180 a, 180 b, 190 SL, 220 a, 219, and 220 S	
Idle fuel jet, idle air jet, or idle air suction pipes blocked	Clean jets
Idle canal or by-pass bores blocked	Clean canal and bores
Suction canals fouled	Clean suction canals
Fuel level incorrect	Adjust fuel level
Excessive delivery pressure of fuel feed pump	Correct fuel feed pump delivery pressure
Float needle valve leaking	Replace float needle valve or sealing ring
Idle mixture adjustment screw damaged or broken	Replace idle mixture adjustment screw

Cause	Remedy
Mixing tube holder loose	Carefully solder guide of mixing tube holder and press into position
Throttle valve shaft worn	Replace throttle valve parts together with parts or replace carburetor
Injection tube dripping	Set fuel level to lowest permissible value
Leaks in insulation flange, carburetor flange, intake pipe flange, in the vacuum system of the Power Brake, or in the pneumatic ignition control	Test joints for leaks by smearing with soap and stop the leaks
Models 220 S and 190 SL	
Uneven adjustment of carburetor linkage	Carry out basic adjustment of carburetor linkage (see Job No. 01-3, Section K)
Model 190 SL	
Throttle valves of Stage 2 not closing completely	Check automatic return adjustment of Stage 2 and, if necessary, readjust (see Job No. 01-3, Section K)
Idle mixture adjustment screws of Stage 2 not closed	Close idle mixture adjustment screws

Models 180 a, 180 b, 220 a, 219, and 220 S

Note: If in countries with particularly high air temperatures the engine shows a tendency to stop at idling speed, the ball valve screwed into the lower part of the accelerating pump can be replaced by a spring-loaded ball valve (DB Part No. 000 070 07 46, Solex No. ZK 3508). In the spring-loaded valve the spring raises the ball a little from its seat in the "at rest" position, so that, as the pressure in the fuel chamber of the accelerating pump gradually increases, the fuel can flow back into the float chamber. When the outside temperature is low, however, and the car is gradually accelerated, a slight unevenness may occur as a result.

Idle too fast	
Models 180 a, 180 b, 190 SL, 220 a, 219, and 220 S	
Return spring for carburetor linkage too weak	Increase tension of return spring
Throttle valve shaft sticking	Check throttle valve shaft for ease of movement
Model 220 S	
Mechanical throttle valve of Stage 2 sticking	Check throttle valve shaft and relay lever

Note: The mechanical throttle valve of Stage 2 must close completely in the idle position. If the throttle valve is not completely closed, a greatly increased idle speed results; in this case the idle will not react to an adjustment of the idle mixture adjustment screw.

Cause	Remedy
Model 190 SL	
Throttle valves of Stage 2 not closing	Check the automatic return mechanism of Stage 2 and, if necessary, readjust (see Job No. 01-3, Section K)

Note: If the idle speed should be higher than usual when the accelerator pedal is released quickly, this may be due to worn throttle valves. In such cases the carburetors should be replaced.

Idle too low

Cause	Remedy
Models 180 a, 180 b, 190 SL, 220 a, 219, and 220 S	
Wrong adjustment of idle adjustment screw	Adjust idle by means of the idle adjustment screw to the prescribed idle speed
Pressure spring of idle adjustment screw too weak	Replace pressure spring or increase spring tension by inserting a washer

Carburetor floods

Cause	Remedy
Models 180 a, 180 b, 190 SL, 220 a, 219, and 220 S	
Float needle valve leaking	Replace float needle valve and sealing ring
Faulty float needle valve sealing ring	Replace sealing ring

Uneven speed build-up

Cause	Remedy
Models 180 a, 180 b, 190 SL, 220 a, 219, and 220 S	
By-pass bores blocked	Clean bores
Injection tube holder gasket leaking	Tighten injection tube or replace gasket
Injection tube blocked	Replace injection tube
Injection amount wrongly adjusted	Correct injection amount
Ball valve of accelerating pump leaking	Replace ball valve
Pump jet blocked	Clean pump jet
Pump diaphragm faulty	Replace pump diaphragm
Model 190 SL	
Fuel suction pipe of Stage 2 or fuel outlet pipe of Stage 1 blocked	Check or clean pipes

Cause	Remedy
Bad idle adjustment	Check idle adjustment: Make sure that in the idle position the throttle valves of Stage 2 are completely closed (see Job No. 01-3, Section K)
Idle fuel jets size 55 not yet installed	Replace in both Stages idle fuel jets size 50 by jets size 55 (possible also on sand-cast carburetors). Idle fuel jets size 55 are standard equipment as from Engine End No. 65 01365
Mixing tube no. 43 of Stage 1 not yet installed in die-cast carburetors and fuel line to accelerating pump not yet calibrated	In order to improve speed build-up, mixing tube no. 42 was replaced by mixing tube no. 43 of Stage 1 in die-cast carburetors as from Engine End No. 55 01823. At the same time the fuel line to the accelerating pump was calibrated to 0.5 mm. On engines from Engine End No. 55 00709 (where die-cast carburetors were first installed) up to Engine End No. 55 01822 mixing tube no. 43, Part No. 000 071 09 49, can be subsequently installed in Stage 1. This mixing tube no. 43 should only be installed subsequently together with the calibrated sleeve Part No. 000 071 03 40. In order to subsequently calibrate the fuel line to the accelerating pump, the calibrated sleeve (2) is installed on the ball valve (1) in the float chamber and is carefully pressed into position. Care should be taken to ensure that the ball valve pressed into the carburetor housing is not displaced and that the sleeve is not damaged. If the sleeve should be too tight, the internal diameter should be modified accordingly (Fig. 01-3/14).

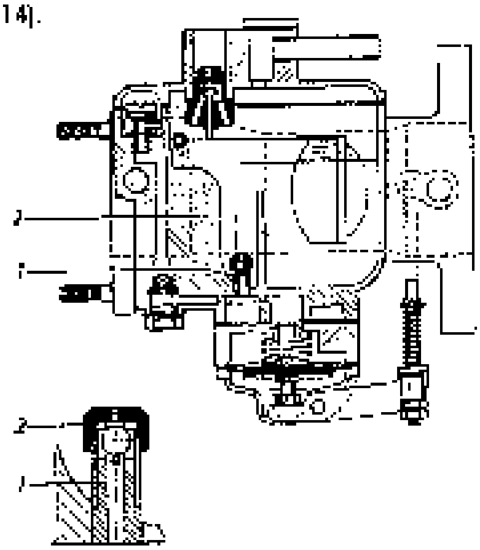


Fig. 01-3/14

1 Ball valve for fuel admission 2 Calibrated sleeve

Cause	Remedy
	Note: Carburetors in which the fuel flow to the accelerating pump is calibrated (as from Engine End No. 55 01823) have no calibrated sleeve. In this design calibration takes place by way of the ball valve.
Lack of response of the engine at full load and engine speeds between n = 3000 and 4000 RPM	
Model 190 SL Fuel overflow line compressed at bends (only in die-cast carburetors)	Replace fuel overflow line **Note:** The line has a cross-section of 10× 1.0 mm. It must have an inside diameter of 8 mm along the whole length of the line. It is necessary therefore to ensure that the line is not bent out of shape. If it should be found that the inside diameter is smaller on bends, the line must be replaced. The full cross-section of the line must be available everywhere, since the compensating air for the main carburetion system passes through this line to the two carburetors (see also Job Nos. 07-0 and 01-4, Section A).
Connecting hose between fuel overflow line and pipe at the air scoop bracket compressed or pipe loose or twisted in the fixing clip	Realign fuel overflow line. If necessary, replace connecting hose **Note:** The pipe must be firmly attached to the air scoop bracket. The distance between the lower end of the pipe and the drain funnel must be app:. 10 mm. Make sure that this distance is maintained. Instructions for fastening and arranging the pipe apply to both die-cast and sand-cast carburetors. On recent cars the pipe is no longer fastened to the air scoop bracket by a pipe clip, but by a retaining plate welded to the pipe. This new retaining plate can also be subsequently welded to the pipe (Fig. 01-3/15).

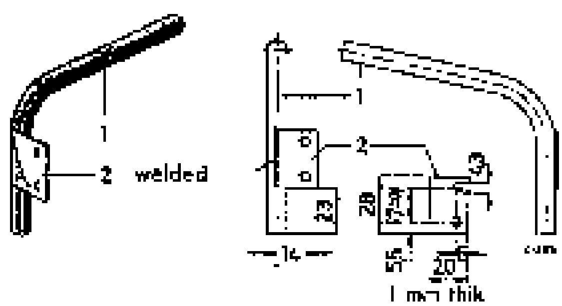


Fig. 01-3/15

1 Pipe 2 Retaining plate

Cause	Remedy
Throttle valves of Stage 2 opening too quickly	Resin deposits on the ball valves (delay valves) on the vacuum side of the vacuum box. Clean or replace ball valves **Note: As from Engine End No. 65 04119 spring-loaded ball valves, Part No. 000 070 02 46, have been installed. These spring-loaded valves improve the build-up between Stage 1 and Stage 2, since the spring lightly presses the ball against the valve seat.**
Throttle valves of Stage 2 opening too slowly.	Check diaphragm and vacuum line for leakage Check ease of movement of the lever linkage and of the throttle valve shaft of Stage 2 **Checking of throttle valves of Stage 2:** The throttle valves of Stage 2 should open under the influence of the vacuum boxes at a speed of appr. n = 3500 rpm under full load. Their function can only be accurately checked on a test stand or during a road test with the engine hood removed. The opening of the throttle valves can be seen from the weights of the throttle valve levers. In general it will be sufficient to make a function check with the car stationary. To do this, cover the air intake pipe on the air intake silencer for a short time and accelerate with the other hand. The throttle valves of Stage 2 must open during this operation. **This should be done very carefully, since there is a danger that without load the engine may race when Stage 2 is fully open.**
Throttle valves of Stage 2 sticking	Check throttle valves **Note:** If there is any obstruction when the throttle valves are actuated, the cause in the case of older engines may be a fouling of the throttle valves of the rubber flanges between carburetor and intake pipe. If this should be the case, the carburetors must be removed and the rubber flanges must be replaced by flanges with an inside diameter of 47 mm. When repairs are carried out, the old flanges with an inside diameter of 46 mm should always be replaced by the new version flanges (see Job No. 01-4, Section A).

Cause	Remedy
High fuel consumption	
Models 180 a, 180 b, 190 SL, 220 a, 219, and 220 S	
Leaking float needle valve	Clean or replace float needle valve
Faulty float needle valve sealing ring	Replace sealing ring
Fuel level too high	Adjust fuel level
Fuel pump delivery pressure excessive	Adjust delivery pressure
Carburetor jets, valves, etc. loose or leaking	Tighten jets and valves and, if necessary, replace sealing rings
Idle air jet or air correction jets blocked	Clean jets
Carburetor cover loose	Tighten carburetor cover, check gasket
Mixing tubes blocked	Clean mixing tubes (including side bores)
Cable of starter rotary slide valve wrongly adjusted	Check cable and adjust correctly (see Job No. 30-6)
Starter rotary slide valve leaking	Check starter rotary slide valve for leaks and, if necessary, reface sliding surfaces
Model 220 S	
Connecting rod of the two start mechanisms bent	Check connecting rod and straighten or replace

Note: In the case of compound downdraft carburetors a leaking starter rotary slide valve or a slide valve which is not quite closed can be detected by examining the vacuum valve of Stage 2.

If the starter rotary slide valve is leak-proof or if it is closed, the vacuum valve is completely closed when the engine is idling.

Check by pressing on the counterweight of the vacuum valve.

If the starter rotary slide valve is leaking or is in operation, the vacuum valve is raised at idling speed, since the engine receives the start mixture via Stage 2. When making this check, however, the mechanical throttle valve of Stage 2 must be completely closed, since otherwise the vacuum valve will be raised by the air flowing via Stage 2.

Model 190 SL	
Start mechanism jammed or cable wrongly adjusted	See under "Engine difficult to start when cold"
Line to mixture outlet tube loose or leaking on die-cast carburetors	Tighten line, replace sealing rings
Fuel suction pipe loose or leaking	Tighten pipe, replace sealing rings

K. Adjustment of Carburetor Linkage and Idle

Before adjusting the carburetor linkage it is advisable first to check the attachment of the intake pipe, the exhaust manifold, the carburetor flange, the throttle valve lever, and the control lever, and to apply grease to the ball joints of the linkage. Any excessive end play at the control and angle levers or of the control shaft on Model 190 SL should be removed by inserting suitable shims.

I. Models 180 a, 180 b, 220 a, and 219

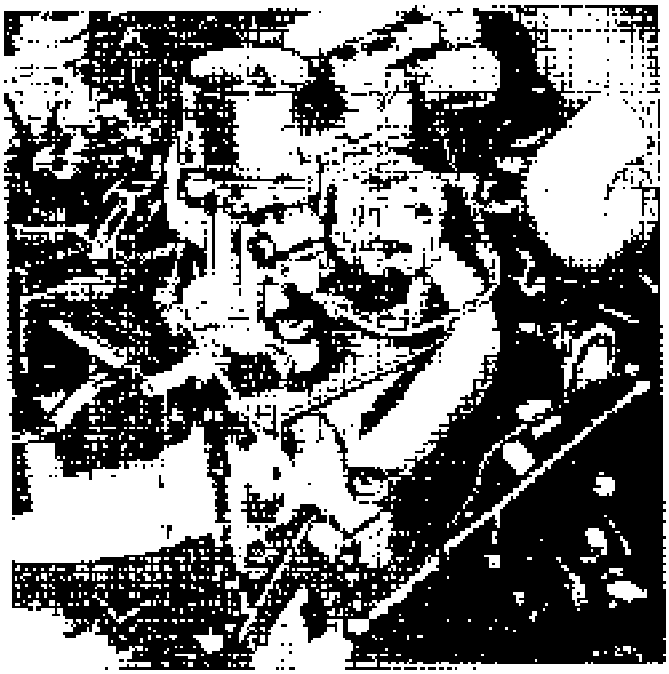


Fig. 01-3/16

1 Clamping screw for choke control [illegible]
2 Choke control
3 Aperture limiting screw
4 Idle adjustment screw
5 Return spring
6 Throttle valve lever
7 Push rod
8 Idle mixture adjustment screw
9 Relay lever
10 Push rod
11 Double lever
12 Clamping screw for choke control

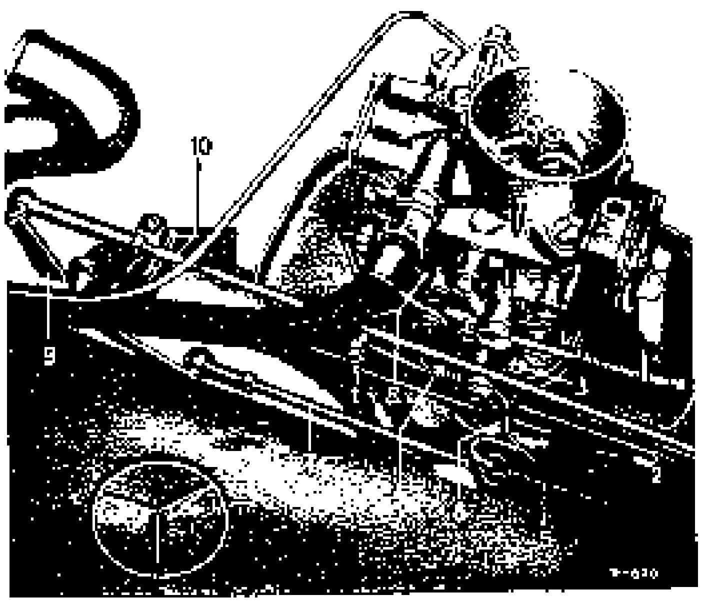


Fig. 01-3/17

1 Clamping screw for choke control
2 Choke control
3 Aperture limiting screw
4 Idle adjustment screw
5 Return spring
6 Throttle valve lever
7 Pull rod
8 Idle mixture adjustment screw
9 Relay lever
10 Pull rod

a) **Adjustment of Carburetor Linkage**

1. Check the throttle valve shaft for freedom of movement. To do this, detach the pull or push rod (7) at the throttle valve lever (6) and, if necessary, detach the return spring (5) (Figs. 01-3/16 and 01-3/17).

2. Turn out the idle adjustment screw (4) on the throttle valve lever until the throttle valve or in the case of double downdraft carburetors the throttle valves, are completely closed. Then turn in the idle adjustment screw until the throttle valve lever is on the point of moving. From this position the screw should be turned in one turn.

3. Press the throttle valve lever as far as the full load stop and check whether the aperture limiting screw (3) is resting against the full load stop of the carburetor housing.

4. Attach the pull or push rod (7) and the return spring (5) to the throttle valve lever. Again check the throttle valve position, actuating the carburetor linkage by depressing the accelerator pedal from inside the car (see also Job No. 30-3).

b) **Adjustment of Idle**

1. In order to adjust the idle on Models 180 a and 180 b, turn the idle mixture adjustment screw (8) right in and back it out by exactly two turns. On Models 220 a and 219 also turn in the two idle mixture adjustment screws completely and back them out by exactly one turn.

2. After warming up the engine to normal working temperature (cooling water temperature at least 70° C), adjust the idle by means of the idle adjustment screw (4) to 700–750 rpm on Models 180 a and 180 b and to 700–800 rpm on Models 220 a and 219. Use a revolution counter for this adjustment.

3. Adjust the idle mixture adjustment screw by slowly turning it in or out, so that

   a) the engine runs smoothly and

   b) the highest possible idle engine speed is obtained.

Note: On double downdraft carburetors the two idle mixture adjustment screws should be adjusted evenly.

4. Then readjust the idle speed by means of the idle adjustment screw (4) once more to a speed of 700–750 rpm on Models 180 a and 180 b and to 700–800 rpm on Models 220 a and 219.

5. By making a further slight correction with the idle mixture adjustment screw check whether the idle can be further improved. If necessary, again adjust the idle speed with the idle adjustment screw.

II. Model 220 S

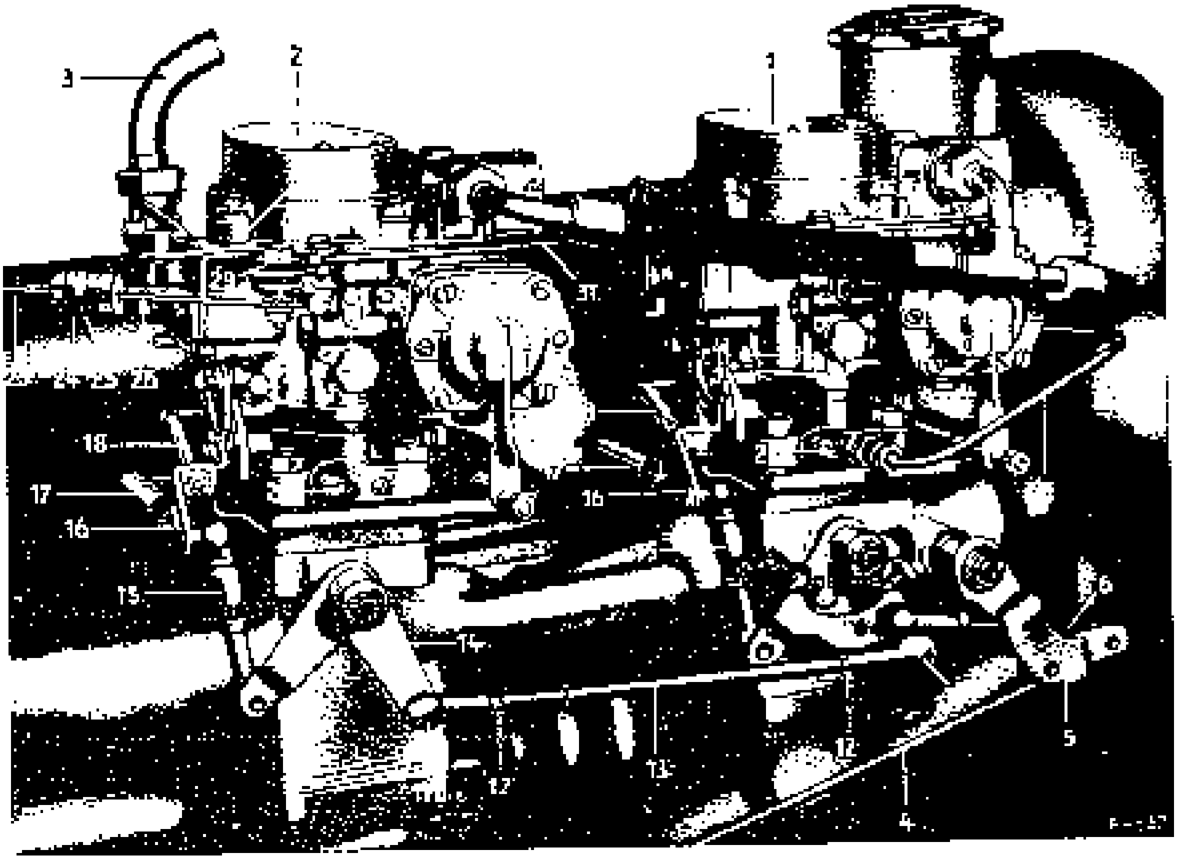


Fig. 01-3/18

1 Front carburetor
2 Rear carburetor
3 Vent tube
4 Pull rod
5 Relay lever
6 Push rod
7 Control lever
8 Stop bolt
9 Idle stop screw
10 Aperture limiting screw
11a Ball socket
11b Ball socket
12 Hexagon nut
13 Push rod
14 Angle lever
15 Spring loaded push rod
16 Throttle valve lever
17 Return spring
18 Tension spring
19 Idle adjustment screw
20 Idle mixture adjustment screw
21 Vacuum line to distributor
22 Fuel line
23 Coil spring
24 Rubber bushing
25 Adjusting nut
26 Spring steel wire
27 Angle lever
28 Clamping screw
29 Rubber bushing
30 Hexagon nut
31 Connecting rod
32 Hexagon screw

Fig. 01-3/18 shows the 2nd version of the carburetor linkage (installed as from Engine End No. 75 06477).

On the 1st version (installed up to Engine End No. 75 06476) the push rod (13) was carried not by ball heads, but by bolts (see Fig. 01-3/19).

a) **Adjustment of Carburetor Linkage**

1. Detach the push rods (6) and (13) at the control lever (7) and the spring-loaded push rods (15) at the two carburetors (Fig. 01-3/18).

   On the 1st version push rod (13) loosen the hexagon nut (3) and the knurled nut (1) of the angle lever (14) for the rear carburetor and slacken it off until the pivoted drive pin (2) is completely free (Fig. 01-3/19).

Fig. 01-3/19

1 Knurled nut
2 Drive pin
3 Hexagon nut
13 Push rod
14 Angle lever

2. Check the throttle valves of the carburetors for freedom of movement and if in doubt detach the return springs (17) and (18) (Fig. 01-3/18).

3. On both carburetors back out the idle adjustment screws (19) until the throttle valves of Stage 1 are completely closed. Then turn in the idle adjustment screws once more until the throttle valves are on the point of opening. From this position turn the screws in by exactly one turn.

4. Now back out the idle stop screw (9) on the control lever (7) until the lever rests against the stop bolt (8). Then turn in the screw by about two turns.

5. Check the length of the spring-loaded push rod (15) of the front carburetor. The push rod is adjusted to the correct length if both the control lever (7) and the throttle valve lever (16) rest against the idle stop. On no account should the push rod be extended against the spring pressure.

   Then check the length of the spring-loaded push rod (15) of the rear carburetor. The front and rear push rods must be of equal length. If necessary, adjust the length of the rear push rod to that of the front push rod.

   After adjusting the spring-loaded push rods, tighten the hexagon nuts on the ball sockets.

6. When the spring-loaded push rods have been adjusted to equal length, push them into position on the two throttle valve levers (16). Then make an accurate adjustment of the idle stop screw (9). To do this, back out the idle stop screw a little and screw it in again to the point where the control lever (7) is on the point of being moved. Then back out the idle stop screw ½ turn. This will ensure that there is no play in the mechanism even if the ball joints are slightly worn.

7. Press the push rod (13) in position on the control lever (7) and the angle lever (14).

Note: The push rod has a ball socket with a right-hand thread on the one side and a ball socket with a left-hand thread on the other side. The ball socket with left-hand thread should be pressed onto the angle lever for the rear carburetor.

8. In order to adjust the push rod (13), loosen the hexagon nuts (12) and slacken them off. Then adjust the push rod in such a way that the throttle valve lever (16) of the rear carburetor is on the point of being moved. From this position turn the push rod about ½ turn and tighten both hexagon nuts, making sure that the adjustment is not altered.

Note: When adjusting the push rod (13), do not pull it out too far, since otherwise the throttle valve lever (16) of the rear carburetor will be opened; on the other hand, it must not be turned too little, since otherwise the rear spring-loaded push rod (15) will be extended.

In order to adjust the 1st version push rod, turn the hexagon nut (3) toward the angle lever (14) as far as is necessary to ensure that the throttle valve lever (16) is on the point of being moved, then turn the hexagon nut back 1/4 turn and tighten the knurled nut and lock by tightening the hexagon nut (see Fig. 01-3/19).

9. Adjust the idle stop screw (9) or the control lever (7) in such a way that there is a clearance of 0.1–0.2 mm between the stop screw and the bolt (8).

Note: Turning back the stop screw on the control lever has the following effect: When the accelerator pedal is released quickly, the shock force is absorbed by the spring-loaded push rods and as a result the throttle valves are relieved to a large extent.

10. To adjust the full-load stop, loosen the aperture limiting screw (10) on the control lever (7) and back it out. Then move the carburetor linkage to the full-load position and turn the aperture limiting screw toward the stop bolt to the point where the control lever is at the point of being moved. The mechanical throttle valves of both Stage 1 and 2 of both carburetors must be fully opened in this position. Then lock the limiting screw by tightening the hexagon nut.

11. After attaching the push rod (4) to the relay lever (5) again check the position of the throttle valves, actuating the carburetor linkage by depressing the accelerator pedal from inside the car (see also Job No. 30-3).

b) Idle Adjustment

1. To adjust the idle, screw the idle mixture adjustment screw (20) on both carburetors right in and back it out by two turns.

2. Warm up the engine to normal working temperature (cooling water temperature 70–80° C) and adjust the idle by evenly adjusting the idle adjustment screws (19) of both carburetors to n = 700–800 rpm by means of a revolution counter.

3. Adjust the two idle mixture adjustment screws by turning them evenly in or out, so that

   a) the engine turns smoothly and

   b) the highest possible idle engine speed is obtained.

4. Readjust the idle speed to n = 700–800 rpm by adjusting the idle adjustment screw (19).

5. By making a further slight correction with the idle mixture adjustment screws check whether the idle can be further improved. If necessary, again adjust the idle speed with the idle adjustment screws.

6. After adjusting the two carburetors, check whether the control linkage and the throttle valve levers work properly. The same applies to the two start mechanisms, which are connected by the connecting rod (51) (see also Job No. 30-6).

Note: When adjusting the idle, the mechanical throttle valves of Stage 2 and the start mechanism of the two carburetors must be completely closed.

7. Check the functioning of the vacuum valves of Stage 2 and of the oil shock-absorber. The cushion effect of the oil shock-absorber must be noticeable almost down to the end of the stroke. If necessary, check the oil level in the shock-absorber and top up (see Model 190 Workshop Manual, Job No. 07-3).

Note: On no account should the idle speed be adjusted by means of the idle stop screw (9), since otherwise the carburetor linkage adjustment is no longer satisfactory (see under a) Adjustment of carburetor linkage, para 9).

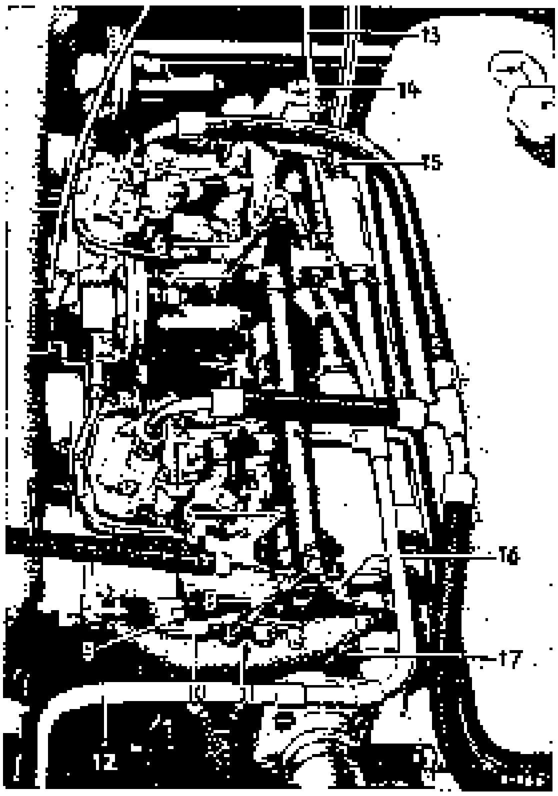


Fig. 01-3/20

1 Choke control
2 Clamping screw for choke control sleeve
3 Clamping screw for choke control
4 Return spring for carburetor linkage
5 Idle mixture adjustment screw of Stage 2
6 Idle mixture adjustment screw of Stage 1
7 Push rod for rear carburetor
8 Push rod for front carburetor
9 Idle adjustment screw
10 Throttle valve lever
11 Aperture limiting screw
12 Overflow line
13 Hot-start control
14 Clamping screw for hot-start control sleeve
15 Threaded union for vacuum connection of ATE Power Brake
16 Control shaft
17 Push rod from angle lever to control shaft

a) **Adjustment of Carburetor Linkage**

1. Detach the push rod (17) between the angle lever and the control shaft and detach the two push rods (7) and (8) between the control shaft and the throttle valve levers (see Fig. 01-3/20).

2. Back out the idle adjustment screw (9) on the two carburetors until the throttle valve of Stage 1 is closed. In this position the throttle valve of Stage 2 must have a certain amount of play: if this is not the case, the adjustment screw (3) on the relay lever of the throttle valve shaft of Stage 1 must be backed out (see Fig. 01-3/21).

Note: The picture shows the 2nd version of the adjustment screw locking device.

On the 1st version there was a lock nut instead of the clamping strap (1) and the clamping screw (2).

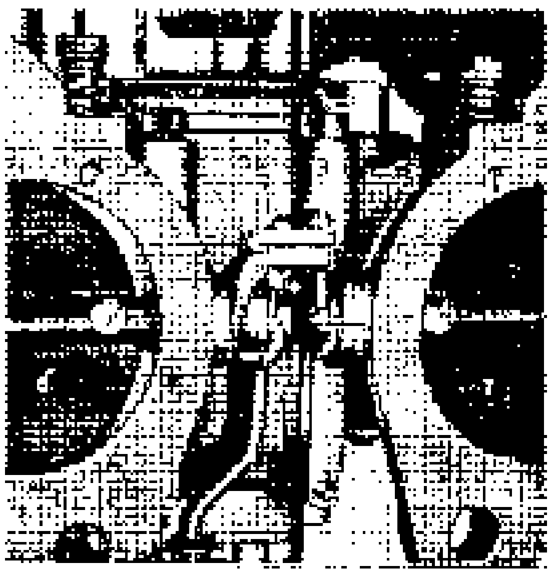


Fig. 01-3/21

1 Clamping strap
2 Clamping screw
3 Adjustment screw
4 Relay lever on throttle valve shaft of Stage 1
5 Drive pin on throttle valve shaft of Stage 2
6 Throttle valve of Stage 1
7 Throttle valve of Stage 2

3. Now turn in the idle adjustment screw (9) on both carburetors to the point where the throttle valves are just about to open. From this position turn the screw in exactly one turn (Fig. 01-3/20).

4. Adjust the push rod (17) between the angle lever and the control shaft (16) to the prescribed length of 175 mm (measured from center ball socket to center ball socket) and attach it.

5. Adjust the push rod (8) between the control shaft (16) and the throttle valve lever (10) of the front carburetor to the prescribed length of 100 mm (measured from center ball socket to center ball socket) and attach the push rod.

6. Now press the push rod (7) onto the rear carburetor, making sure that the ball socket with left-hand thread points downward. Then adjust the push rod so that the throttle valve levers of both carburetors are in the idle stop position.

   When doing this, make sure that the two ball sockets are absolutely parallel after the lock nuts on the ball sockets have been tightened. The adjustment of the push rod must be very accurate, since too long a push rod will push open the throttle valve of Stage 1 of the rear carburetor and too short a push rod will push open the throttle valve of the front carburetor. When the control linkage is being operated, the throttle valves at both carburetors must open simultaneously without any idle travel.

7. Press the control linkage as far as the full load stop and check whether the aperture limiting screw (11) of the front carburetor rests against the full load stop of the carburetor housing.

8. On both carburetors check the drive pin (5) on the throttle valve shaft of Stage 2 for tightness and turn in the adjustment screw (3) for the automatic return of the throttle valve of Stage 2 until the adjustment screw just rests against the drive pin (5) (Fig. 01-3/21). In this position the control linkage must be in the idle position and the throttle valve (7) of Stage 2 must be closed.

This position can be checked at the throttle valve lever of Stage 2, which in this position should still have a small amount of play. On no account should the adjustment screw (3) be turned in till the throttle valve of Stage 1 is being turned open.

After having made the adjustment, tighten the clamping screw (2).

b) **Adjustment of idle**

1. Turn in the idle mixture adjustment screw (6) of Stage 1 on both carburetors and from this position back it out by exactly 1½ turns.

Note: The idle mixture adjustment screw (5) of Stage 2 remains closed on both carburetors.

2. Warm up the engine to operating temperature (cooling water temperature 70–80°C) and adjust the idle by evenly adjusting the idle adjustment screws (9) on both carburetors by means of a revolution counter.

   In the case of distributors

   VJUR 4 BR 11 and VJ 4 BR 12 adjust to 1200–1300 rpm,

   VJ 4 BR 11 and VJR 4 BR 24 adjust to 900–1000 rpm.

3. Adjust the idle mixture adjustment screw (6) of Stage 1 on both carburetors by turning it in and out evenly until

   a) the engine turns smoothly and

   b) the highest possible idle engine speed is obtained.

4. Readjust the idle speed to the specified values by means of the idle adjustment screws (9).

5. By making a further slight correction with the idle mixture adjustment screws check whether the idle can be further improved. If necessary, again adjust the idle speed with the idle adjustment screws.

6. After adjusting the idle again adjust the automatic return mechanism for the throttle valves of the 2nd stage (refer to a) adjustment of carburetor linkage, para B).

7. Set the adjustment screw at throttle valve lever of rear carburetor in such a manner that there is a clearance of 0.4 mm between the screw and the relay lever. Then tighten the locking nut of the adjustment screw. During the adjustment the control linkage should be in idle position and the start mechanism should be completely disengaged, that is, the choke valves should be horizontal. The relay lever should be pressed to the choke valve lever and cam by means of the return spring. If required, the return spring should be replaced (Fig. 01–3/22).

Note: The start mechanism on the front carburetor has no cam and no relay lever. Raising of the 1st stage throttle valve with the start mechanism engaged is effected by way of the control linkage.
When the start mechanism is switched off the choke valves of both carburetors should be completely open. The stop lever of the choke valve shaft should then abut against the carburetor housing.

8. Check start mechanism for proper functioning (refer to Job No. 30-6 and Job No. 07–0, Section IV).

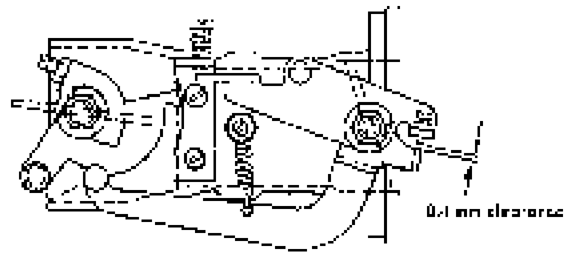


Fig. 01–3/22

9. Check return spring for carburetor linkage.

The 1st version of the return spring (free length 169 mm) has a connecting strap, which is attached at the bottom of the lever on the control shaft.

The 2nd version of the return spring (free length 214 mm) uses no such connecting strap. In addition, the lever on the control shaft is provided with a bolt to hold the return spring.

As from engine end No. 85 02730 the 2nd version of the return spring is installed as a standard part.

If a vehicle having a return spring of 1st version shows signs of chafing at bottom of control shaft lever, both the 2nd version of the return spring and control shaft should be subsequently installed.

L. Testing Valve Timing

Checking and corrections, if required, of the valve timing for models 180 a, 180 b, 180 c, 190, 190 b, 190 c, 190 SL, 220 a, 219, 220 S and 220 SE are the same as described in the Workshop Manual for model 190.

Valve Timings with a Test Clearance of 0.4 mm

Model	Camshaft		Code No.[2]	Inlet		Outlet		Remarks
	Design acc. to Part No.	Assembly[1] acc. to Part No.		opens BTDC	closes ABDC	opens BBDC	closes ATDC	
180 a 180 b 190, 190 b	121 051 11 01	121 050 00 01	11	12°	44°	51°	15°	–
180 c 190 c	121 051 42 01	–	42	10°	46°	44°	12°	improved valve control
190 SL	121 051 14 01	121 050 01 01	14	15°	63°	60°	25°	1st Version: standard equipment up to engine No. 5500183
190 SL	121 051 15 01	121 050 02 01	15	17.5°	60.5°	61.5°	22.5°	2nd Version: standard equipment as from engine No. 5500184
190 SL	121 051 44 01	–	44	13°	55°	51°	17°	improved valve control
220 a	180 051 14 01	180 050 03 01	14	9°	41°	51°	15°	1st Version: standard equipment up to engine No. 5504778
220 a, 219 220 S	180 051 14 01	180 050 03 01	14/1	12°	44°	51°	15°	For model 220 a: 2nd Version (standard equipment as from engine end No. 5504779) For models 219 and 220 S with compression ε = 7.6:1
219, 220 S	180 051 33 01	180 050 05 01	33	10°	46°	42°	10°	with compr. ε = 8.7:1
220 SE	180 051 50 01	180 050 09 01	50	9°	41°	44°	6°	–

[1] Camshafts are supplied complete only (with cam case, for 6-cyl. engine with or additional oil line) acc. to part No. named in column "Assembly"
[2] The Code No. of camshaft is always punched on camshaft end face

Note: If replacements are required, only camshaft part No. 180 050 06 01 will be supplied for models 220 a, 219 and 220 S. Camshaft part No. 180 050 06 01 may be used only in combination with sodium-filled exhaust valves. If instead of camshaft part No. 121 050 01 01 camshaft part No. 121 050 02 01 is installed in models 190 SL, the supporting surfaces at the cylinder head for the thrust rings of the inlet valves opposite the top edge of the cylinder head should be milled deeper by 1.0 mm, because otherwise the larger stroke of the inlet cams might punch solid the valve springs when the valves are fully open (refer to Fig. 01–4/32).

M. Measuring Intake Pipe Vacuum

The amount of intake pipe vacuum is reliable evidence of the sealing properties of the pistons and piston rings, the intake pipe, the cylinder head, the cylinder head gasket, and the valves. The intake pipe vacuum is measured in mm Hg (mercury column) by means of a vacuum measuring instrument, e. g. the instrument produced by the firm of "Sun". When measuring the vacuum, use the test take-off union on the carburetor or on the venturi control unit. (The values in the Table below refer only to these measuring points.)

When measuring the intake pipe vacuum, make sure that both cooling water and oil temperature of the engine are definitely above 80°C.

Model	Vacuum in mm Hg at engine speed rpm (no load)			
	800	1500	3000	4500
180 a	470—520	480—530	470—520	410—460
180 b	470—520	490—540	490—540	460—510
190	410—460	480—530	490—530	460—510
190 b	470—520	510—560	510—560	480—530
190 SL[1]	420—470	490—530	500—550	430—480
220 a, 219	410—460	490—530	510—560	480—530
220 S	430—480	480—530	510—560	480—530
220 SE 220 SE Convertible and Coupe 1st version[2]	430—480	440—490	390—450	340—390

[1] For model 190 SL with the 1st and 2nd versions of the distributor (Bosch designation VJUR 4 BR 11 or VJ 4 BR 12) use the vacuum value of 450—500 mm Hg at an idle speed of 1200—1300 rpm

[2] Model 220 SE Convertible and Coupe 1st version: Engine Type 127,980 (output 115 HP).

N. Exhaust-Gas Test Values

(applicable only to "Sun" Exhaust-Gas Tester)

The percentage values given refer to the degree of combustion of the fuel-air mixture. At idle speeds the values are on the rich side, whereas as a rule the mixture is leaner when the engine speed increases (see Table). When the prescribed values are obtained, the composition of the fuel-air mixture and consequently the adjustment of the carburetor or injection system is satisfactory.

When the exhaust-gas test is made, both the cooling water and the oil temperature should be appr. 80°C.

Model	Exhaust-gas test values (percentage) at engine speed rpm (no load)			
	800	1500	3000	4500
180 a	77—79	77—83	83—87	87—91
190 b	77—79	77—82	80—86	83—89
190 D¹)	77—79	80—84	85—89	85—89
190 c	77—79	77—82	80—86	85—89
190 SL²)	75—77	80—84	78—82	85—87
220 a 219	77—79	79—83	73—79	80—84
220 S	77—79	82—86	86—90	88—92
220 SE³) 220 SE Convertible and Coupé 1st version⁴)	79—81	78—82	—	—

¹) For model 190 D with the 1st version distributor (Bosch designation VJUR 4 BR 14) the exhaust-gas test value is 70—74% at 1500 rpm.

²) For Model 190 SL with the 1st and 2nd version distributors (Bosch designation VJUR 4 BR 11 or VJ 4 BR 12) the exhaust-gas test value is 79—81% at an idle speed of 1200—1300 rpm.

³) For the adjustment of the 220 SE engines the exhaust gas test values at 3000 rpm and 4500 rpm are not required.

⁴) Model 220 SE Convertible and Coupé 1st version. Engine type 127.980 (output 135 HP).

O. Engine Testing on Roller Test Stand

Performance: The performance data given in HP are based on an inlet air temperature of + 20°C and a barometer value of 760 mm Hg (mercury column).

Fuel Consumption: Fuel consumption measurements are based on the flow period for 100 cc or 200 cc measuring vessel capacity.

Note: a) When these measurements are taken, the cooling water and oil temperature of the engine should not be below 75°C.

b) When the car is tested on the roller test stand, the tire pressure should be adjusted to the values for free-way driving given in the Owner's Manual.

Performance Correction

The measured engine output must be corrected to the reference values of + 20°C and 760 mm Hg (mercury column) in accordance with the formula

$$N_k = N_m \times K$$

where N_k is the corrected value, N_m the measured value, and K the correction factor.

The correction factor K is determined in relation to temperature and atmospheric pressure according to the following formula:

$$K = \frac{760}{b} \sqrt{\frac{273 + t}{273 + 20}}$$

where b is the atmospheric pressure in mm Hg and t the temperature in °C.

Example: Engine performance N_m = 100 HP is measured at b = 740 mm Hg and t = 35°C.

$$K = \frac{760}{740} \sqrt{\frac{273 + 35}{273 + 20}} = 1.053$$

$$N_k = 100 \times 1.053 = 105.3 \text{ HP}$$

The correction factor K can be read off the following diagram with sufficient accuracy for all practical purposes (Fig. 01.3/23). For the above example the necessary procedure for finding the correction factor is indicated in the diagram.

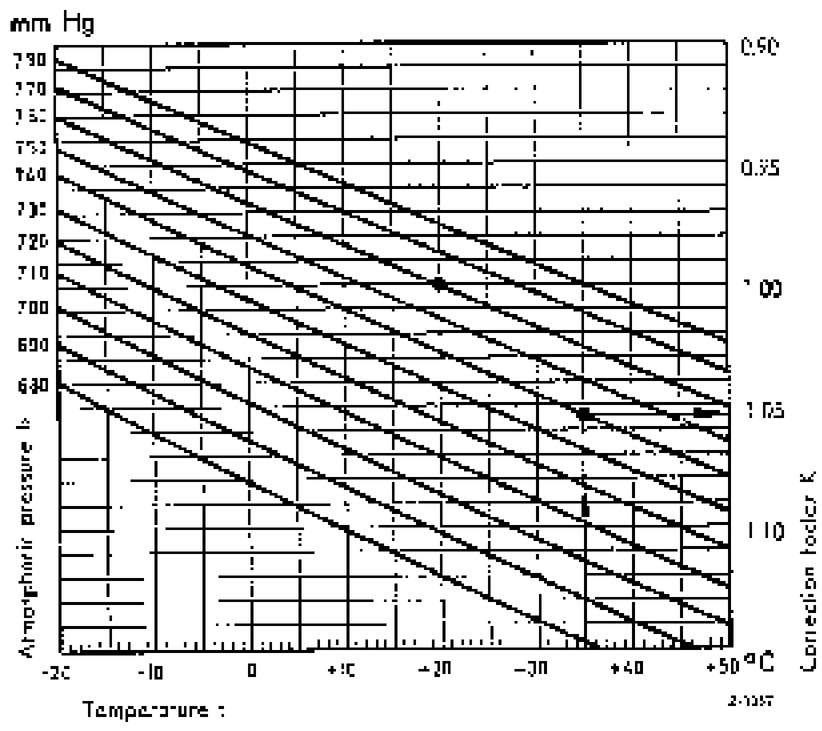


Fig. 01.3/23

Guide Values for Testing the Engine on the Clayton Roller Test Stand

Test			Model 180 a	180 b	190	190 b	190 SL
Full-load output	2nd gear n = 4000 rpm	Output HP	47.5	55	—	—	—
Full-load output	2nd gear n = 4400 rpm	Output HP	48	51	58	59	67
Full-load output	2nd gear n = 4800 rpm	Output HP	—	—	56	61	72
Fuel consumption, Full load	2nd gear n = 4000 rpm	Vacuum mm Hg	60—100				
Fuel consumption, Full load	2nd gear n = 4000 rpm	Exhaust-gas analysis %	81—86	80—85	83—84		82—86
Fuel consumption, Full load	2nd gear n = 4000 rpm	Sec. per 200 cc	30—32	28.5—31	27.5—30	27—29.5	22—24
Fuel consumption, Full load	3rd gear n = 3000 rpm	Exhaust-gas analysis %	79—83	79—82	76—80		80—84
Fuel consumption, Full load	3rd gear n = 3000 rpm	Sec. per 200 cc	42—45	40.5—43.5	40—43		37—40
Fuel consumption, Full load	4th gear n = 1500 rpm	Exhaust-gas analysis %	74—78		74—80	74—78	80—84
Fuel consumption, Full load	4th gear n = 1500 rpm	Sec. per 100 cc	39—42.5		41—44.5	40—43.5	35.5—39
Fuel consumption, Partial load	4th gear 60 km/h load 10 HP	Vacuum mm Hg	300—340				
Fuel consumption, Partial load	4th gear 60 km/h load 10 HP	Exhaust-gas analysis %	85—90		84—88		86—90
Acceleration	20—80 km/h in 3rd gear with flywheel (adjust to 10 HP load at 60 km/h in 4th gear)	Stop-watch time in sec.	22		20		

Guide Values for Testing the Engine on the Clayton Roller Test Stand

Test			Model: 180 D, 180 Db	Model: 190 D, 190 Db
Full-load output	2nd gear n = 3000 rpm	Output HP	32	—
	2nd gear n = 3200 rpm		33	—
	2nd gear n = 3600 rpm		—	36
	2nd gear n = 4000 rpm		—	38
Fuel consumption Full load	2nd gear n = 3200 rpm	Sec. per 100 cc	29—31	—
	2nd gear n = 3600 rpm		—	26—28
Acceleration	20—65 km/h*) in 3rd gear with flywheel (adjust to 5 HP load at 60 km/h in 4th gear)	Stop-watch time in sec	22	—
	20—75 km/h*) in 3rd gear with flywheel (adjust to 5 HP load at 60 km/h in 4th gear)		—	22

Note: When carrying out the performance test, make sure that the engine oil temperature is not less than 80° C.

*) Before carrying out the acceleration test with flywheel engaged, run the engine in 4th gear without the flywheel at 60 km/h and a load of 5 HP; then engage the flywheel.

Guide Values for Testing the Engine on the Clayton Roller Test Stand

Test				Model: 220 a / 219 (i = 7.6 : 1)	Model: 219 (i = 8.7 : 1)	Model: 220 S (i = 7.6 : 1)	Model: 220 S (i = 8.7 : 1)
Full-load output		2nd gear n = 4000 rpm	Output HP	61	64	71	73
		2nd gear n = 4400 rpm	Output HP	64	67	75	77
		3rd gear n = 4800 rpm	Output HP	63	68	77	81
Fuel consumption	Full load		Vacuum mm Hg	70—110			
		2nd gear n = 4000 rpm	Exhaust-gas analysis %	80—84		86—90	
			Sec. per 200 cc	25—27		23.5—25.5	
		3rd gear n = 3000 rpm	Exhaust-gas analysis %	72—76		84—86	
			Sec. per 200 cc	31—34		38—42	
		4th gear n = 1500 rpm	Exhaust-gas analysis %	74—80		84—88	
			Sec. per 100 cc	35.5—39		41—45	
	Partial load	4th gear 60 km/h load 10 HP	Vacuum mm Hg	310—350			
			Exhaust-gas analysis %	84—86		86—90	
Acceleration		20—80 km/h in 3rd gear with flywheel (adjust to 10 HP load at 60 km/h in 4th gear)	Stop-watch time in sec	16.5	16	16.5	16

Note: a) On Models 219 and 220 S with hydraulic automatic DB clutch, consumption measurement under full load and at an engine speed n = 1500 rpm in 4th gear should not be carried out.

b) On Models 219 and 220 S with hydraulic automatic DB clutch, the acceleration test should not be repeated more than once in order to avoid excessive heating up of the hydraulic clutch.

Guide Values for Testing the Engine on the Clayton Roller Test Stand

Test					Model: 220 SE, 220 SE Convertible Engine type 127.980 (115 HP)
Full-load output		3rd gear n = 4400 rpm	Output HP		83
		3rd gear n = 4800 rpm	Output HP		87
Fuel consumption	Full load	3rd gear n = 4800 rpm	Vacuum mm Hg		20—40
			Exhaust-gas analysis %		82—87
			Sec. per 200 cc Inlet air temperature °C	30	21.5—23.5
				20	21—23
				10	20.5—22.5
				0	20—22
		3rd gear n = 3000 rpm	Exhaust-gas analysis %		79—84
			Sec. per 200 cc Inlet air temperature °C	30	34—37
				20	33—36
				10	32—35
				0	31—34
		4th gear n = 1500 rpm	Exhaust-gas analysis %		80—85
			Sec. per 200 cc Inlet air temperature °C	30	38—41
				20	37—40
				10	36—39
				0	35—38
	Partial load	4th gear 60 km/h load 10 HP	Vacuum mm Hg		300—340
			Exhaust-gas analysis %		93—98
Acceleration		20—80 km/h in 3rd gear with flywheel (adjust to 10 HP load at 60 km/h in 4th gear)	Stop watch time in sec.		15

Note: a) On cars with hydraulic automatic DB clutch, consumption measurement under full load and at an engine speed n = 1500 rpm in 4th gear should not be carried out.

b) On cars with hydraulic automatic DB clutch, the acceleration test should not be repeated more than once in order to avoid excessive heating up of the hydraulic clutch.

P. Adjustment of Gasoline Injection Pump in Model 220 SE

See Workshop Manual Passenger Car Models starting August 1959, Job No. 00-14.

Q. Checking Gasoline Injection System of Model 220 SE

See Workshop Manual Passenger Car Models starting August 1959, Job No. 00-15.

R. Trouble-Shooting Hints on Gasoline Injection System on Model 220 SE

See Workshop Manual Passenger Car Models starting August 1959, Job No. 00-18.

S. Adjustment of Control Linkage, Idle Adjustment, and Readjustment of Speed Build-Up of Gasoline Injection Engine in Model 220 SE

See Workshop Manual Passenger Car Models starting August 1959, Job No. 00-16.

Job No.:
01-4

Disassembly and Reassembly of Engine

Change: Models 180 c and 190 SL with new engine type designation added.

In the event of repairs normally only those assemblies and engine parts are removed, which have to be repaired or tested. The procedures are therefore subdivided. If an engine has to be completely disassembled, refer to the operations given in sections A to Q.

A. Removal and installation of carburetor or injection system including venturi control unit and control linkage.
B. Removal and installation of intake pipe and exhaust manifold.
C. Removal and installation of cylinder head, valves, camshaft, chain tensioner, sprocket bearing and rocker arms.
D. Removal and installation of generator and starter.
E. Removal and installation of water pump with fan.
F. Removal and installation of distributor with bearings.
G. Removal and installation of drive for oil pump, distributor, injection pump and revolution counter.
H. Removal and installation of fuel feed pump.
I. Removal and installation of oil filter.
K. Removal and installation of oil relief valves crankcase.
L. Removal and installation of oil pan.
M. Removal and installation of oil pump.
N. Removal and installation of counterweight and vibration damper on crankshaft.
O. Removal and installation of crankshaft with counterweight and flywheel.
P. Removal and installation of pistons and connecting rods.
Q. Disassembly and reassembly of crankcase.
R. Removal and installation of front grease seal for crankshaft with engine installed in vehicle.
S. Removal and installation of flywheel.
T. Removal and installation of roller chain with engine in vehicle.

Clean and check all removed parts and assemblies (refer to checking and repair procedures). Small damaged parts such as screws, nuts, washers, lock washers, etc. should be checked for re-use and replaced, if required. They should not be put back when damaged.

Definitely replace: Gaskets, sealing rings, locking plates, cotter pins, etc.

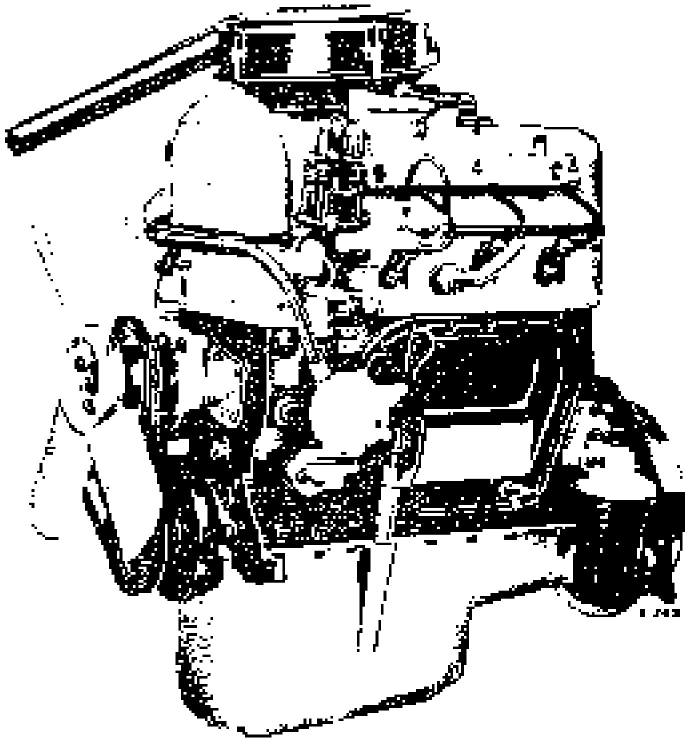
All ground and precision parts, above all the respective bearing surfaces, should be subjected to one more visual inspection prior to installation into engine.

If damaged, bearing surfaces should be refinished now. Also watch out for burrs.

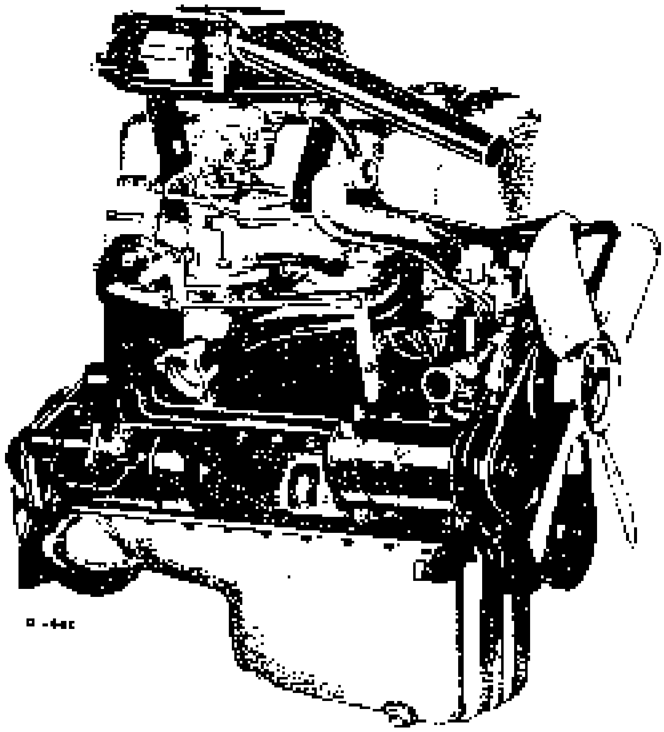
Engine M 121 B IV for Model 180 a

(Type Designation 121.923)

The pictures of the engine model 180 a show the earlier design. On later models the side walls of the cylinder crankcase, for example, have no cylinder cover. For further modifications see Job No. 01–4.
The engine for model 180 b carries the designation M 121 B IV–b (type designation 121.923). The engine for type 180 c carries the designation M 121 B VIII (type designation 121.927). Both engines have exactly the same outside appearance as the more recent engine for model 180 a.



Spark Plug Side

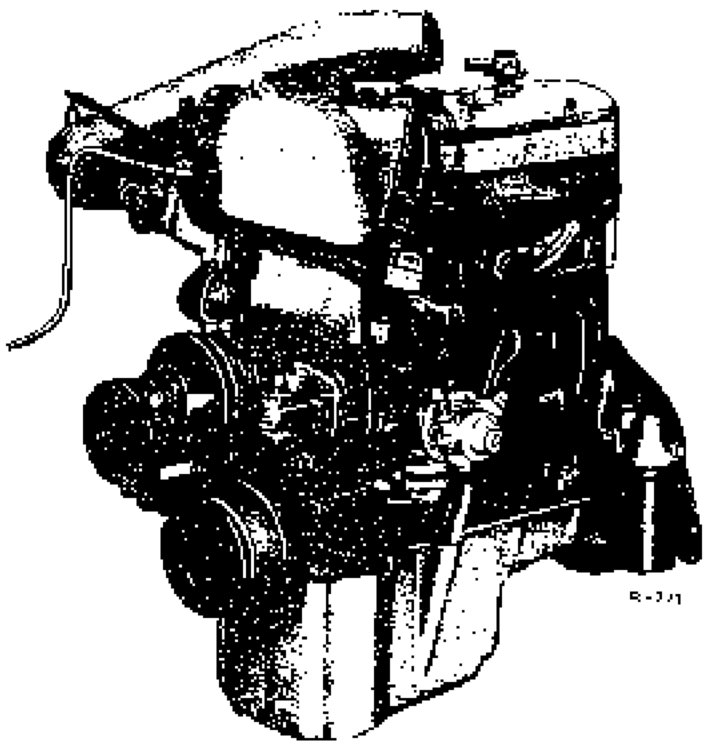


Carburetor Side

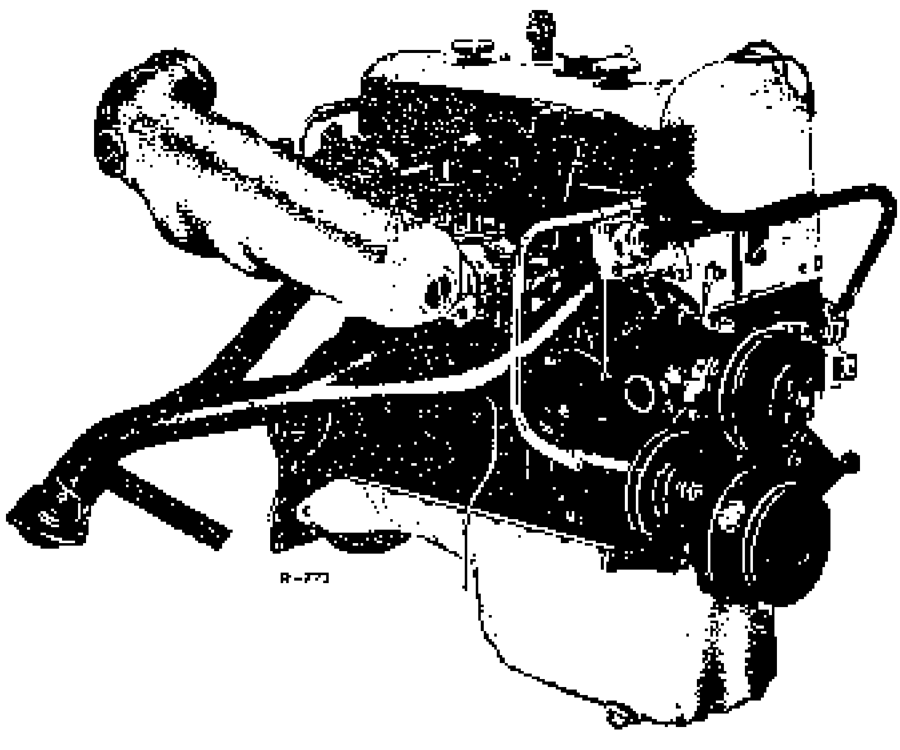
Engine M 121 B II for Model 190 SL

(Type Designation 121.921)

As from further modified valve timing with engine designation M 121 B IX and type designation 121.928



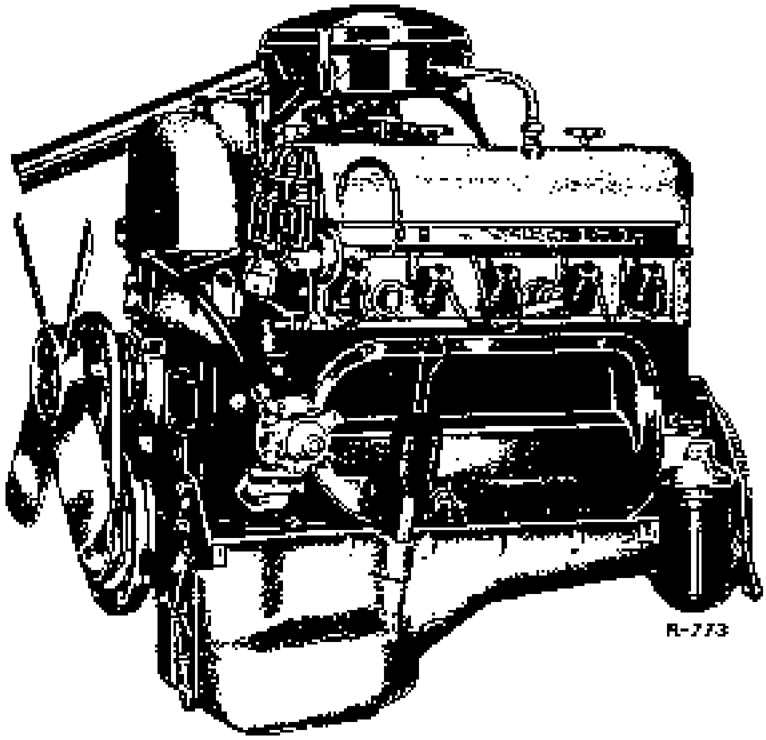
Spark Plug Side



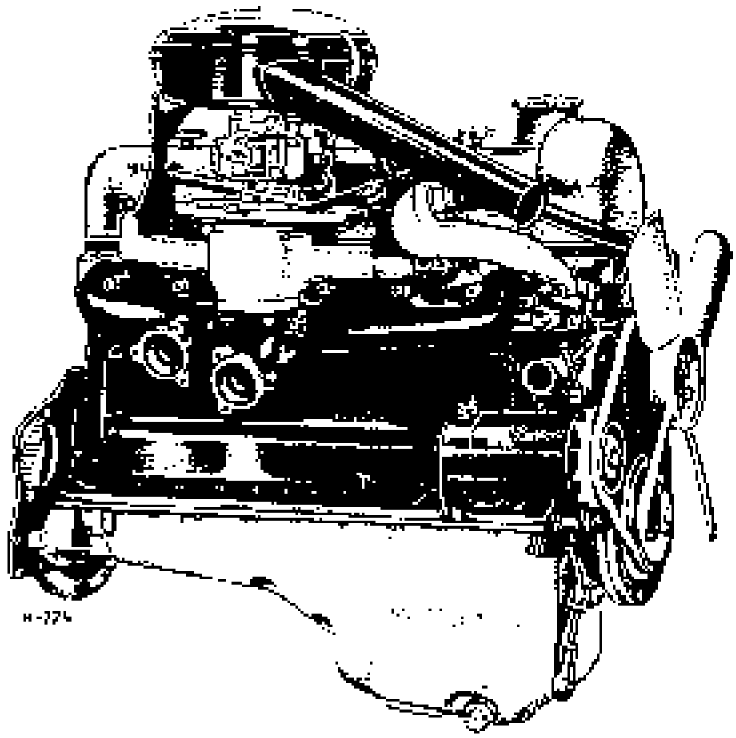
Carburetor Side

Engine M 180 II for Models 220 a and 219

(Type designation 180.921)



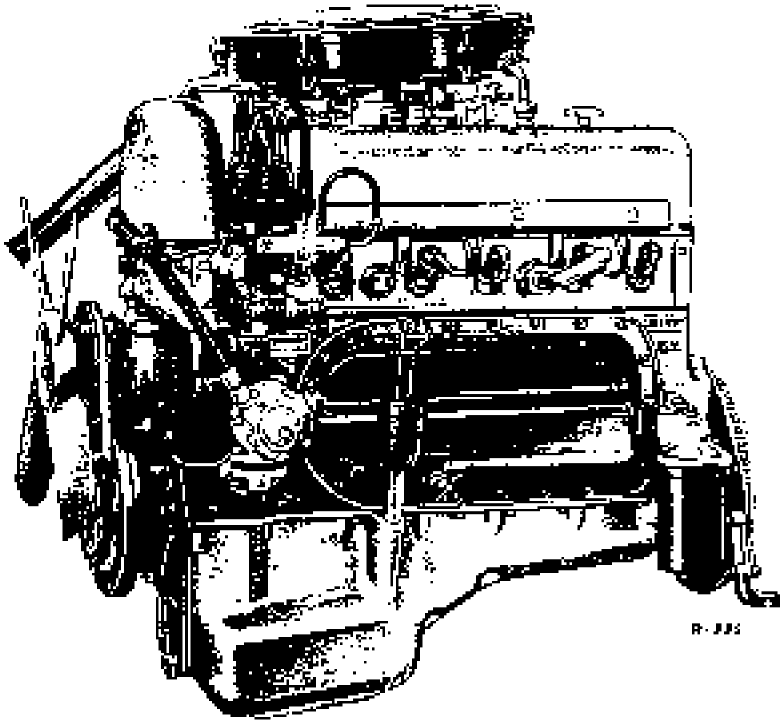
Spark plug side



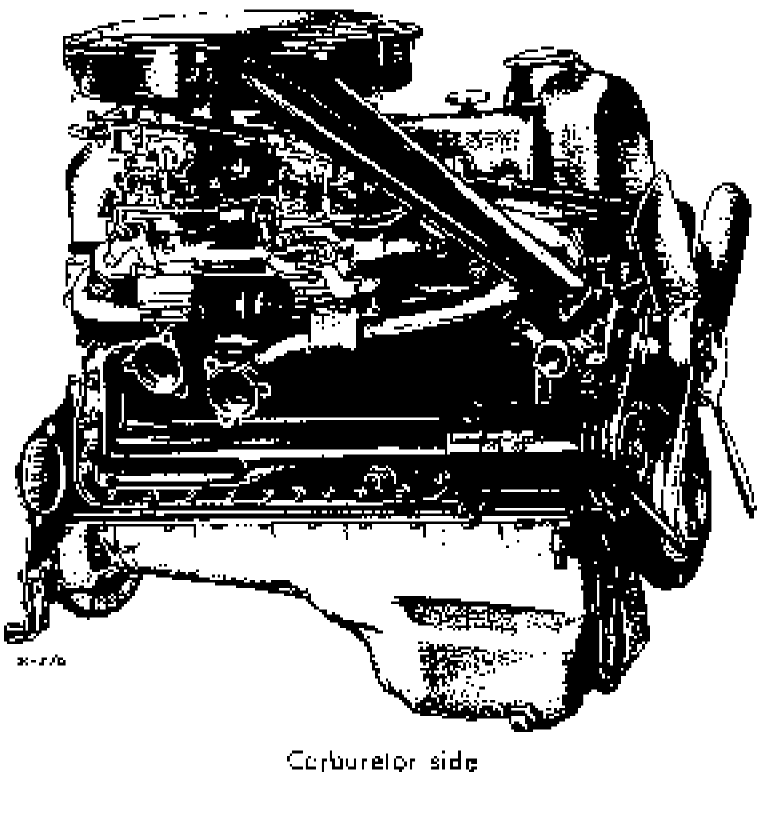
Carburetor side

Engine M 180 III for Model 220 S

(Type designation 180.924)



Spark plug side

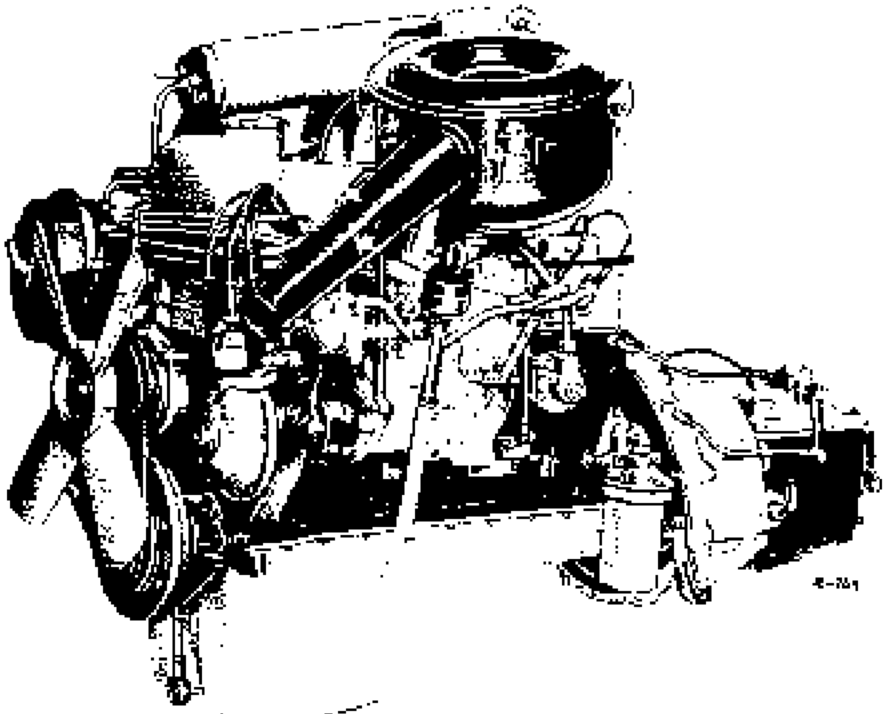


Carburetor side

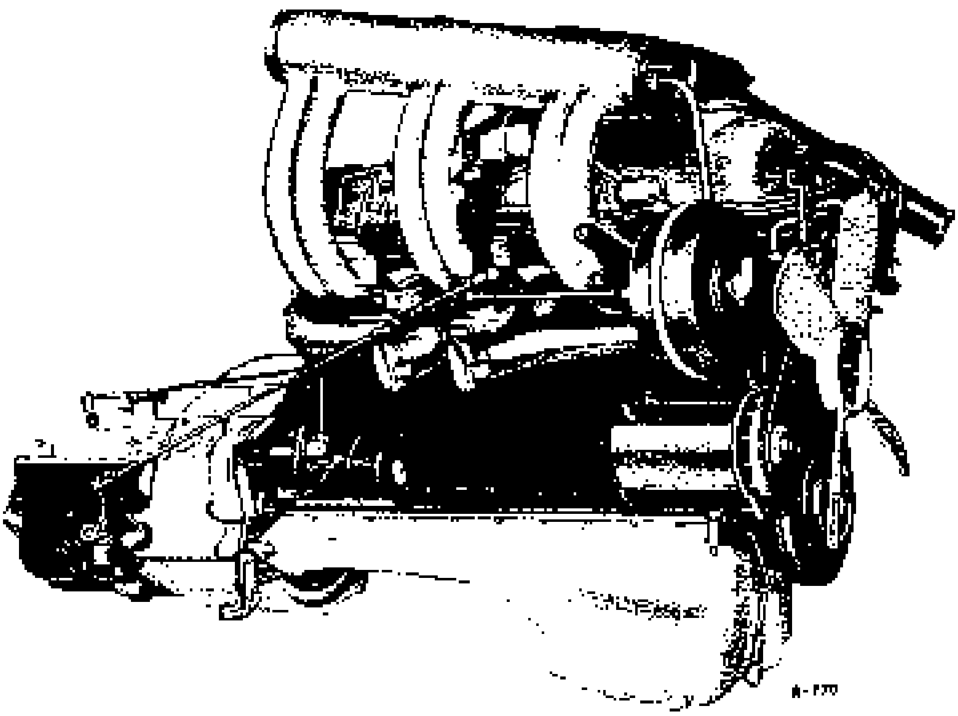
Engine M 127 I for Model 220 SE

for cars with hydraulic automatic clutch

(Type designation 127.980)



Injection pump side



Intake pipe side

A. Removal and Installation of Carburetor or Fuel Injection System including Venturi Control Unit and Control Linkage

I. Removal and Installation of Carburetor on Models 180 a, 180 b, 220 a, 219, and 220 S

For repair procedure see Job Nos. 07-0 and 07-4.

Removal:

1. Loosen the air vent line cap nut on the cylinder head cover and remove the air intake silencer.
   On Models 180 a and 180 b the air intake silencer is screwed to the two brackets; it is advisable to remove it together with the brackets. To do this, unscrew the fixing nuts for the brackets at the intake pipe.
   On Models 219 and 220 a the air intake silencer is fastened to the brackets by means of snap catches. The brackets need not therefore be detached from the intake pipe. On Model 220 S the intake silencer is fastened to the carburetors by means of two pipe clips. In order to remove the air intake silencer, the two clamping screws on the pipe clips must be loosened.

2. Unscrew the fuel line and the vacuum line to the distributor, **holding the pipe union at the carburetor steady.**

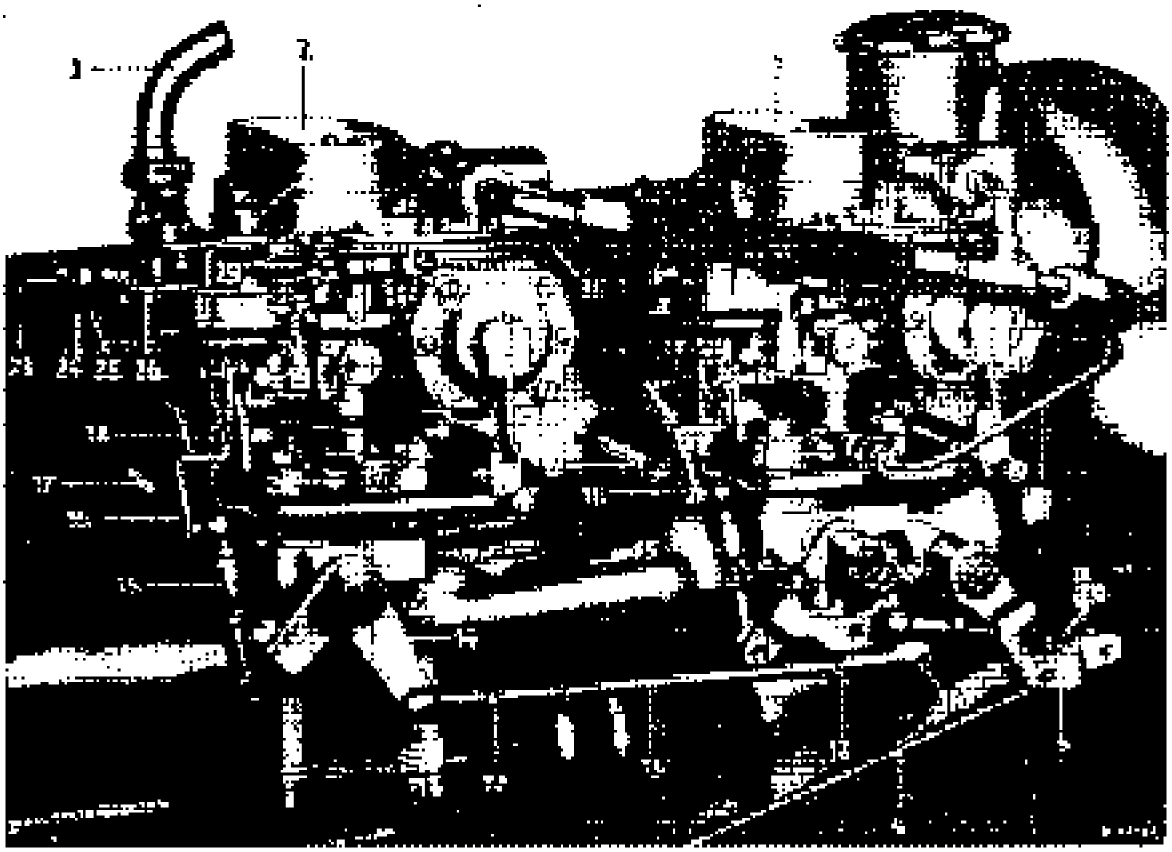


Fig. 01-4/1
Carburetor system for Model 220 S

1 Front carburetor
2 Rear carburetor
3 Vent tube
4 Pull rod
5 Relay lever
6 Push rod
7 Control lever
8 Stop ball
9 Idle stop screw
10 Aperture limiting screw
11a Ball socket
11b Ball socket
12 Hexagon nut
13 Push rod
14 Angle lever
15 Spring-loaded push rod
16 Throttle valve lever
17 Return spring
18 Tension spring
19 Idle adjustment screw
20 Idle mixture adjustment screw
21 Vacuum line to distributor
22 Fuel line
23 Coil spring
24 Rubber bushing
25 Adjusting nut
26 Spring steel wire
27 Angle lever
28 Clamping screw
29 Rubber bushing
30 Hexagon nut
31 Connecting rod
32 Hexagon screw

3. Detach the carburetor linkage and the return spring at the throttle valve lever.

On Model 220 S also detach the connecting rod (31) to the start mechanism of the front carburetor (Fig. 01-4/1).

If the engine is installed in the vehicle, the choke cable must be disconnected on all Models (see Job No. 30-6).

4. Unscrew the carburetor fixing nuts and remove the carburetor, taking care that the lock washers do not fall into the intake pipe.

Remove the upper insulating flange (on carburetors with grey cast iron flange on Models 219 and 220 a remove the gasket), remove the screening plate and the lower insulating flange from the intake pipe.

In the case of the carburetor for Model 220 S of Stage I, the upper insulating flange is provided with an air jet (1), which should be taken out after the flange has been removed (Fig. 01-4/2).

Installation:

5. Before the carburetor is installed, the insulating flanges, the screening plate, the attaching flange at the carburetor, and the intake pipe must be checked for plane surfaces. Damaged insulating flanges must be replaced. Small rough spots on the attaching flange of the carburetor and on the intake pipe can be removed on a surface plate by means of abrasive cloth.

The flange surfaces must be absolutely smooth, even and clean in order to ensure that the carburetor connections are leak-proof and that the engine cannot take in any excess air. Leaky carburetor flanges are responsible for uneven engine performance. Furthermore, they make it impossible to regulate the idle speed properly.

This is particularly important on cars of Model 220 a which have a carburetor with a die-cast flange.

On later cars this carburetor was fitted with a grey cast iron flange, which ensures better dimensional stability. The same carburetor was installed also on Model 219.

Note: When the grey cast iron flange was installed, it was necessary to dispense with the upper insulating flange so as not to change the installation height of the carburetor. By way of compensation, a standard paper gasket, Part No. 180 071 00 80, is installed on these carburetors between the carburetor flange and the screening plate (Fig. 01-4/3).

6. Install the lower insulating flange, and in the case of Models 220 a and 219, the gasket on the intake pipe (Fig. 01-4/3).

On Model 220 S insert the air jet (1) in the first Stage bore of the upper insulating flange (2) (Fig. 01-4/2).

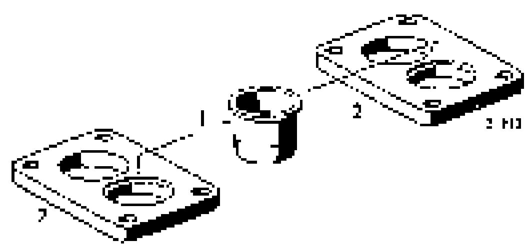


Fig. 01-4/2

1 Air jet
2 Upper insulating flange

On Models 219 and 220 a mount the insulating flange and the gasket with **sealing compound.** Use only a thin coat of sealing compound.

On all other carburetors the insulating flanges are mounted without sealing compound.

7. Install the carburetor, put on the spring washers, and tighten the carburetor by means of the hexagon nuts.

Tighten the nuts evenly in order to prevent distortion of the carburetor flange.

On Models 220 a and 219 the spacer sleeves (5) must be installed in the bores of the carburetor flange from the throttle valve part (7) before the fixing nuts are screwed on (Fig. 01-4/3).

The purpose of the spacer sleeves is to ensure that the tightening torque is transferred not to the carburetor flange (7), but to the grey cast iron flange (9). For this reason the spacer sleeves must project beyond the carburetor flange by the distance "a" = appr. 0.2 mm (Fig. 01-4/3).

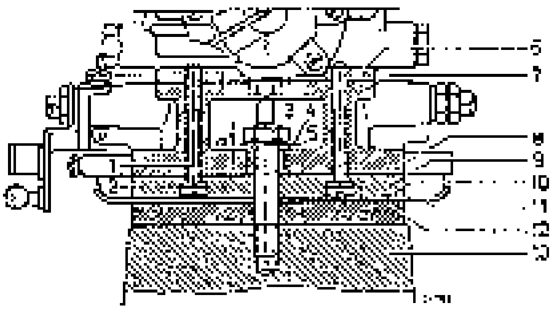


Fig. 01-4/3

a = appr. 0,2 mm

1 Cylinder head screw	8 Gasket
2 Spring washer	9 Grey cast-iron flange
3 Hexagon nut	10 Gasket
4 Lock washer	11 Screening plate
5 Spacer sleeve	12 Insulating flange
6 Float chamber	13 Intake pipe
7 Throttle valve part	

8. Screw on the fuel line and the vacuum line to the distributor, **holding the pipe union** at the carburetor **steady**.

9. Attach the carburetor linkage and the return spring to the throttle valve lever.

   On Model 220 S also attach the connecting rod (3) to the start mechanism of the front carburetor (Fig. 01-4/1).

   When the engine is installed in the vehicle, connect up the choke cable (see Job No. 30-6).

10. Attach the air intake silencer and attach the air vent line from the cylinder head cover to the air intake silencer. In order to attach the air intake silencer on Models 180 a and 180 b, screw the two brackets to the intake pipe, and on Models 219 and 220 a, close the snap catches at the brackets, and on Model 220 S screw down the two clamping screws on the pipe clips.

11. Check the adjustment of the carburetor linkage and adjust the idle (see Job No. 01-3, Section K).

II. Removal and Installation of Carburetor on Model 190 SL

For repair procedure see Job Nos. 07-0 and 07-4.

Removal:

Note: It is advisable to remove the carburetor only together with the intake pipes, since otherwise the upper spring washers (2) may drop into the intake pipe and cause damage when the carburetor is removed or installed (see Fig. 01-4/4).

1. Loosen the clamping screw (1) for the sleeve of the choke control on the air suction tube and the clamping screws (2) for the choke control on the choke valve levers of the two carburetors and pull out the cable (Fig. 01-4/5). Also loosen the clamping screw (4) for the hot-start cable and pull out the cable. Then detach the return spring (3) for the accelerator linkage and the connecting rod (8) at the carburetor control shaft lever.

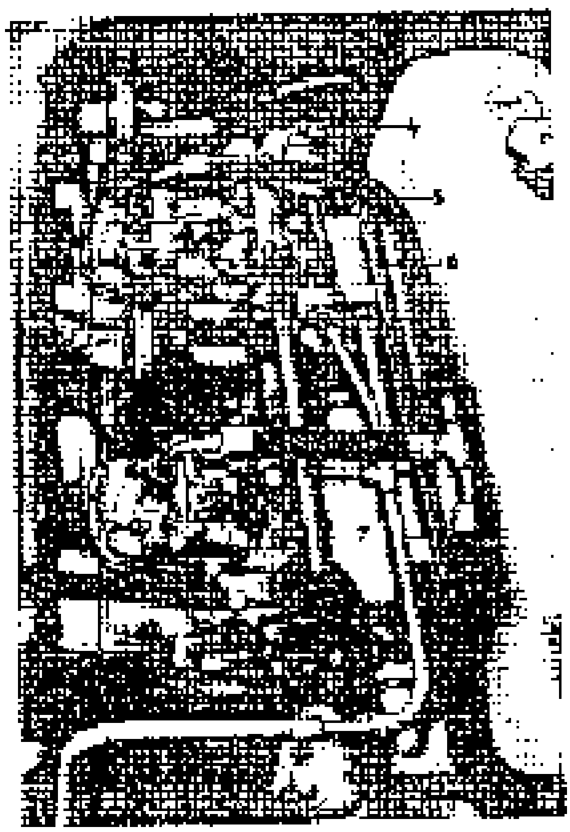


Fig. 01-4/5

Die cast carburetor

1 Clamping screw for choke control sleeve
2 Clamping screw for choke control on both carburetors
3 Return spring for accelerator linkage
4 Clamping screw for hot-start cable
5 Control vacuum tube for ATE Power Brake
6 Rear intake pipe
7 Front intake pipe
8 Connecting rod
9 Fuel overflow line

2. Unscrew the strut (4) supporting the carburetor system at the air suction tube (Fig. 01-4/6) and unscrew the hexagon nuts from the air suction tube.

3. Open the snap catches (5) on the air filter, detach the rubber hose (4) from the vent tube of the cylinder head cover, and remove the upper part of the filter (3) together with the air hose (2) and the air suction tube (1) (Fig. 01-4/7). Pay attention to the gaskets between air suction tube and carburetor.

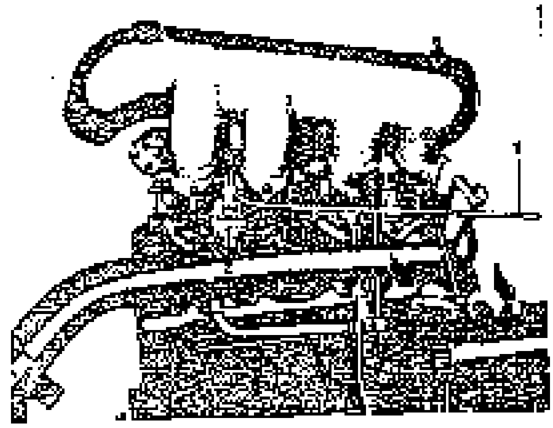


Fig. 01-4/6

Sand-cast carburetor

1 Fuel overflow line
2 Suction line
3 Leak-off pipe
4 Strut for supporting air suction tube
5 Return pipe to water pump

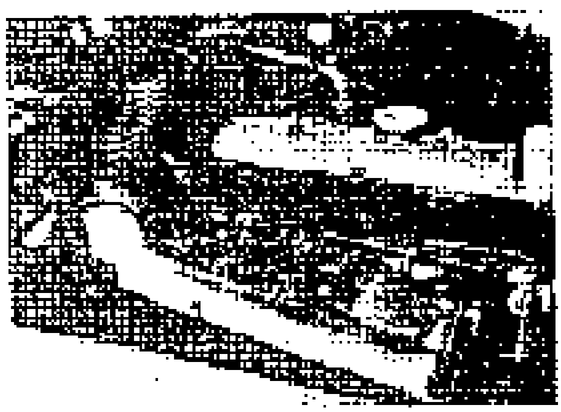


Fig. 01-4/7

Die-cast carburetor

1 Air suction tube
2 Air hose
3 Upper part of filter
4 Rubber hose
5 Snap catches

4. Disconnect the fuel line (4) at the two carburetors, holding the pipe union steady (Fig. 01-4/8). Then detach the hose between the fuel overflow line (3) and the front pipe union (on the bracket of the right radiator support).

Note: The fuel overflow line need not be detached from the carburetor and suction system.

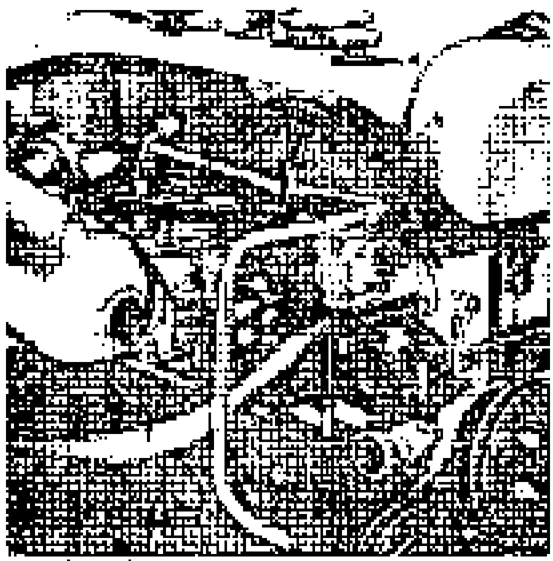


Fig. 01-4/8

Removing carburetor

1 Water return pipe
2 Leak-off pipe
3 Fuel overflow line
4 Fuel line
5 Cooling water drain union with cooling water thermostat
6 Chain tensioner
7 Air vent line

5. Unscrew the cap nut at the Tee-piece of the leak-off pipe (2) (Fig. 01-4/6). It is not necessary to detach the lower part of the leak-off pipe from the strut supporting the carburetor or the upper part from the carburetors.

6. If the car is provided with an ATE Power Brake, disconnect the vacuum line at the threaded union (6) of the rear intake pipe (Fig. 01-4/5).

7. If the engine is installed in the vehicle, drain off part of the cooling water, collecting the water if additives are present.

8. Detach the water hose from the radiator to the cooling water thermostat (5) and the cooling water return line (1) at the connections of the front and rear intake pipes (Fig. 01-4/8). Unscrew the hexagon nuts on the intake pipes, the exhaust manifold, and the cooling water drain union. Then remove the carburetors together with the intake pipes and the cooling water drain union together with the cooling water thermostat.

9. Detach the fuel overflow line (9) from the two carburetors and the fixing clip on the bearing bracket for the hot-start mechanism (Fig. 01-4/5). Then detach the connecting hose from the cooling water drain union to the front intake pipe and remove the fuel overflow line together with the fuel water drain union and the cooling water thermostat.

10. Disconnect the leak-off pipe (3) at the two carburetors (Fig. 01-4/6).

11. Detach the return spring for the hot-start mechanism. Unscrew the hexagon screws and nuts fastening the carburetors to the intake pipe. Remove the rear carburetor together with the hot-start mechanism and the front carburetor together with the control shaft bearing.

Installation:

12. Before installing the front carburetor, check whether the throttle valve of Stage 1 is absolutely horizontal under full load. If this should not be the case, correct the position of the throttle valve at the full-load stop as far as necessary.

13. Check the rubber flanges (3) and the rubber washers (5) between carburetor and intake pipe to see if they are fit for re-use and, if necessary, replace them (Fig. 01-4/9).

Note: Since the rubber flanges may be squeezed outward when they are compressed, the flanges used on former cars with a bore of 46 mm may project too far into the intake pipe and may cause the throttle valve and vacuum valve to jam. For this reason the bore in the rubber flange was enlarged to 49 mm. For this reason only rubber flanges with the larger bore should be installed.

14. Attach the carburetors to the intake pipes and evenly tighten the hexagon screws.

Do not forget the spring washers (2) between carburetor flange and rubber flange (Fig. 01-4/9).

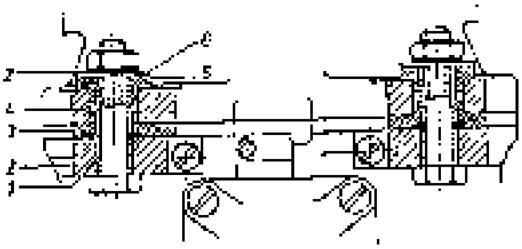


Fig. 01-4/9

1 [illegible]
2 Spring washer
3 Rubber flange
4 Sleeve
5 Rubber washer
6 Washer

Note: If the suction tubes have been disassembled, they must be reassembled again before the carburetors are installed and must be fitted to the cylinder head in order to ensure that the distance between them is correct; only then should the coupling nuts (5) of the compensating line (3) and the hose straps (14) at the connecting hose (12) be tightened (see Fig. 01-4/18).

When installing the carburetors, it is advisable first to attach the rear carburetor together with the hot-start mechanism and then the front carburetor together with the control shaft bearing.

Furthermore, the carburetors should be attached to the intake pipes before these are mounted in order to ensure that the spring washers (2) have not dropped into the intake pipe, since otherwise engine damage may occur (Fig. 01-4/9).

15. Attach the leak-off pipe (3) to the two carburetors (see Fig. 01-4/6).
Attach the fuel overflow line to the two carburetors and the fixing clip to the bearing bracket of the hot-start mechanism (see Fig. 01-4/5). Attach the connecting hose from the cooling water drain union to the first intake pipe.

16. Check the gaskets of the intake pipes and of the cooling water drain union and, if necessary, replace them.

17. Install the carburetors on the cylinder head together with intake pipes and cooling water drain union and tighten evenly.

Attach the water hose from the radiator to the cooling water thermostat (5) and the water return pipe (1) (see Fig. 01-4/8) to the various unions below the front and rear intake pipes. Top up the cooling water.

18. If the car is provided with an ATE Power Brake, attach the vacuum line to the threaded union (5) of the rear intake pipe (see Fig. 01-4/5).

19. Screw the cap nut of the lower leak-off pipe (3) to the Tee-piece (see Fig. 01-4/6). Attach the fuel line (4) to the two carburetors, holding the connecting union steady (see Fig. 01-4/8).

Attach the hose to the front pipe length of the fuel overflow line (3), making sure that the fuel overflow line is not bent when the hose is being installed.

20. Adjust the carburetor linkage (see Job No. 01-3, Section K).

21. Check the gaskets of the air suction tube and, if necessary, replace them. Place the air suction tube (1) on the carburetors and the upper part of the filter (3) together with air hose (2) on the air filter and close the snap catches (5) (see Fig. 01-4/7).

Screw on the air suction tube. Then attach the rubber hose (4) to the vent tube of the cylinder head cover (see Fig. 01-4/7). Attach the return spring (3) for the accelerator linkage (see Fig. 01-4/5).

22. Screw the strut supporting the carburetors to the air suction tube (Fig. 01-4/10).

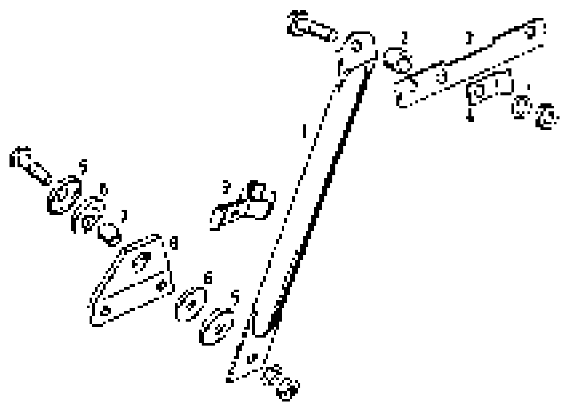


Fig. 01-4/10

1 Strut for supporting air suction tube
2 Spacer tube
3 Holder of air suction tube
4 Pipe clip
5 Cup washer
6 Rubber washer
7 Sleeve
8 Holder at crankcase
9 Pipe clip for fuel leak-off line

Note: The air suction tube upper attachment shown in the above picture 01-4/10 is the first version. In the second version the strut is screwed directly to a fixing eye cast integral with the suction tube. In this version the holder (3), the spacer tube (2), and the pipe clip (4) for the leak-off pipe are no longer required.

23. Insert the choke cable and attach the clamping screw (1) for the sleeve of the choke cable and the clamping screws (2) for the choke cable to the choke valve levers of the two carburetors (see Fig. 01-4/5).

When doing this, check whether the choke valves are closed when the starter button is pulled out and whether, when the starter button is pushed in, the two valves are horizontal and the levers rest against the lower stop.

24. Insert the hot-start cable and lock the sleeve by means of the clamping screw (4) (see Fig. 01-4/5). Attach the return spring. Then press the angles of the hot-start mechanism against the counterweights until the distance is no more than appr. 2 mm. In this position tighten the clamping screw for the cable.

Check the hot-start cable for ease of movement, depressing the accelerator as far as it will go. When the cable is released, the hot-start cable must return properly to its initial position. In the released position the angle levers must not rest against the weights of Stage 2.

25. Check the adjustment of the carburetor linkage and adjust the idle (see Job No. 01-3, Section K).

Subsequent installation of die-cast carburetors

In Model 190 SL, up to Engine End No 55 00708, sand-cast carburetors were installed, and as from Engine End No. 55 00709 die-cast carburetors are installed.

If sand-cast carburetors are subsequently replaced by die-cast carburetors, take care to ensure that also the pipe (Part No. 121 070 09 35) of the fuel overflow line at the front part of the air scoop bracket is replaced. In the case of sand-cast carburetors, the pipe has a cross-section of 6 × 0.75 mm, whereas on die-cast carburetors the cross section is 10 × 1.0 mm. The larger cross-section of the fuel overflow line on die-cast carburetors is necessary, since in addition to the fuel also the total compensating air passes to the carburetors through this line. Therefore the pipe with the smaller cross-section must on no account be used for die-cast carburetors, since otherwise carburetor trouble is bound to occur.

When installing a new or a replacement engine, which are supplied only with die-cast carburetors, in a vehicle which was equipped with sand-cast carburetors, the pipe with the larger cross-section (Part No. 121 070 09 35) must also be used. When installing this, take care to ensure that the fuel overflow line and the pipe are screwed on in the correct position and without forcing, since otherwise speed build-up will be uneven (see Fig. 01-3/15 and No. 3 in Fig. 01-4/8).

The following parts are required when die-cast carburetors are subsequently installed.

Designation	Part No.	Number per car required
Front carburetor	000 071 61 01	1
Rear carburetor	000 071 62 01	1
Bearing bracket for hot-start cable	121 070 02 40	1
Fuel line	121 070 01 32	1
Fuel overflow line	121 070 08 35	1
Fixing clip at bearing bracket		
for hot-start cable	121 995 00 03	1
Hexagon socket screw	M 5 × 10 DIN 912–8 G	2
Washer	5.3 DIN 433	1
Lock washer	B5 DIN 127	2
Hexagon nut	M5 DIN 934-5 S	2
Fixing clip		
at cooling water thermostat	121 995 03 35	2
Pipe to overflow line	121 070 09 35	1
Fillister head screw for pipe	AM 4 × 12 DIN 7985-4 S	2
Lock washer	B 4 DIN 127	2
Hexagon nut	M 4 DIN 934-5 S	2
Fuel hose	B 8 × 12 × 40 DIN 73379	2
Hose clip	S 12/9 N 728 u	4
Fuel hose	A 9 × 14 × 70 DIN 73379	1
Air suction tube	121 090 04 25	1
Sealing flange	121 094 01 79	4
Sealing ring for fuel leak-off pipe	A 6 × 10 DIN 7603 Fiber	4
Cheese-head screw	M 6 × 18 DIN 912–8 G	2

III. Removal and Installation of Fuel Injection System, including Venturi Control Unit and Control Linkage on Model 220 SE

a) Injection Pump

Removal:

1. Remove air filter. For this purpose loosen vent line to cylinder head, supplementary air line (2), the connection to the venturi control unit and the fixing screw on supporting rod (19) (Fig. 01—4/11 c).

   Then remove air filter **upward,** because the inlet air thermostat (13) projects into the air filter.

2. Drain part of the cooling water. Unscrew cooling water lines (3) and (14), as well as the supplementary air line (4), the oil line (6) and the fuel lines on the injection pump. Also loosen cable for cold start magnet.

3. Detach push rod on adjustment lever (16), and unscrew guide tube with bracket (18) for oil dipstick.

4. Then unscrew the three fixing nuts and pull injection pump out toward the rear.

5. If an injection pump is replaced pull off drive lug on camshaft and attach to new pump, because spare pumps are delivered without drive lugs.

   Loosening of nut on camshaft requires a hold on drive lug using serrated wrench 621 589 00 08. The drive lug is pulled off with puller 621 589 00 33.

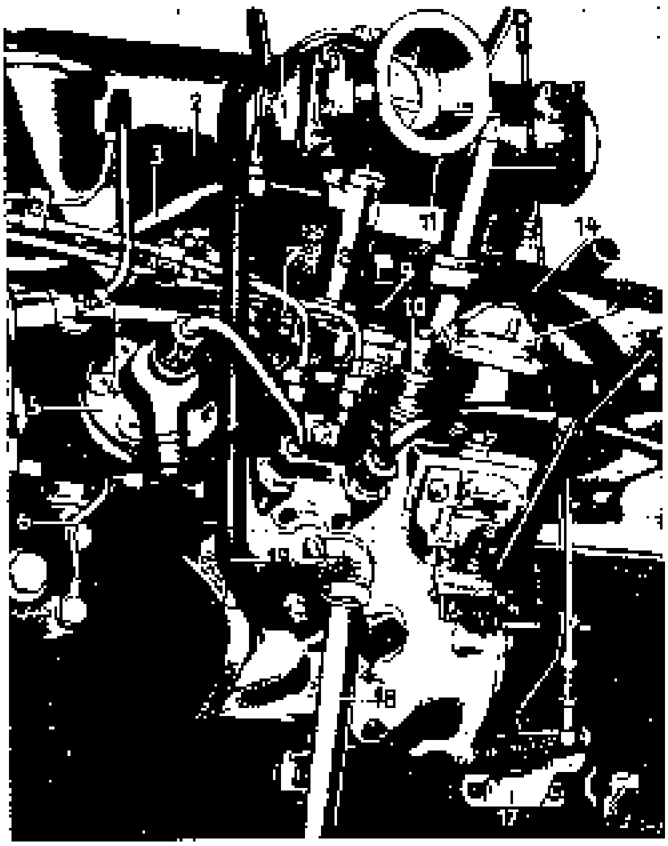


Fig. 01—4/11 a

7SA Injection Pump

1 Vacuum line to distributor
2 Line for cold-start supplementary air
3 Cooling water line
4 Line for cold-start supplementary air
5 Damper unit
6 Oil line for oil [illegible]
7 Stop bolt for cooling water thermostat
8 Cooling water thermostat
9 Stop screw for inlet air thermostat
10 Air filter for governor housing
11 Idle air throttle
12 Venturi control unit
13 Inlet air thermostat
14 Cooling water line
15 Cold-start magnet
16 Adjustment lever
17 Control lever with bearing block
18 Guide tube for oil dipstick
19 Supporting rod for air filter

Note: On the first version of the drive lug dimension a = 1.5 mm, on the second version = 2.7 mm (Fig. 01—4/11 b). Drive lugs of the 1st version should no longer be installed.

To obtain a good grip for the puller, two adjoining cylinder screws which hold the flange on the injection pump have to be screwed out (refer to Fig. 01—4/11 c). After the drive lug has been pulled, don't forget to screw the two screws down again.

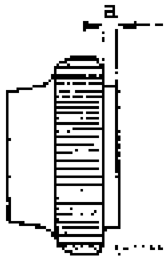


Fig. 01 4/11 a

Installation:

6. The injection pump for Model 220 SE is not set to an end of 60° after TDC in the delivery stroke as for the other gasoline injection engines, it should be set as follows:

   Prior to installing the injection pump the piston of No. 1 cylinder is set to TDC (intersection dead center or ignition dead center) and the camshaft of the injection pump is rotated in such a manner that the marking line on the camshaft is aligned with the mark on the flange of the injection pump (Fig. 01–4/11 c).

   This is the position in which the injection pump is installed. Installation according to instructions will then provide a delivery end of 120° before TDC for the No. 1 cylinder. An extra delivery end checkup by means of container and overflow pipe is not required for injection pump for Model 220 SE. This is why the fastening flange of the pump has no slotted holes for correcting the pump position.

7. Connect all lines and check whether cap nuts have been tightened well.

   Pay special attention to the check valve for the oil lock. The hollow screw should be tightened well, because otherwise oil may be lost.

8. Attach push rod on injection pump lever and check adjustment of control linkage (refer to Workshop Manual Passenger Car Models starting August 1959, Job No. 00–16).

9. Install air filter, fasten and connect all lines. When installing air filter, make sure that the rubber grommet is accurately seated in filter bottom and is not pushed into filter housing.

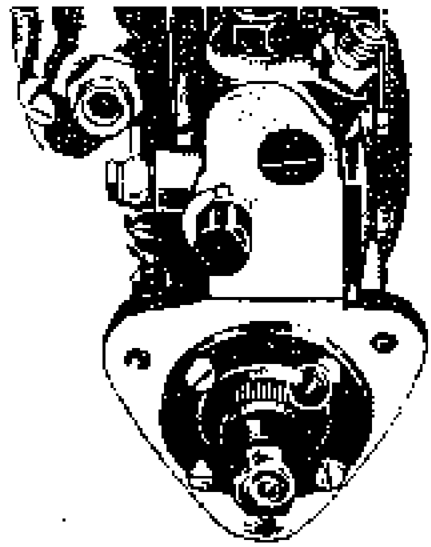


Fig. 01 4/11 c

b) **Injection Valves and Fuel Distributor Fittings**

The uniform distribution of the fuel to the individual cylinders does not only depend on uniform ejection pressure and flow volume of injection valves, but also from the condition of the pertinent fuel distributor fittings.

Fuel distributor fittings and injection valves are selected during production in such a manner that the injected quantity of the three injection valves which belong to one distributor fitting is of uniform size. The correlated parts are marked with letters and are supplied as a complete distribution group (Fig. 01–4/12 a).

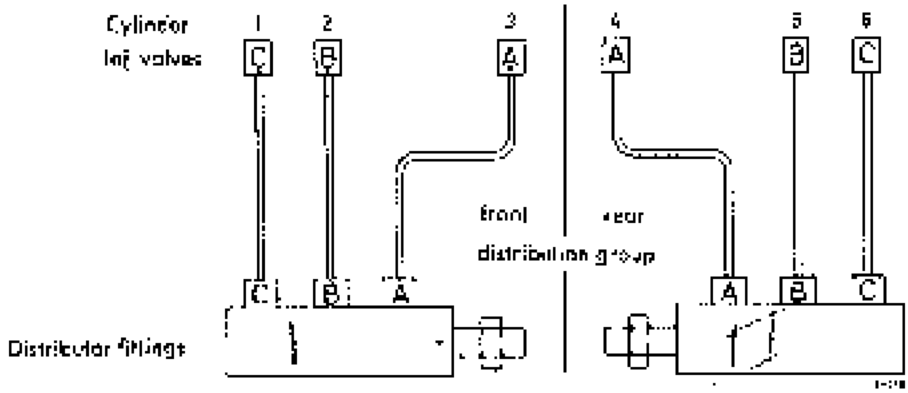


Fig. 01–4/12 a

In addition the front distribution group (fuel distributor fitting and injection valves for cylinders 1–3) is marked during production with a red dot (Fig. 01–4/12 a).

This mark should be heeded during assembly because otherwise nonuniform fuel distribution to the individual cylinders and a correspondingly bad-running engine might result.

When the injection valves and the distributor fittings are disassembled their sequence should be marked, or the two distributing groups should be placed in separate containers to prevent confusion.

Check Injection Valves and Fuel Distributor Fittings

The injection valves should be checked by means of a commercial tester and a pressure gauge with a measuring range of 0–25 kg/cm² and with test oil (OL 61 v 1) to the specified ejection pressure, proper shape of jet and for leaks.

Prior to the test check **whether the tester and the test oil are absolutely clean. The same applies to the filter of the tester,** which should be cleaned, if required. The pressure gauge is disconnected by closing the shutoff valve on the tester. Then the tester is first actuated several times **without** injection valve, to flush any **remaining contaminations** out of the apparatus. Then the unit **with the injection valve** is actuated several times **quickly and energetically**, to force out any remaining air.

1. **Jet Shape – Visual Control of Injection Valves**

The observation of the jet shape is effected by pushing the pump lever down quickly several times (2–3 strokes per sec.) with the pressure gauge disengaged. The jet should be uniformly well atomized and should have the shape of a cone-shaped shell.

If the jet drips, and is too wide, with too many strands and not completely compact, the injection valve is not in order.

If after another clearing of the injection valve the test conditions are not met, the injection valve or the complete distribution group, of which the objected injection valve is a part, should be replaced.

2. **Check Ejection or Opening Pressure of Injection Valves**

Push hand pump lever of switched-on pressure gauge slowly (1 stroke per sec.) down and read ejection pressure **on** pressure gauge when valve opens or ejection begins.

Caution: With pressure gauge switched-on increase pressure only slowly and above all blow off only slowly, because the pressure gauge might otherwise be damaged.

The opening or ejection pressure of the injection valves should be 13.0 to 15.5 atü. The difference of the ejection pressure within three injection valves (distribution group) belonging to one fuel distributor fitting should not be more than 0.5 atm. to guarantee uniform distribution of the fuel to the individual cylinders.

If there is a larger difference than 0.5 atm. the injection valve or the complete distribution group to which the objected to injection valve belongs should be replaced.

3. **Check Injection Valves for Leaks**

Push hand pump lever of switched-on pressure gauge slowly down to the point where the indicator stops on the pressure gauge 3 atm. below the previous measured ejection pressure. The injection valve is leakproof if no drop comes out of mouth of injection valve.

If an injection valve leaks the complete distribution group to which the objected to injection valve belongs should be replaced.

4. **Measuring for Uniform Distribution of the Fuel of the Distributor Groups**

Measuring the delivered quantity of fuel a distribution group for uniform distribution of the fuel may be done on a Bosch pump test stand or as follows:

The distribution group consisting of a distributor fitting and three injection valves about to be checked are connected to a two-plunger pump, exactly as in the vehicle. Only perfectly ejecting injection valves, in which the ejection pressure differs no more than 0.5 atm. from each other, should be used. A measuring glass is set under each injection valve.

The difference (max spread) of the fuel quantity delivered by the injection valves may not be more than 2.5 cc/1000 strokes at idling speed (350 rpm of the injection pump), and at full load (1000 rpm of the injection pump) no more than 3.0 cc/1000 strokes.

The cold-start quantity per injection valve at 40 rpm of the injection pump in a 220 SE should be mean 11 to 13 cc/100 strokes, but definitely not less than 8 cc/100 strokes (with OL 61 v 1). If there are larger differences between idling and full load, or if the fuel quantity is not reached during a cold start, as stated above, the complete distribution group should be replaced.

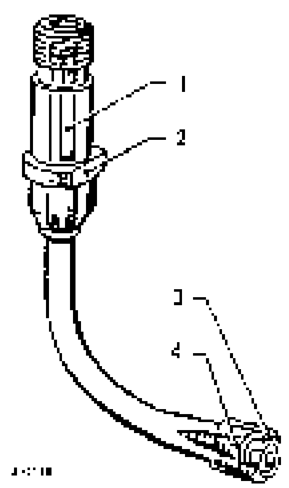


Fig. 01–4/12 b

Injection Valve

1 Filter
2 Connecting socket
3 Sheet metal cap
4 Valve insert

If a distribution group requires replacement, the rejected distribution group can now be completely replaced under part No. 000 078 01 95/80 (Bosch designation EPVT 1 P 12 Z injection valves with screen filter) or under part No. 000 078 00 95/80 (Bosch designation EPVT 1 P 11 Z injection valves with rod-type filter) (Fig. 01–4/12 a), that is, upon returning of a disassembled, complete, correlated distribution group you will receive an overhauled distribution group, in which the 3 injection valves (Fig. 01–4/12 a) have been given new valve inserts (4), the injection valve pipes have been provided with connecting sockets (2), and the respective fuel distributor fitting has been cleaned, and the reconditioned distribution group has been tested for uniform distribution of the fuel.

If no replacement distribution group is available, any Bosch service will replace the valve inserts (4) of the rejected distribution group or the injection valves (Fig. 01–4/12 b), while using the disassembled injection valve pipes and connecting sockets again, and will then re-install the assembly with the respective fuel distributor fitting.

Prior to installing a new distribution group or new injection valves with new valve inserts, the injection valves should be well flushed on a tester (for measuring the ejection pressure), to prevent any sticking of the injection valve needle as the result of resinification after extended storage.

Prior to installing the holders for the injection valves check whether the surface of the holder (10) and the surface on the intake pipe are undamaged. These surfaces must be perfectly level, because otherwise leaks may occur. Be sure to replace the seal between the holder (10) and the intake pipe and to use Teroson sealing compound for installation. When mounting the flange (9), which holds the injection valves in the holder (10), the hexagon nut which holdes the flange (9) and the holder (10) may not be tightened more than 1.5 mkg (Fig. 01–4/12 c).

The cap nuts (6) should be tightened with about 2.5 mkg.

Following installation, the holders (10) of the injection valves should suitably be checked for seal tightness by spraying with gasoline while the engine is running.

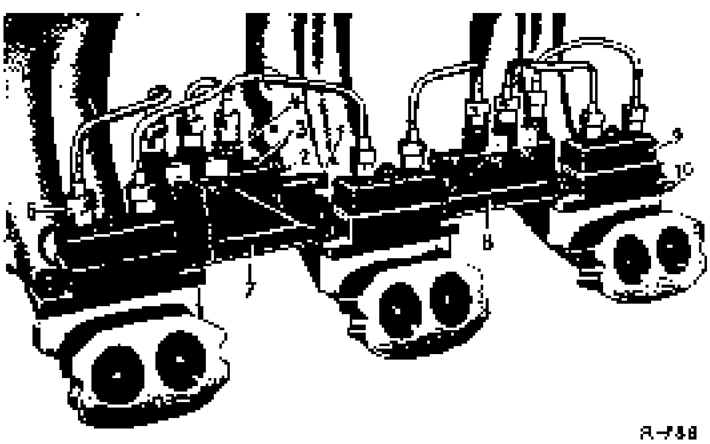


Fig. 01–4/12 c

1 Pressure pipe connection
2 Disc
3 Fuel distributor fitting
4 Pressure pipe connection
5 Injection pipe
6 Cap nut
7 Support for front distributor fitting
8 Support for rear distributor fitting
9 Flange
10 Holder for injection valves

Note: **Whenever injection valves made by Bosch are tested or reconditioned, the respective, local Bosch agencies should be consulted, whenever possible.**

Fuel Distributor Fittings

Each of the two fuel distributor fittings (3) is screwed to the support (7) or (8) (Fig. 01–4/12c) by means of two hexagon bolts and one nut and one lock washer each. The supports (7) in turn are attached to the intake pipe together with the holders (10), with the higher support mounted in front and the lower at the rear.

Injection Valves with Holder

After disconnecting injection pipes (4) and unscrewing flange (7), the injection valve may be removed from the holder (8) (Fig. 01–4/12 d).

The holders (8) themselves are attached to the intake pipe (Fig. 01–4/12d) by means of two hexagon socket screws (9) with lock washers and washers (10) and gasket (11).

Note: On the side of the holder (8), to which the support for the fuel distributor fitting is attached does not require washer (10).

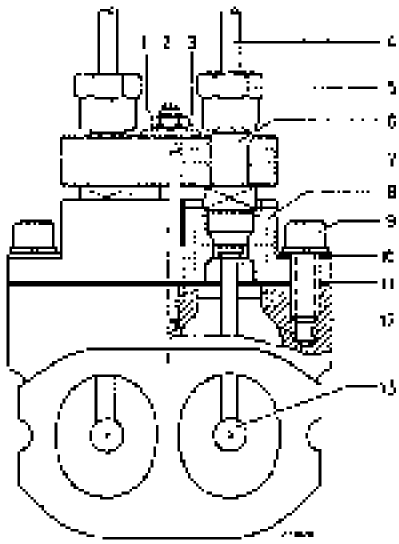


Fig. 01–4/12 d

1 Nut	8 Holder
2 Stud	9 Hexagon socket screw
3 Washer	10 Washer or support
4 Injection pipe	11 Gasket
5 Cap nut	12 Intake pipe
6 Injection valve	13 Locking cap on injection valve
7 Flange	

c) Venturi Control Unit

Removal:

1. Remove the air filter. To do this, unscrew the vent line to the cylinder head, the supplementary-air line (2), the connection to the venturi control unit and the fixing screw at the supporting rod (19) (see Fig. 01-4/11a). Then remove the air filter **upward**, since the inlet air thermostat (13) projects into the air filter.

2. Disconnect the vacuum line to the distributor at the venturi control unit, detach the pull rod and the return spring at the throttle valve lever and unscrew the control unit.

Installation:

3. Attach the venturi control unit and the return spring holder to the intake pipe; do not omit the sealing ring. Attach the vacuum line to the distributor and attach the pull rod and the return spring to the throttle valve lever.
4. After installing the venturi control unit, **check the adjustment of the control linkage** (See Workshop Manual Passenger Car Models, starting August 1959, Job No. 00-16).
5. Place the air cleaner in position and attach it. Connect up the supplementary-air line and the air vent line.

d) Control Lever with Bearing Block, and Control Linkage

Control Lever with Bearing Block

The control lever with bearing **block** is fastened to the crankcase by means of two hexagon socket screws and washers. Both parts, the control lever and the bearing block **must be replaced as a unit,** since the bore for holding the control linkage in the idle position is bored through both parts together.

The "O" rings (2) and the needle bearings (3) can be replaced individually (Fig. 01-4/13).

Before reassembly the needle bearings should be well filled with grease.

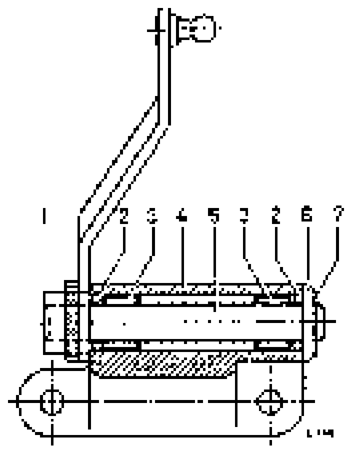


Fig. 01-4/13

1 Control lever
2 "O" ring
3 Needle bearing
4 Bearing block
5 Pivot pin
6 Washer
7 Locking plate

Control Linkage

The ball sockets of the control linkage must not have any play. **Worn ball sockets must always be replaced.** Before installing the control linkage, the ball sockets should be well filled with grease.

After installing the control lever with bearing block and the control linkage, **check the adjustment of the control linkage** (see Workshop Manual Passenger Car Models starting August 1959, Job No. 00-16).

B. Removal and Installation of Intake Pipe and Exhaust Manifold

I. Models 180 a, 180 b, 220 a, 219, 220 S and 220 SE

Repair procedure see Job No. 14-5.

Removal and Installation:

On Models 180 a, 180 b, 220 a, 219, and 220 SE the intake pipe and the exhaust manifold can only be removed together. If the intake pipe has to be replaced, the carburetor must be removed beforehand. In all other cases the intake pipe and the exhaust manifold can be removed with the carburetor screwed to them. However, the air intake silencer with the supports must always be removed. Removal and installation on these Models is essentially the same as on Model 190.

On Models 220 a and 219 the rear exhaust manifold half can be removed separately, and there is no necessity to remove the intake pipe and the front exhaust manifold half as well (Fig. 01-4/15). On Model 220 S, however, the rear exhaust manifold half is screwed to the intake pipe (Fig. 01-4/16).

On Model 220 SE, the intake pipe, the front and the rear exhaust manifold can be removed individually.

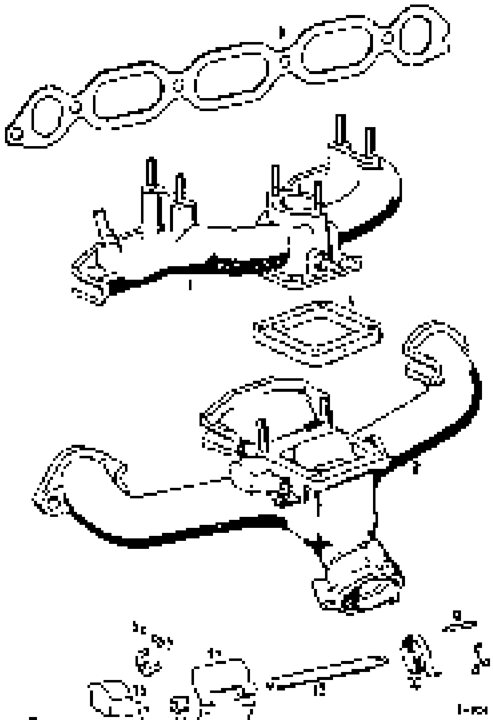


Fig. 01-4/14

Intake pipe and exhaust manifold on Models 180 a and 180 b

1 Intake pipe
2 Exhaust manifold
3 Gasket
4 Regulating flange
5 Damper spring
6 Lock washer
7 Hexagon screw
8 Tension spring
9 Right notched collar pin
10 Heating funnel
11 Heater valve
12 Bushing for heater valve shaft
13 Heater valve shaft
14 Rear notched collar pin
15 Balancing weight for heater valve
16 Dowel pin

Note: On Model 180 a the suction canal in the intake pipe has a diameter of 32 mm, on Model 180 b of 34 mm.

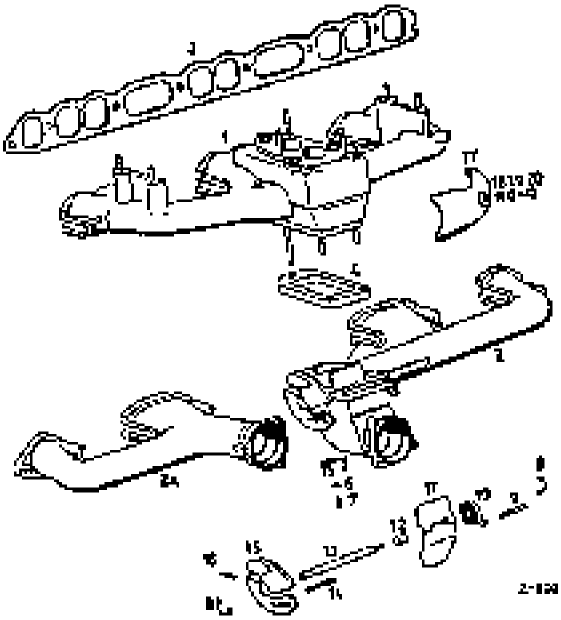


Fig. 01-4/15

Intake pipe and exhaust manifold on Models 220 a and 219

1 Intake pipe
2 Exhaust manifold, front part
2a Exhaust manifold, rear part
3 Gasket
4 Insulating flange
5 Damper spring
6 Lock washer
7 Hexagon socket screw
8 Tension spring
9 Front notched collar pin
10 Heating spiral
11 Heater valve
12 Bushing for heater valve shaft
13 Heater valve shaft
14 Rear notched collar pin
15 Balancing weight for heater valve
16 Dowel pin
17 Screening plate for intake pipe
18 Washer
19 Lock washer
20 Hexagon screw

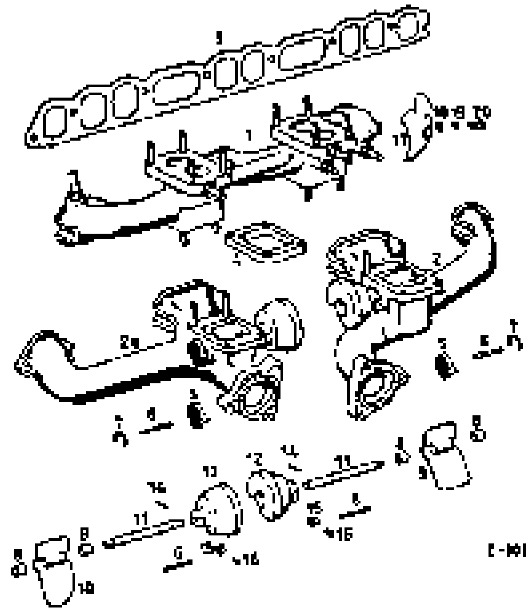


Fig. 01-4/16

Intake pipe and exhaust manifold on Model 220 S

1 Intake pipe
2 Exhaust manifold, front part
2a Exhaust manifold, rear part
3 Gasket
4 Insulating flange
5 Heating spiral
6 Notched collar pin
7 Torsion spring
8 Bushing for heater valve shaft
9 Heater valve in exhaust manifold, front part
10 Heater valve in exhaust manifold, rear part
11 Heater valve shaft
12 Balancing weight for heater valve
13 Balancing weight for heater valve
14 Dowel pin
15 Damper spring
16 Fillister head screw
17 Screening plate for intake pipe
18 Washer
19 Lock washer
20 Hexagon screw

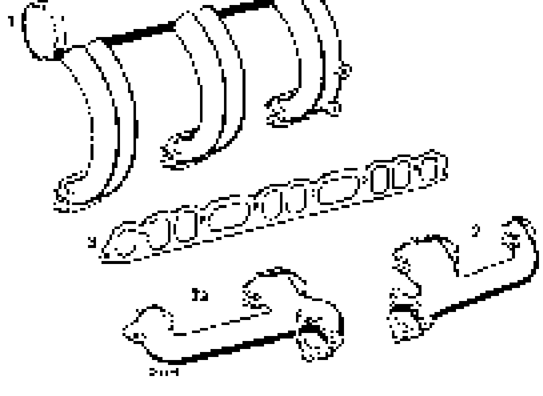


Fig. 01-4/17

Intake pipe and exhaust manifold on Model 220 SE

1 Intake pipe
2 Exhaust manifold, front part
2a Exhaust manifold, rear part
3 Gasket

Repair procedure see Job No. 14-5.

On Model 190 SL the intake pipes and the exhaust manifold can be removed separately.

a) Intake Pipes

Removal:

1. Remove the carburetors and the intake pipes (see Job No. 01-4, Section A/II, para 1-11).

2. Unscrew the coupling nuts (5) and remove the compensating line (3) together with the clamp rings (4) (see Fig. 01-4/18).

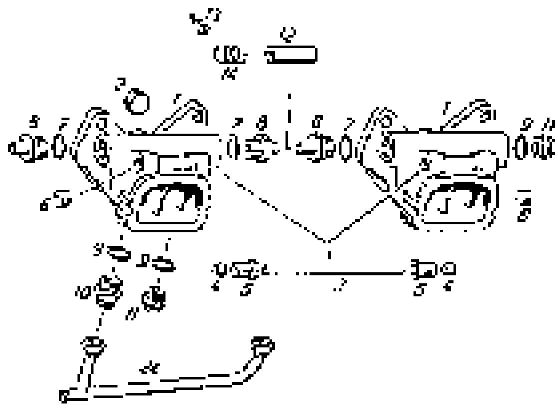


Fig. 01-4/18

1 Intake pipe	9 Sealing ring
2 Screw plug	10 Adapter
3 Compensating line	11 Screw plug
4 Clamp ring	12 Rubber hose
5 Coupling nut	13 Hose clamp
6 Slotted plug	14 Hose strap
7 Sealing ring	24 Return line
8 Threaded union	

3. Loosen the hose clamp (13) and remove the rubber hose (12).

Installation:

4. Check the gasket (3) for the intake pipes and the exhaust manifold (see Fig. 01-4/19). If the gasket is damaged, it must be replaced. To do this, remove the exhaust manifold. Also check the gasket for the cooling water drain union.

5. Connect the two intake pipes by means of the compensating line (3), but only tighten the coupling nuts by hand, since the intake pipes have first to be fitted to the cylinder head in order to ensure that the distance between them is accurate.

6. Press the water hose (12) onto the threaded union (8).

7. Fit the intake pipes to the cylinder head and tighten the hexagon nuts by hand. Now tighten the coupling nuts (5) on the two intake pipes evenly and attach the hose clamps (13).

Note: The compensating line must be leak-proof, since otherwise the idle will become irregular.

The mixture is pre-heated when the intake pipes are connected to the cooling water circulation.

8. Unscrew the hexagon nuts for fastening the intake pipes to the cylinder head again and remove the intake pipes.

9. Screw the intake pipes to the carburetors and install the whole system (see Job No. 01-4, Section A/II, para 12-25).

b) Exhaust Manifold

Removal:

1. Screw out the two hexagon screws (5a) for fastening the holder (10) to the support (8) and unscrew the hexagon screws together with nuts on the three-hole flange (11) (Fig. 01-4/19). Then unscrew the exhaust manifold and remove.

Note: The exhaust attachment shown is for left-hand drive cars. For right-hand drive cars the exhaust is freely suspended.

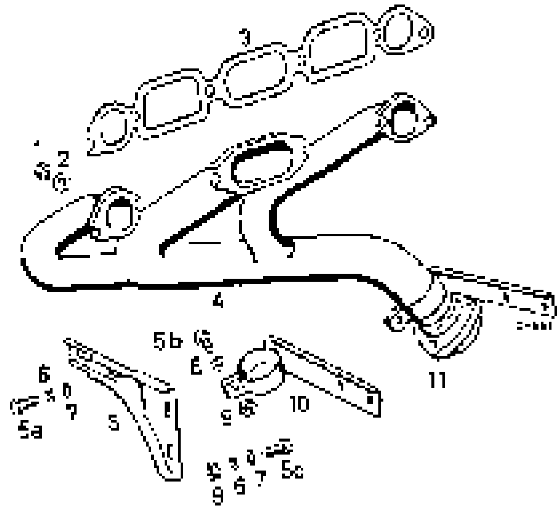


Fig. 01-4/19

1 Hexagon nut	6 Spring washer
2 Washer	7 Washer
3 Gasket	8 Support
4 Exhaust manifold	9 Hex nut
5a Hex screw	10 Bracket
5b Hex screw	11 Three-hole flange
5c Hex screw	

Installation:

2. Test gasket (3) for intake pipes and exhaust manifold. Damaged gaskets should be replaced. For this purpose, remove intake pipes (Fig. 01-4/19).

3. Hold exhaust manifold to cylinder head and tighten hexagon nuts. Tighten hexagon nuts on screw of three-hole flange (11) and hexagon screw (5 a) which hold bracket (10) to support (8).

C. Removal and Installation of Cylinder Head, Valves, Camshaft, Chain Tensioner, Tension Sprocket Bearing and Rocker Arms

Repair procedures see Job No. 01-5 and 05-5.

Removal and installation of cylinder head, valves, camshaft, chain tensioner, tension sprocket bearing and rocker arms for Models 180 a, 180 b, 190 SL, 220 a, 219, 220 S and 220 SE is substantially similar to Model 190. Deviations are described in section I to III.

Unless the cylinder head requires disassembly for reconditioning, the intake pipe with the carburetor system and the exhaust manifold should suitably remain attached to the cylinder head during removal and installation. This applies particularly to Model 190 SL, because the loosening and re-attachment of these components in built-in condition is difficult.

I. Removal and Installation of Cylinder Head on Model 190 SL

Also refer to Section III.

Removal:

1. Loosen choke cable on air suction tube and on choke valve levers, as well as the hot-start cable on bearing block and angle lever.

Note: With built-in idle cutout valve disconnect cable on rear carburetor.

2. Remove air hose from air intake silencer to air suction tube, and vent tube from cylinder head cover to air intake silencer.

3. With built-in ATE power brake disconnect vacuum line at the threaded union of rear intake pipe.

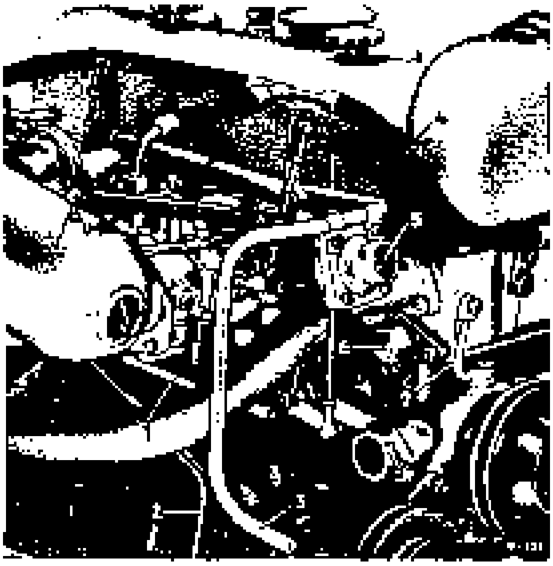


Fig. 01–4/20

Die-Cast Carburetor

1 Water return pipe
2 Leak-off pipe
3 Fuel overflow line
4 Fuel line
5 Cooling water drain union with cool. water thermostat
6 Chain tensioner
7 Air vent line

4. Detach fuel line (4) on both carburetors and on fuel feed pump while supporting pipe union (Fig. 01–4/20). Then loosen clamp which holds fuel line to cylinder head and remove line.

5. Then loosen strut (4) which supports the carburetor system at top of air suction tube (refer to Fig. 01–4/6).

6. Unscrew fuel leak-off pipe (3) on Tee-piece (refer to Fig. 01–4/6).

7. Pull fuel overflow line (3) out of connecting hose to front pipe connection (Fig. 01–4/20).

8. With engine installed drain part of the cooling water, be careful of additives.

9. Loosen water hose from radiator to cooling water thermostat (5) and water return pipe (1) on connecting hose to distributor pipe (Fig. 01–4/20).

10. Unscrew air vent line (7) on water pump and on cylinder head.

11. Unhook accelerator linkage and unscrew exhaust pipe on exhaust manifold.

12. Remove distributor with distributor bearing (refer to Job No. 01–4, Section F). If the distributor bearing is the first version, that is a bearing without fixing eye, there is no need for removal.

13. Unscrew thermostat for cooling water telethermometer from cylinder head and take capillary tube from clamp on ignition cable conduit.

14. Unscrew water pipe bend for heating pipe union on cylinder head.

15. For further disassembly proceed as for Model 190.

Installation:

16. Following the installation of the cylinder head, which is done vice-versa, set ignition (refer to Job No. 01–3, Section E).

17. Warm up engine and tighten cylinder head screws (refer to Section III, (Para i)

Note: On model 190 SL with the new, further modified valve controls (Fig. 01–4/20 a) the valve stem seal and the removal of the rocker arms differ as desribed below. Rocker arms for inlet and outlet valves are of similar design.

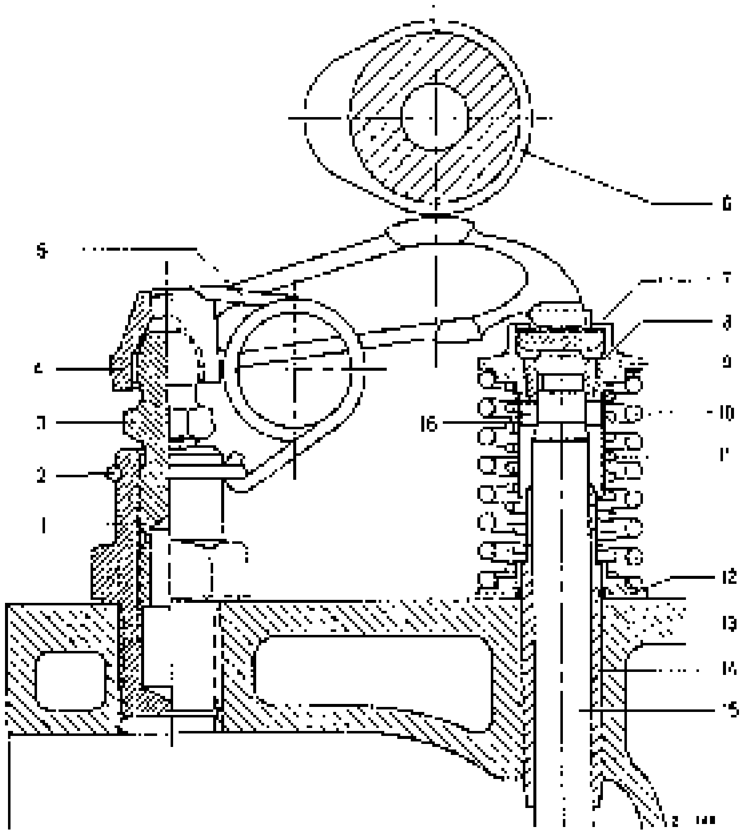


Fig. 01–4/20 a

New, further modified valve controls types 180 c and 190 SL

1 Ball pin socket
2 Annular spring
3 Ball pin top
4 Rocker arm
5 Tension spring
6 Camshaft
7 Thrust plate
8 Valve cone collet
9 Valve plate with sealing ring holder
10 Outer valve spring
11 Inner valve spring
12 Thrust plate
13 Snap ring
14 Valve guide
15 Valve
16 Sealing ring

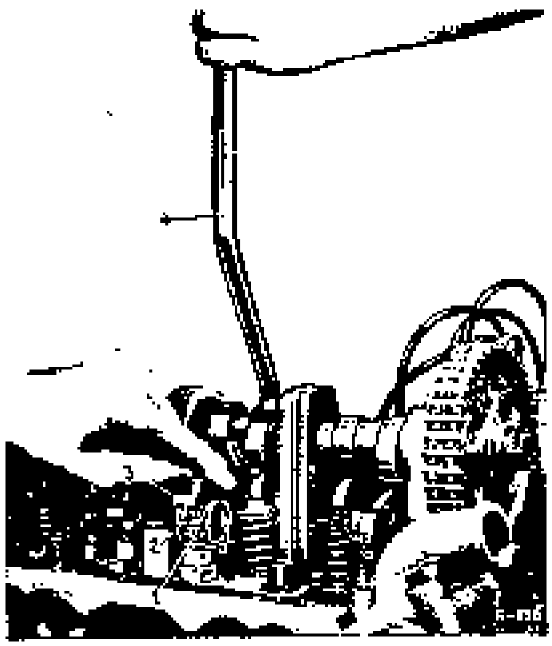


Fig. 01 4/20 b

1 Ball pin top
2 Tension spring
3 Rocker arm
4 Disassembly and assembly tool 111 589 01 61

Disassembly of Rocker Arm:

1. Push tension spring (2) out of notch at top of rocker arm (3) and slide spring over ball socket of rocker arm outwards (refer to Fig. 01–4/20 b).

2. Apply disassembly and assembly tool (4) 111 589 01 61 to camshaft and valve spring plate and force valve downward to relieve rocker arm (3) (Fig. 01–4/20 b).

3. Lift rocker arm (3) from ball pin top (1) and remove (Fig. 01 4/20 b).

Note: Prior to installation check slide surfaces and ball socket of rocker arm. Damaged rocker arms should be replaced.

Installation of Rocker Arms:

4. Apply disassembly and assembly tool 111 589 01 61 to camshaft and to valve spring plate and press valve downward to the point where the rocker arm with its ball socket can be inserted into the ball pin top.

5. Insert rocker arm.

6. Push tension spring across ball socket of rocker arm toward the front until it snaps into the notch of the rocker arm.

7. Check or adjust valve clearance (refer to Job No. 00–3).

Valve Stem Sealing

A sealing ring holder (3) in the shape of a bell enveloping the valve guide is soldered to the valve spring plate (5) at the exhaust valve (8). The rubber sealing ring (4) is inserted into sealing ring holder from below (Fig. 01–4/20 d).

Valve stem sealing at inlet valve (8) is effected by a sealing ring holder (3) by means of a Silicon sealing ring (4). The sealing ring holder is pushed over the valve guide and held in place by the inner valve spring (10) (Fig. 01–4/20 c).

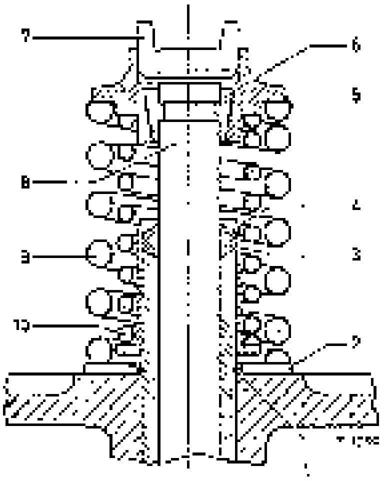


Fig. 01–4/20 c

Inlet Valve

1 Lock washer
2 Washer for valve spring
3 Sealing ring holder
4 Silicon sealing ring
5 Valve spring plate
6 Valve cone section
7 Thrust plate
8 Inlet valve
9 Outer valve spring
10 Inner valve spring

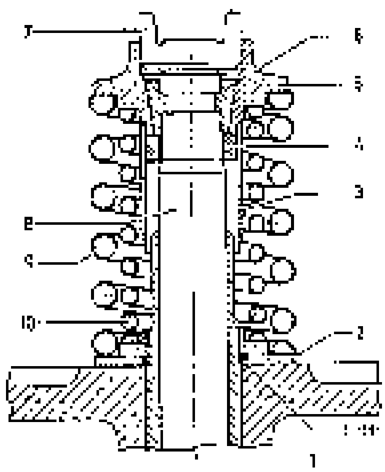


Fig. 01–4/20 d

Exhaust Valve

1 Lock washer
2 Thrust ring
3 Sealing ring holder
4 Sealing ring
5 Valve spring plate
6 Valve cone section
7 Thrust plate
8 Exhaust valve
9 Outer valve spring
10 Inner valve spring

During assembly the following points should be observed:

a) Valves should have no burr at the groove for the valve cone sections to eliminate any possibility of damage when the sealing rings are attached.

b) Don't forget washer (2) or thrust ring (2) for spring support (Fig. 01–4/20 c and 01–4/20 d).

c) The sealing ring holder (3) at the inlet valve (8) should slide easily over valve guide, but without play (Fig. 01–4/20 c).

d) The sealing ring holder at the exhaust valve should not cover the valve guide more than 2.5 to 3 mm when the valve is closed.

e) Valve cone section should bear only at top and bottom of stem next to the groove, but not on bottom of groove.

f) The gap between the two valve cone sections should be of similar size on both sides when assembled.

g) During assembly be sure that sealing ring holder (3) does not touch valve spring (10) (Fig. 01–4/20 d).

II. Removal and Installation of Cylinder Head of Model 220 SE

Also refer to Section III.

Removal:

1. Remove air filter. For this purpose loosen vent line to cylinder head, supplementary air line (7), connection to venturi control unit and fixing screw on supporting rod (19) (refer to Fig. 01–4/11 a). Then remove air filter in upward direction, since the inlet air thermostat (13) projects into the air filter.

2. Disconnect the vacuum line to the distributor at the venturi control unit, detach the pull rod and the return spring at the throttle valve lever and unscrew the venturi control unit.

3. If the engine is installed in the car, drain off part of the cooling water and collect additives if present.

4. Remove the supplementary-air line, the injection pipes from the injection pump to the fuel distributor fittings, and the cooling water lines for the cooling water thermostat.

5. Further removel procedures are the same as for Model 190.

Installation:

6. Installation of the cylinder head is the reverse of the removal procedure. After installation attach all pipes and lines.

7. Attach the venturi control unit and the return spring holder to the intake pipe; do not omit the sealing ring (O-ring). Attach the vacuum line to the distributor and attach the pull rod and the return spring to the throttle valve lever.

8. **Check the adjustment of the control linkage** (see Workshop Manual Passenger Car Models starting August 1959, Job No. 00-16).

9. Install the air filter, fasten it, and connect all lines. When installing the air filter, take care to ensure that the rubber grommet is properly seated in the filter bottom and is not pushed into the filter housing.

10. Top up the cooling water.

11. Set the ignition (see Job No. 01-3, Section E).

12. Warm up the engine and retighten the cylinder head screws (see Section III, para i).

III. Procedure Differences for the Individual Models Concerning Removal and Installation of Cylinder Head, Valves, Camshaft, Chain Tensioner, Tension Sprocket, and Rocker Arms

a) Cylinder Head

1. **Compression Ratio**

When the cylinder head is replaced, pay attention to the stamped or cast-in compression ratio.

In order to exclude confusion between the cylinder heads for the different compression ratios, the compression ratio of the engine has been cast into the left side of the cylinder head above the threaded union for the water pipe connection (Fig. 01–4/21).

On previous cars the compression ratio was stamped into the left rear part of the machined surface (Fig. 01-4/21).

In order to increase engine performance and torque, the compression ratio was increased on Models 219 and 220 S from $\varepsilon = 7.6 : 1$ to $\varepsilon = 8.7 : 1$.

Fig. 01-4/21

Compression ratio on cylinder head

Cast-in on recent cars — Previously stamped

On Model 190 SL the compression ratio was also increased from $\varepsilon = 8.5 : 1$ to $\varepsilon = 8.8 : 1$. When cylinder heads are replaced on Models 220 a, 219, and 220 S, replacement cylinder heads are only supplied for a compression ratio ε = 8.7 : 1, even if the engine was originally supplied with a cylinder head for a compression ratio ε = 7.6 : 1. We recommend, however, that when the higher compression cylinder head is installed, particularly in cars which are normally driven at high speeds, that the exhaust valves are replaced by sodium-filled exhaust valves as installed originally on Model 220 S and installed as a standard part on Model 219 with a compression ratio ε = 8.7 : 1.

In the same way replacement cylinder heads for Model 180 a are only supplied with a compression ratio ε = 7.0 : 1 and for Model 190 SL with a compression ratio ε = 8.8 : 1.

If pinking occurs during acceleration in the lower speed range when lower octane-number fuel is used in the case of Model 180 a with a compression ratio ε = 7.0 : 1, distributor VJU R 4 BR 28 should be installed. This distributor has a retarded centrifugal governor advance. When distributor VJU R 4 BR 28 is being installed, the ignition should at the same time be retarded to 4° BTDC, since otherwise ignition would be too early in the upper speed range. For countries using fuel of a lower octane rating, Models 220 a, 219, and 220 S have occasionally been supplied with a compression ratio of ε = 6.8 : 1.

The correct compression ratio for countries above 2000 meters altitude is ε = 7.5 : 1 for Models 180 a and 180 b.

2. **Cylinder Head Gasket and Water Distributor**

   The water distributor, which on Models 180 a, 190 SL, 220 a, 219, and 220 S was previously stamped into the crankcase, has for some months now been pressed into the cylinder head. This alteration makes it necessary to use a different cylinder head gasket.

   On Models 180 b, 219, and 220 S with a compression ratio of ε = 8.7 : 1 and on Model 220 SE the water distributor was pressed into the cylinder head on all cars.

Note: All replacement cylinder heads are supplied with a pressed-in water distributor system. If such replacement cylinder heads are used on engines on which the water distributor is located in the crankcase, the water distributor in the crankcase must be removed and the correct gasket type must be installed.

Four-cylinder engines

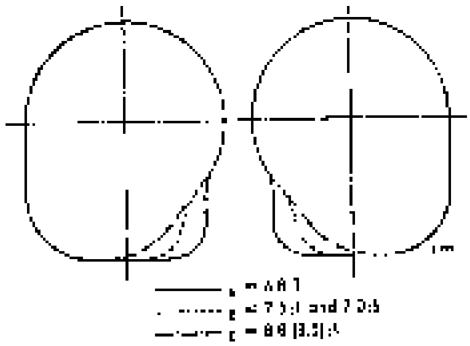


Fig. 01-4/22

Six-cylinder engines

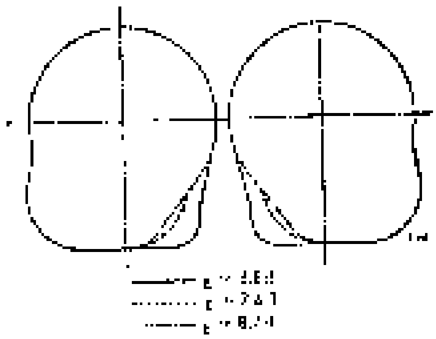


Fig. 01-4/23

It follows that different gaskets must be used for engines with water distributors in the cylinder head as for engines with water distributors in the crankcase.

Before installing the cylinder head gasket, check

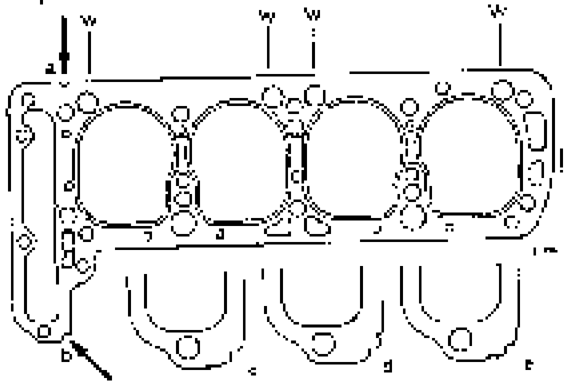
a) the location of the water distributors,
b) the compression ratio of the engine.

The easiest way of checking this is to put the cylinder head gasket on the cylinder head and to check whether the shape of the combustion chamber in the cylinder head and in the gasket correspond (Figs. 01-4/22 and 01-4/23).

Together with the introduction of the higher compression ratio (ε = 8.7 : 1) on Models 219 and 220 S the cylinder head gasket was increased from 1.5 mm to 2 mm (unpressed). On the other hand, the crankcase was made 0.5 mm lower at the separating surface in accordance with the thicker gasket.

On recent cars of Models 220 a, 219, and 220 S of a compression ratio of 6.8 : 1 these 2 mm cylinder head gaskets and the lower crankcases have been installed as standard parts.

Be sure that no thin seal of 1.5 mm thickness is placed into engine having the lower crankcase, because in unfavorable cases the piston may then touch the inlet valve.



For better distinction of cylinder head gaskets – also when installed – the gaskets for the engines with water distributors are marked with notches on the cylinder head, which were first at the front right part, but are now at the left front part (see arrows in Fig. 01–4/24).

Fig. 01–4/24

Marking of Cylinder Head Gasket in the 4-Cylinder Engine

a = 1st version of notch marks
b = 2nd version of notch marks
c = 1 notch as identification mark
d = 2 notches as identification mark
e = 3 notches as identification mark
W = Water holes right

The table below shows the various cylinder head gaskets including the various notch marks

Cylinder Head Gaskets

Model	Compression Ratio	Part-No. of Cylinder Head Gaskets for Engines with Water Distributors in: Cylinder Crankcase	Cylinder Head	Notch Mark
180 c (190 after SA 10790)	6.8 : 1	121 016 10 20 (Diring)	121 016 19 20 (Goetze) 121 016 22 20 (Diring)	—v—
180 a, 180 b, 180 c, (190, 190 b acc. to SA 50250)	7.0 : 1	The water distributors are pressed into cylinder head from the beginning	121 016 25 20 (Goetze)[1] 121 016 24 20 (Diring)[1]	—v v—
190, (180 a, 180 a acc. to SA 10931)	7.5 : 1	121 016 09 20 (Diring)	121 016 25 20 (Goetze)[1] 121 016 24 20 (Diring)[1]	—v v—
190 b, 190 c, 190 SL	8.5 : 1 8.7 : 1 8.8 : 1	121 016 08 20 (Diring)	121 016 26 20 (Goetze)[1] 121 016 23 20 (Diring)[1]	—v—v—v—
220 a and 219 acc. to SA 10037 220 S acc. to SA 10187	6.8 : 1	180 016 15 20	180 016 28 20 (Diring)[1]	v—
220 a 219, 220 S	7.6 : 1	180 016 16 20 (Diring) optional 180 016 17 20 (Goetze)	In the event of a replacement for Models 220 a, 219, 220 S, only one cyl. head of a compr. ratio of ε = 8.7 : 1 will be supplied	—
220 a, 219 220 S	8.7 : 1	The water distributors are pressed into cylinder head from beginning	180 016 27 20 (Diring)[1] 180 016 29 20 (Goetze)[1]	v—v—
220 SE	8.7 : 1		127 016 08 20 (Diring)[1]	—

[1]) Only for cylinder head gaskets of engine with water distributors in cylinder head
[1]) With copper lined water holes

b) Valve Guides with Valve Stem Sealing Systems

Valves stem sealing for Models 190 a, 180 b, 190 b, 190 SL, 220 a, 219 and 220 S at inlet and exhaust valves is according to Fig. 01–4/26 or 01–4/27. However, on Model 220 SE the inlet valve is sealed acc. to Fig. 01–4/25 by means of a silicone ring, and the exhaust valve acc. to Fig. 01–4/27.

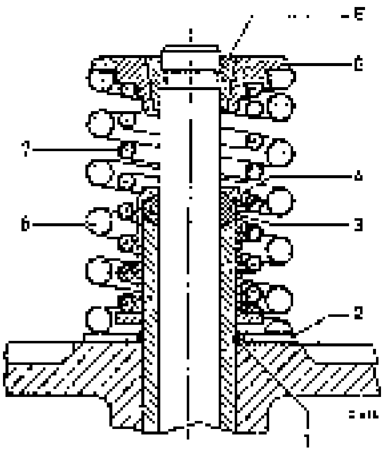


Fig. 01–4/25

Inlet Valve Stem Sealing for Model 220 SE

1 Snap ring	5 Valve spring retainer
2 Washer	6 Valve cone half
3 Sealing ring retainer	7 Inner valve spring
4 Sealing ring	8 Outer valve spring

When installing the thrust collars which serve to hold the valve guides and as a support for the valve springs, attention should be paid to the type of valve guides used. Formerly, only shouldered valve guides were used (Fig. 01–4/26).

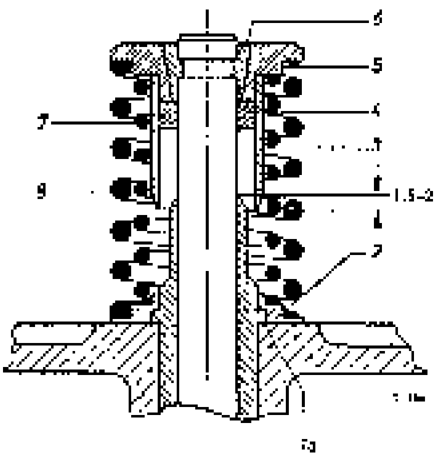


Fig. 01-4/26

1st Version

1a Shoulder on valve guide	5 Valve spring retainer
2 Thrust collar	6 Valve cone half
3 Sealing ring retainer	7 Inner valve spring
4 Sealing ring	8 Outer valve spring

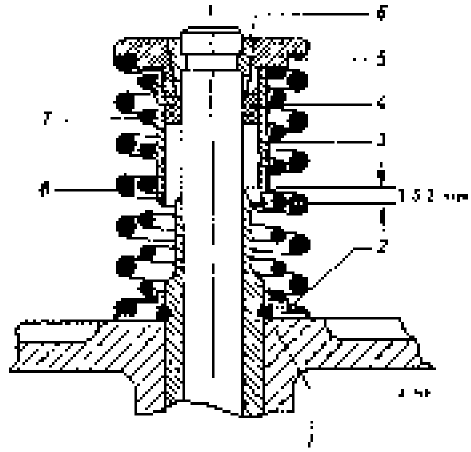


Fig. 01–4/27

2nd Version

1 Snap ring	5 Valve spring retainer
2 Thrust collar	6 Valve cone half
3 Sealing ring retainer	7 Inner valve spring
4 Sealing ring	8 Outer valve spring

Now we are using only valve guides with snap ring (Fig. 01–4/27).

For shouldered valve guides only thrust collars, part No. 121 053 01 62 with the dimension a = 2.2 + 0.2 mm may be used, and for valve guides with snap ring only thrust collars, part No. 121 053 02 62, with the dimensions a = 1.1 + 0.2 mm (Fig. 01–4/28).

In exceptional cases valve guides with snap ring may also use thrust collars of a dimension a = 2.2 + 0.2 mm, but in no case vice-versa.

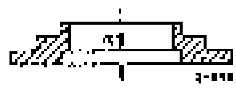


Fig. 01–4/28

a = 2.2 + 0.2 mm for shouldered valve guides
a = 1.1 + 0.2 mm for valve guides with snap ring

Note: More recently valve shaft sealing on Models 190 SL, 190 c and 190 c is from the beginning as shown in Fig. 01–4/20 c and 01–4/20 d.

c) Valves

The following engines are provided with sodium-filled exhaust valves as standard parts:

180 b	as from engine end No. 029 202	Part No. 121 053 15 05
180 c	as from 1st engine	Part No. 121 053 15 05
190 b	as from engine end No. 027 409	Part No. 121 053 15 05
190 SL	as from compression 8.8:1	Part No. 121 053 15 35
219	as from compression 8.7:1	Part No. 180 053 11 35
220 S	as from 1st engine	Part No. 180 053 11 35
220 SE	as from 1st engine	Part No. 180 053 11 35
220 SE	Cabriolet A and Coupe A as from 1st engine	Part No. 180 053 15 35

In no case may normal exhaust valves be installed in these engines, since this may lead to burning of the valves.

During subsequent installation of a high-compression cylinder head (ε = 8.7:1) on Models 220 a and 219 the use of sodium-cooled exhaust valves is recommended.

The use of sodium-cooled exhaust valves for these models is a must, if a camshaft with the code. No. 33 has been used (also refer to Section d).

On Models 180 a and 180 b sodium-cooled exhaust valves may be used in the event of repairs up to engine end No. 029 282.

To prevent confusion, the part No. punched into valve stem end should be observed.

Note: When scrapping sodium-cooled exhaust valves observe safety regulations!

Because of a danger of explosion sodium-cooled valves may not be melted down without first removing the sodium charge. It is similary dangerous to forge tools such as punches, screw drivers, chisels, etc. from sodium-cooled valves without previously removing the sodium charge.

Be careful when removing the sodium from valves, because sodium reacts extremely strongly and explosive when in contact with water and aqueous solutions, while in addition the developing inflammable hydrogen gas may start fires.

For removal and installation of valves the valve mounting bridge 180 589 05 63 should be used for 6-cylinder engines, and valve mounting bridge 121 589 01 63 for 4-cylinder engines.

d) **Camshaft**

The valve timing has been changed for engines of Models 190 SL, 220 a, 219 and 220 S (also refer to Job No. 01–3, Section I). To distinguish between the various camshafts they are marked at their rear end face with a number (Fig. 01–4/31).

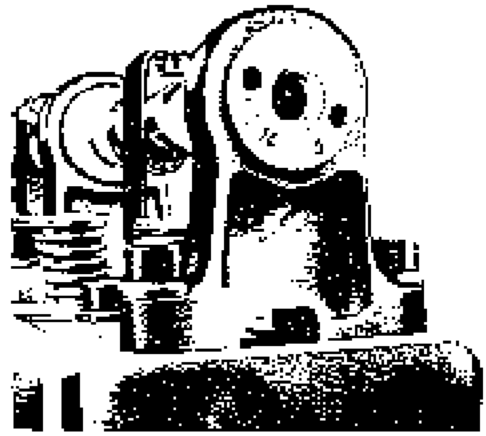


Fig. 01–4/31

Code Numbers of Camshafts

Model	Engine End No.	Code No.
180 a, 180 b 190, 190 b	—	11
180 c, 190 c		42
190 SL	up to 55 00105	14
190 SL	from 55 00106	15
190 SL	from further modified valve timing	44
220 a	up to 55 04778	14
220 a	from 55 04779	14/1
219	up to 75 04047	14/1
220 S	up to 75 09083	14/1
219	from N 75 04048 Z 75 00002	33
220 S	from N 75 09084 Z 75 00003	33
220 SE	—	50

N = Engine with standard clutch
Z = Engine with hydraulic automatic clutch.

On Model 190 SL the two camshafts having the code numbers of 14 and 15 may not be mixed up. Because of the longer stroke of the inlet valve the camshaft with Code No. 15 may be used only in combination with the cylinder head now used. If the new camshaft (with the Code No. 15) is nevertheless used with an old cylinder head, the supporting surface on the cylinder head for the thrust collars of the valve springs have to be milled down another Millimeter, because otherwise the valve springs may be crushed when the valve block is fully open (Fig. 01–4/32).

For Models 220 a, 219 and 220 S (also at a compression of ε = 7.6:1) only spare camshafts having the Code No. 33 will be supplied.

However, this camshaft may only be used in combination with sodium-cooled exhaust valves.

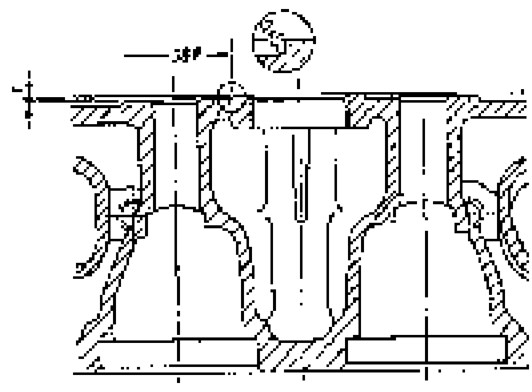


Fig. 01-4/32

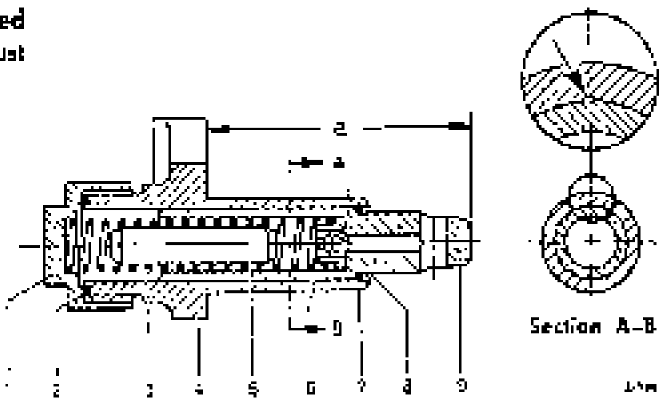


Fig. 01-4/33 b

2nd Version

1 Cap nut
2 Sealing ring
3 Pressure spring
4 Housing
5 Pin
6 Ball retainer
7 Snap ring
8 Ball
9 Pressure pin

e) Chain Tensioner

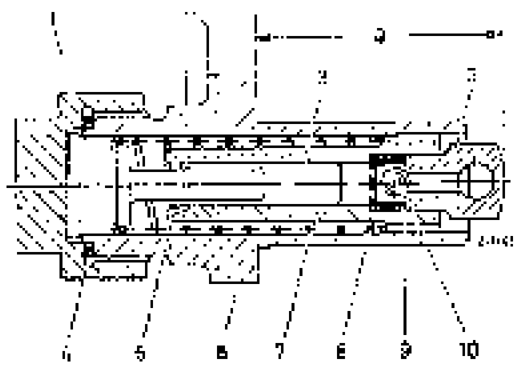


Fig. 01-4/33 a

1st Version

1 Cover cap
2 Pressure pin
3 Head
4 Sealing ring
5 Dowel pin
6 Chain tensioner housing
7 Pressure sleeve
8 Pressure spring
9 Ball retainer
10 Steel ball

A self bleeding chain tensioner has been installed (Fig. 01-4/33 b). This chain tensioner may be used instead of first version acc. to Fig. 01-4/33 a for subsequent installation, also for Model 220 a. Models 180 b, 190 b, 190 SL and 220 SE have the 2nd and 3rd version. Installation and removal is similar to model 190. However, it is emphasized once again that the two fixing nuts should be tightened uniformly and carefully. A new seal should also be used.

Following installation check, whether chain tensioner operates accurately without jamming, because otherwise the chain may run noisy.

Model	Part No.	Dimension "a" with removed chain tensioner
	1st Version	
180 a, 190, 190 SL	121 050 03 11	58
220 a, 219, 220 S	180 050 03 11	[illegible]
	2nd Version	
180 a, 180 b, 190, 190 b, 190 SL	621 050 00 11	58
219, 220 S, 220 SE	180 050 05 11	52

3rd Version[1]

Model	Installed as from engine end No.	Part No.	Dimension "a" with removed chain tensioner
180 a	017 223	121 050 04 11	53
190 b	015 336		
190 SL	018 423		
220 SE Cb and CbA	001 059 000 240	180 050 06 11	52
	4th Version[2]		
180 c	000 001	121 050 05 11	58
190 c	000 341		
190 SL	000 007		

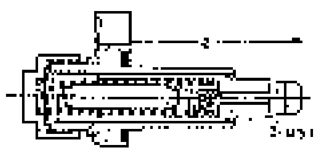


Fig. 01-4/33 c

3rd Version

[1] The chain tensioner of 3rd design is in its function similar to the 2nd version. The chain tensioner housing is however provided with an annular groove and a rubber ring is inserted between chain tensioner and cylinder crankcase; the up to now used gasket is therefore omitted (flange gasket).

[2] The chain tensioner of 4th version (for 4-cyl. engine with improved valve timing) is distinguished from the 3rd version by its stronger pressure spring. This chain tensioner is marked by a red dot on the cap nut.

f) Tension Sprocket Bearing

If a new tension sprocket bearing is installed in Model 190 SL first measure the height "H" of the web of the oil case (Fig. 01-4/33c). The height of the web was changed from 28 mm to 32 mm and later to 36 mm in order to prevent air from being sucked up by the chain tensioner. On various engines this web was subsequently increased in height by adding a rubber gasket.

In order to prevent the tension sprocket bearing from fouling the web, old tension sprocket bearings with the Part No. 180 050 04 10 or 121 050 01 10 must not be installed in engines with a higher web and in engines modified as shown in Fig. 01-4/33 c. The new tension sprocket bearings with the Part No. 121 050 09 10 (Fig. 01-4/33 c) can be used in any engine.

The subsequent increase of the web height is described in detail in Workshop Manual Model 190 (see Job No. 05-5, Section F).

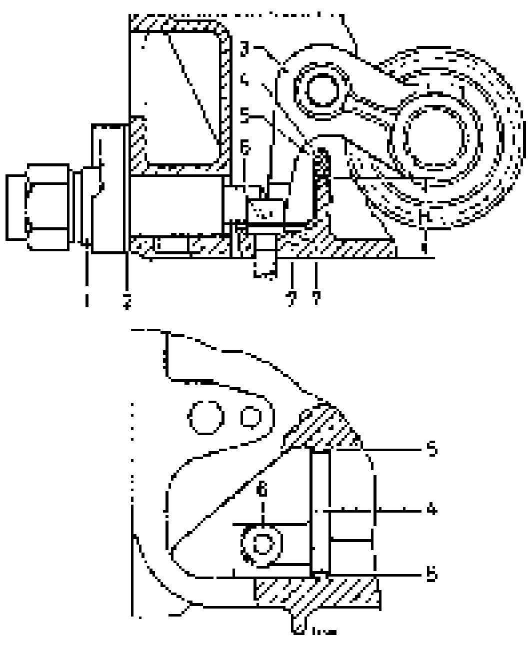


Fig. 01-4/33 c

1 Chain tensioner
2 Gasket
3 Tension Sprocket Bearing 121 050 09 10
4 Insert Plate 121 018 03 40
5 Rubber Gasket 121 997 00 46
6 Hexagon socket screw M 6 X 22 DIN 912-8 G
7 Washer 6.4 DIN 433

g) Chain Guides

On Model 220 SE the arrangement has been modified by adding a guide sprocket in the cylinder head; as a consequence, the chain guide is now fastened to a bracket screwed to the cylinder head. (Fig. 01-4/34).

Fig. 01-4/34

1 Bracket   2 Chain guide

h) Rocker Arm Blocks and Rocker Arms

On earlier models sheet-metal spring clamps were used to secure the rocker arms (Fig. 01-4/35).

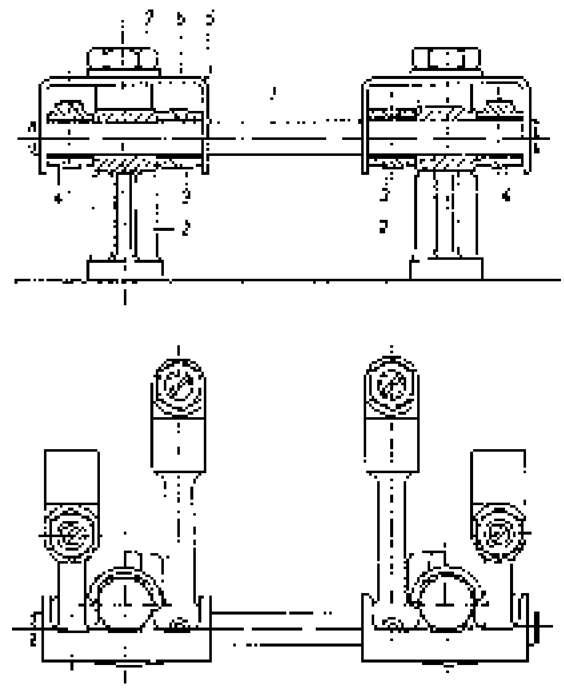


Fig. 01-4/35

1 Rocker arm shaft
2 Rocker arm block
3 Rocker arm for inlet valve
4 Rocker arm for exhaust valve
5 Spring clamp
6 Washer
7 Stretch screw

These sheet-metal clamps have now been replaced by spring clamps of spring steel wire (Fig. 01-4/36). At the same time, the

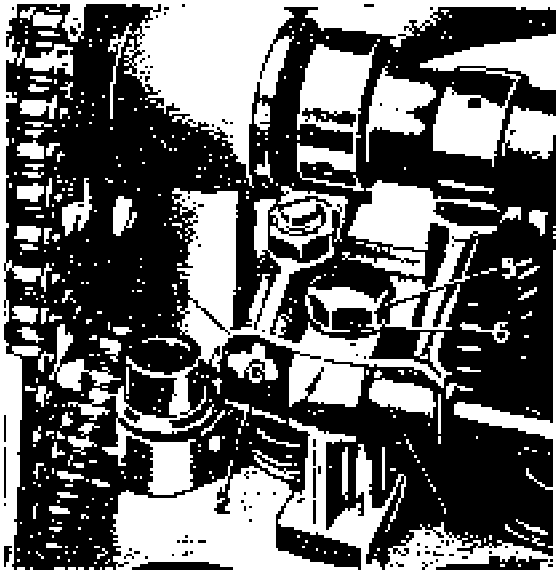


Fig. 01-4/36

1 Rocker arm block
2 Rocker arm for exhaust valve
3 Rocker arm for inlet valve
4 Spring clamp
5 Stretch screw
6 Washer

rocker arm blocks were provided with a notch in which the clamp springs engage (Figs. 01-4/36 and 01-4/37).

When repairs are being carried out, it is advisable to replace the sheet-metal spring clamps by spring clamps of spring steel wire with the Part No. 180 055 00 93. If the old rocker arm blocks are not being replaced, they must be provided with a notch to secure the spring clamp as shown in Fig. 01-4/37. The notch must correspond exactly to the dimensions given above in order to ensure that the clamp is tensioned sufficiently and engages securely.

Note: On Models 220 S and 220 SE the length of the rocker arm shafts is 153 mm for the 1st version and 159 mm for the 2nd version. The projecting ends of the 2nd version shafts prevent the spring clamps from jumping off the rocker arm shafts at high engine speeds. If complaints are received, the 1st version can without any modification be replaced by the 2nd version (Part No. 180 055 08 05) on Models 219, 220 S, and 220 SE.

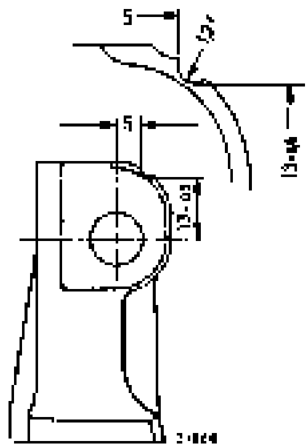


Fig. 01-4/37

i) Tightening of Cylinder Head Screws

The cylinder head screws must be tightened in stages and in the sequence shown in Figs. 01-4/38 and 01-4/39.

1st tightening	4 mkg
2nd tightening	6 mkg
3rd tightening	8 mkg
4th tightening (check tightening)	8 mkg
5th tightening with engine hot	9 mkg

Tightening Sequence for 4-Cylinder Engines

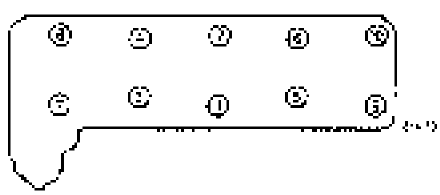


Fig. 01-4/38

Tightening Sequence for 6-Cylinder Engines

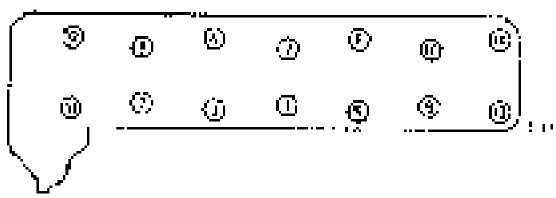


Fig. 01-4/39

The four hexagon socket screws M 8 at the front of the cylinder head should be tightened by hand.

After tightening the cylinder head screws check whether the camshaft can be turned easily by hand.

For the final tightening of the cylinder head screws on the warm engine proceed as follows:

Warm up the engine under slight load until the cooling water temperature reaches 80° C. Run the engine for another 5 minutes at this cooling water temperature and then tighten the cylinder head screws **to 9 mkg** in the sequence indicated above.

After a road test or after a mileage of no more than 20 km check the tightening torque of the cylinder head screws (9 mkg.) Do not force the engine during the road test.

After the road test also check all unions for leakage and all screws for tightness and, if necessary, retighten.

Finally check the tappet clearance once more with the **engine cold.**

After the car has run a further 500 km carry out a third check on the tightening torque of the cylinder head screws with the engine at normal running temperature; the tightening torque must be **9 mkg.**

D. Removal and Installation of Generator and Starter

a) **Removal and Installation of Generator, see Job No. 15–11.**

b) **Removal and Installation of Starter, see Job No. 15–0.**

E. Removal and Installation of Water Pump with Fan

Repair procedures see Job No. 20–5.

On Models 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE, with the exception of the pump on Model 190 SL, the removal and installation procedures are the same as for Model 190.

The usual by-pass line (8) (Fig. 01–4/40) is not installed in Model 190 SL, since the line heating the intake pipe also serves as a by-pass line. The threaded union (10) in the water pump housing has been replaced by a screw plug (Fig. 01–4/41). Furthermore, the hub pressed onto the water pump shaft and to which the pulley and the fan are fixed has four threaded bores, whereas on all other models pulley and fan are fastened with only three screws.

The water pumps of Models 180 a, 180 b, 190, 220 a, 219, 220 S, and 220 SE with the same capacity are interchangeable, whereas the pulleys vary in size (see table).

Pulley for Water Pumps

Model	180 a, 180 b, 190, 190 b, 220 S	190 SL	220 a, 219 220 SE
External diameter of pulley	133	125	149

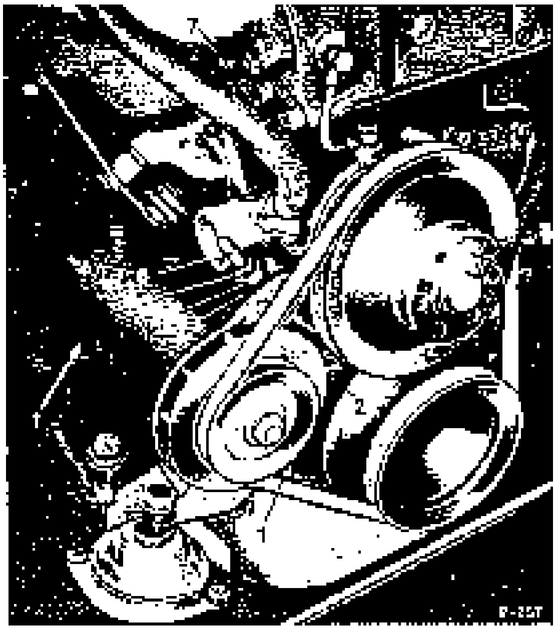


Fig. 01-4/40

1 Generator mounting
2 Tensioning screw for mounting
3 Clamping piece
4 Tensioning nut
5 Hexagon nut
6 Tensioning screw
7 Chain tensioner
8 By-pass line
9 Air vent line

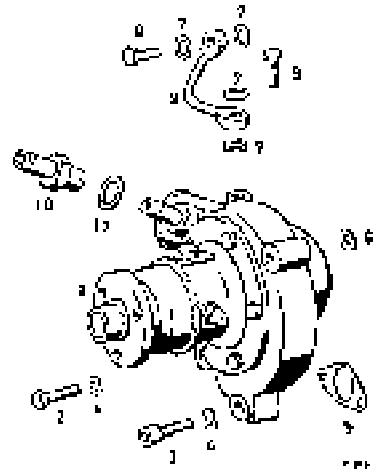


Fig. 01-4/41

1 Water pump
2 Hexagon screw
3 Hexagon socket screw
4 Spring washer
5 Gasket
6 Sealing ring
7 Sealing ring
8 Hollow screw
9 Compensating line
10 Threaded union
11 Sealing ring

On Models 220 a, 219, 220 S, and 220 SE the fixing screw (3) is a hexagon socket screw (Fig. 01-4/41). This screw can only be removed and installed through the vibration damper. To do this turn the crankshaft until one of the six bores in the vibration damper is accurately aligned with the screw.

When installing the water pump do not forget the sealing ring (6) under the top fixing lug. On no account should a standard washer be used, since when the water pump fixing screws are tightened the sealing ring (6) must be compressed to the same degree as the gasket (5) in order to achieve a proper tight seal between the water pump and the crankcase.

Water Pump with Higher Capacity

In recent cars of Models 180 a, 190 SL, 219, and 220 S water pumps with a capacity of 4 kg/sec are installed (previous capacity 3.25 kg/sec). Models 180 b and 220 SE have all been provided with this high capacity water pump. The new water pump has a larger impeller and as a consequence also a larger water pump housing, see also Job No. 20-5. The high capacity water pump can be installed subsequently in older engines of the above-mentioned models and also in Model 220 a. In future, only high capacity pumps will be supplied as replacement parts.

In the case of the high capacity water pump a distinction must be made between the intermediate version and the final version. The intermediate version water pump has no connecting branch for the by-pass line on the inlet branch for the cooling water, whereas the final version water pumps are fitted with such a connecting branch.

The installation of an intermediate version water pump therefore requires a distributor pipe for cooling water return flow, heating, and by-pass line, whereas for the installation of the final version and the lower capacity water pump only a distributor pipe for cooling water return flow and heating is required.

When subsequently installing the water pump in Model 220 a up to engine end no. 55 09040 use a pulley Part No. 180 205 07 10 with 3 hexagon screws M 8X18 DIN 933-8 G and 3 spring washers B 8 DIN 137, since up to this engine number the pulley is cast integral with the hub. When installing the high capacity water pump subsequently, make sure that there is sufficient space between the recess on the crankcase and the modified water pump housing (Fig. 01-4/42). If necessary, increase the recess (b) by milling down the crankcase.

In addition, on Models 220 a, 219, and 220 S the eye (a) for the front stud bolt on the cylinder head must be milled down to ensure that the water pump does not touch the cylinder head (Fig. 01-4/42).

The previous air vent line from the water pump to the cylinder head can no longer be used for the new water pump. Models 180 a and 190 SL require an air vent line Part No. 121 200 02 58 and Models 220 a, 219, and 220 S require an air vent line Part No. 180 200 02 58.

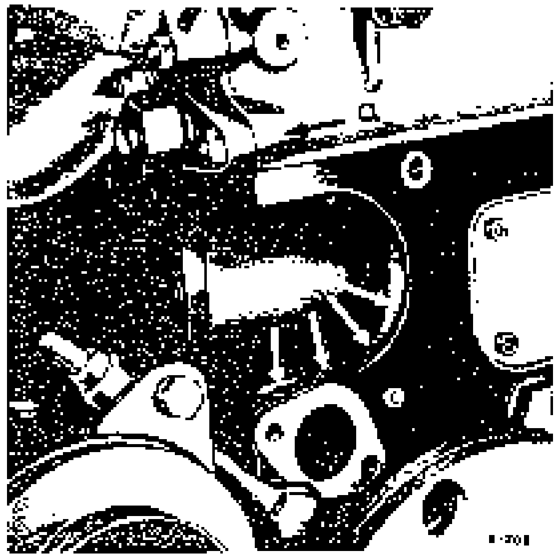


Fig. 01–4/42

F. Removal and Installation of Distributor with Bearing

Repair procedures see Job No. 15–23.

a) Distributor

The removal and installation procedures for the distributor on Models 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE are the same as described for Model 190.

In addition to the details given in the Workshop Manual for Model 190 the following points are of importance:

Before installing the distributor check whether the piston of the 1st cylinder is at ignition dead center and whether the distributor rotor arm points to the timing mark for the 1st cylinder on the distributor housing (Fig. 01–4/44).

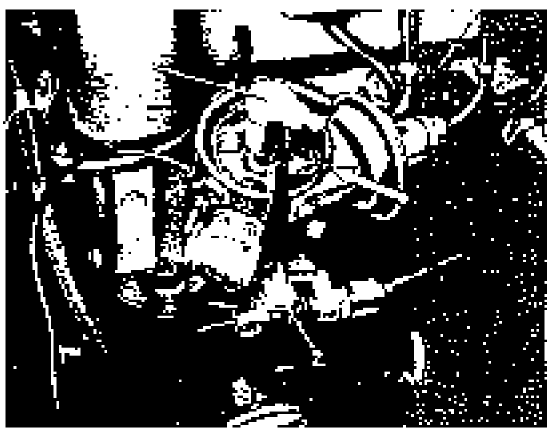


Fig. 01–4/44

1 Distributor rotor arm
2 Timing lever

If the helical gear has been removed, note the following points when re-installing it:

The groove in the helical gear and the two driving jaws of the distributor shaft are offset from the center by a = 0.8 mm (Fig. 01-4/45). When installing the helical gear make sure that the offset part of the groove is on the correct side, i. e. the wider segment must point toward the crankcase. Since groove and jaws are only slightly offset, the distributor can be forced into position if the helical gear has been installed the wrong way round, i. e. displaced by 180°. However, an incorrectly installed helical gear will make the distributor housing wobble and may cause scoring of the distributor drive.

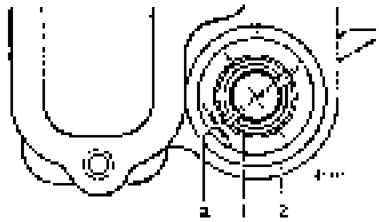


Fig. 01–4/45

a = 0.8 mm
1 Helical gear
2 Crankcase

On recent models the distributor is connected to the cylinder head by a ground lead (1) (Fig. 01–4/46).

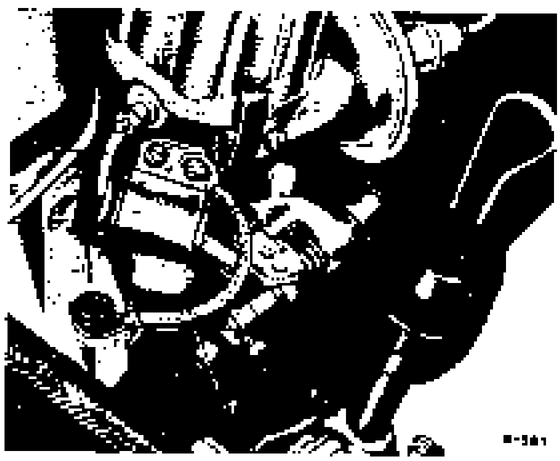


Fig. 01–4/46

1 Ground lead
2 Cable

Because of faulty ground connection between distributor and engine block, engines without ground lead may be subject to ignition failure at high engine speeds. In such cases, and when distributor bearings are replaced, we recommend the installation of this ground lead Part No. 121 150 02 32. The ground lead is fastened to the distributor by the right condenser screw; on Model 220 SE by the screw for the vacuum box; the ground lead is attached to the engine by the cylinder head screw on the sprocket housing.

b) Distributor Bearing

With the exception of Model 220 SE the procedures for removing and installing the distributor bearing on Models 180 a, 180 b, 190 SL, 220 a, 219, and 220SE are basically the same as described for Model 190. The deviations from the standard procedure result from the fact that in the course of time the distributor bearing and the timing device for the distributor have undergone a number of modifications.

The 1st version of the distributor bearing is shown in Fig. 01–4/47. Later, the distributor bearings were provided with a fixing lug (3) with which the bearing was fastened to the cylinder head by means of the hexagon socket screw (1) (Fig. 01-4/49); the stud screw (4) was no longer fitted (Fig. 01–4/47). Later, the octane number compensator on the instrument panel was dispensed with and the distributor bearing was modified to enable the distributor to be adjusted directly on the bearing by means of the adjusting screw (13) (Fig. 01–4/50).

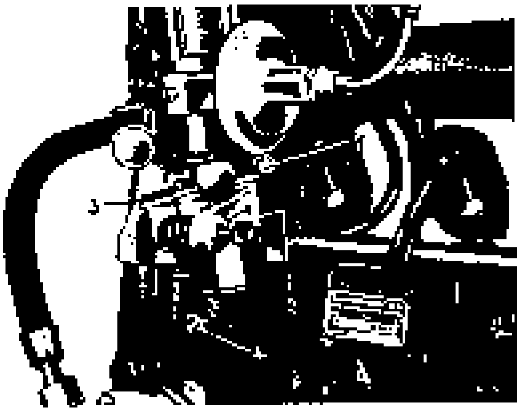


Fig. 01–4/47

1st Version distributor bearing
for octane number compensator

1 Clamping screw for clamping timing lever to distributor
2 Stud screw for securing distributor to distributor bearing
3 Timing lever of distributor bearing
4 Stud screw for fixing distributor bearing in crankcase

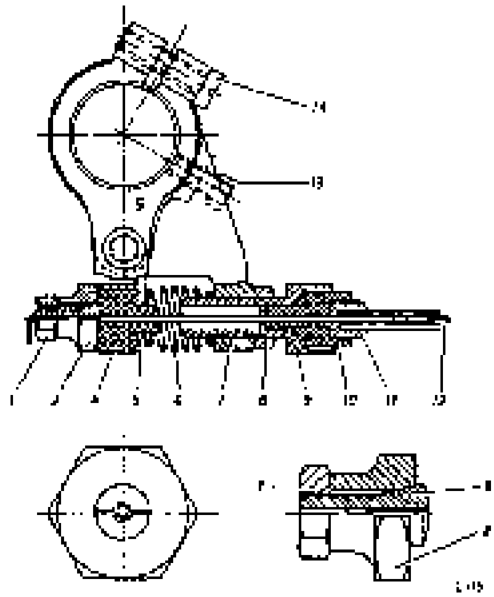


Fig. 01–4/48

1st Version distributor bearing
for octane number compensator

1 Hexagon nut
2 Clamping chuck
3 Collar
4 Damping rubber
5 Timing lever
6 Pressure spring
7 Distributor bearing
8 Hexagon nut
9 Adjusting screw
10 Rubber sleeve
11 Sleeve
12 Coil spring
13 Hexagon screw for fixing distributor
14 Clamping screw

When installing a distributor bearing with the fixing lug (3) cast integral, please note that the hexagon socket screw (1) is 45 mm long, whereas on distributor bearings of the 1st Version (without fixing lug) the hexagon socket screw was only 20 mm long (Fig. 01–4/49).

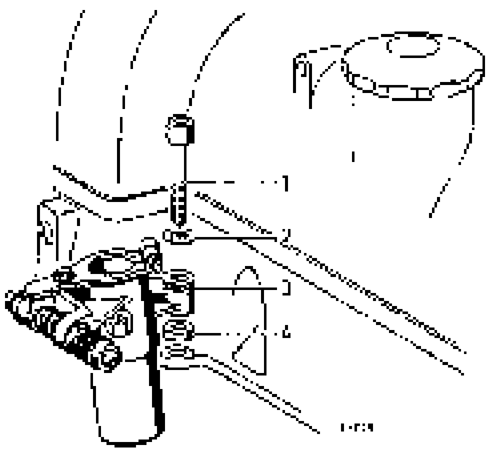


Fig. 01–4/49

2nd Version distributor bearing for octane number compensator

1 Hexagon socket screw (45 mm long)
2 Washer
3 Fixing lug on distributor bearing
4 Spacer ring

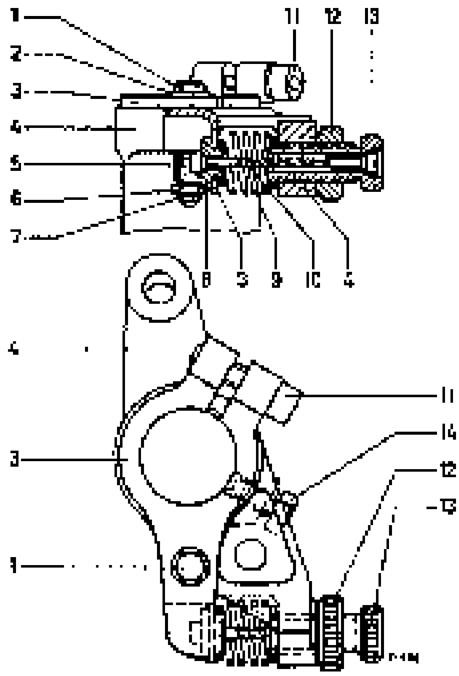


Fig. 01–4/50

3rd Version distributor bearing with adjusting screw

1 Hexagon screw
2 Washer
3 Timing lever
4 Distributor bearing
5 Spring
6 Hexagon nut
7 Cotter pin
8 Washer
9 Pressure spring
10 Cable with 2 nipples
11 Clamping screw
12 Milled nut
13 Adjusting screw
14 Hexagon screw for fixing distributor

On recent models the adjusting screw and control cable on the distributor bearing have been replaced by a hand lever (2) with eccentric disk (Figs. 01–4/51 a and 01–4/51 b). In addition, the stud screw (14) which projects into the circular groove in the distributor collar, is no longer fitted (Fig. 01–4/50).

On Model 220 SE the distributor bearing disc serves as a cover plate and is screwed to the end face of the crankcase (Fig. 01–4/51 b).

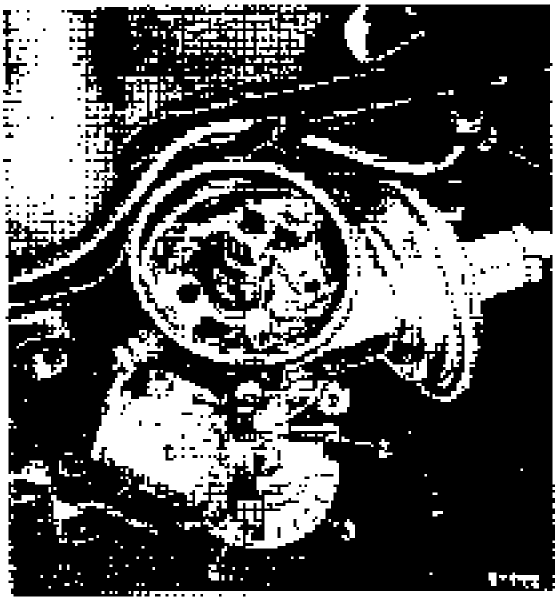


Fig. 01–4/51 a

4th Version distributor bearing with hand lever and eccentric disk

1 Hexagon screw with spring washer
2 Hand lever with eccentric disk
3 Timing lever
4 Distributor bearing

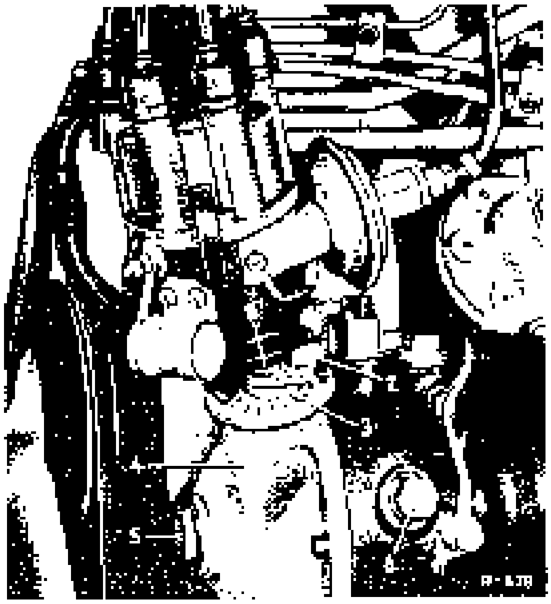


Fig. 01–4/51 b

4th Version distributor bearing photographed on Model 220 S

1 Hexagon screw with spring washer
2 Hand lever with eccentric disk
3 Timing lever
4 Distributor bearing
5 Screw plug
6 Lock screw for shaft drive

When the hand lever (2) is turned, the timing lever (3) is moved via the eccentric disk and automatically moves the distributor. To provide a means of checking the ignition adjustment, these distributor bearings have a graduated scale. Movement of the hand lever by one graduation results in a change of the ignition setting by 2° on the crankshaft.

To adjust the hand lever (2) loosen the hexagon screw (1) and then tighten it again.

Note: In future, only distributor bearings with hand lever and eccentric disk will be supplied as replacement parts. If such a bearing is installed in a car which has an octane number compensator remove the control cable.

The following table shows which distributor bearing types are installed as standard parts in the various models.

190 c	190 b	190 SL	220 b	219	220 S	220 SE	Distributor bearing type
		+	+	+	+		1. with octane number compensator as shown in Figs. 01-4/47 and 01-4/48
		+		+	+		2. with octane number compensator and fixing lug as shown in Fig. 01-4/49
+		+		+	+		3. with fixing lug, adjusting screw, and cable as shown in Fig. 01-4/50
+	+	+		+	+	+¹)	4. with fixing lug, hand lever and eccentric disk as shown in Figs. 01-4/51 a and 51 b

¹) On Model 220 SE the distributor bearing serves at the same time as a cover plate (Fig. 01-4/51 b).

G. Removal and Installation of Oil Pump Drive, Distributor Drive, Injection Pump Drive, and Revolution Counter Drive

Repair procedures see Job No. 18-1.

I. Models 180 a, 180 b, 220 a, 219 and 220 S

Removal and installation procedures for the oil pump and the distributor drive are the same as described for Model 190.

On Model 180 a the idling gear on older cars was designed for the single roller chain; on recent cars the idling gear is the same as for Model 190, since Model 180 a is now also provided with a twin roller chain.

II. Model 190 SL

Removal and installation procedures for the oil pump and distributor drive are basically the same as described for Model 190

On Model 190 SL the idling gear shaft (10), via the driving screw (5), also drives the angle drive for the revolution counter (15). The idling gear (8) has a shoulder on the end face which carries the centering disk (7) for the driving screw (5) (Fig. 01-4/52). On no account should an idling gear without shoulder be installed in Model 190 SL.

In place of the cover plate, the flange bushing (1) with the angle drive for the revolution counter (15) is screwed to the crankcase (Fig. 01-4/52). See also Fig. 01-4/53, Nos. (5) and (4).

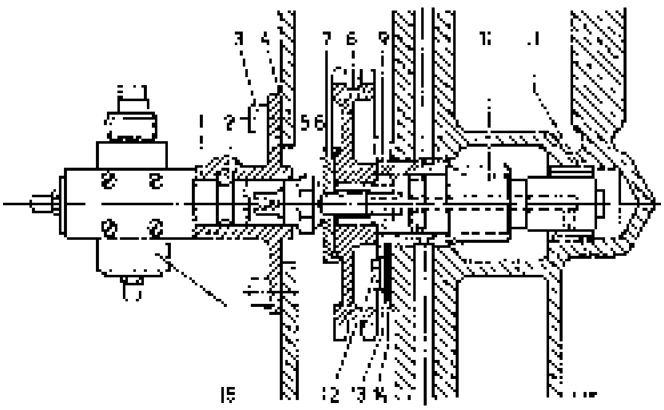


Fig. 01-4/52

1 Flange bushing
2 Hexagon screw
3 Hexagon socket screw
4 Gasket
5 Driving screw
6 Spring washer
7 Centering disk
8 Idling gear
9 Front bearing bushing
10 Idling gear shaft
11 Rear bearing bushing
12 Hexagon screw
13 Lock washer
14 Locking plate for front bearing bushing
15 Angle drive for revolution counter

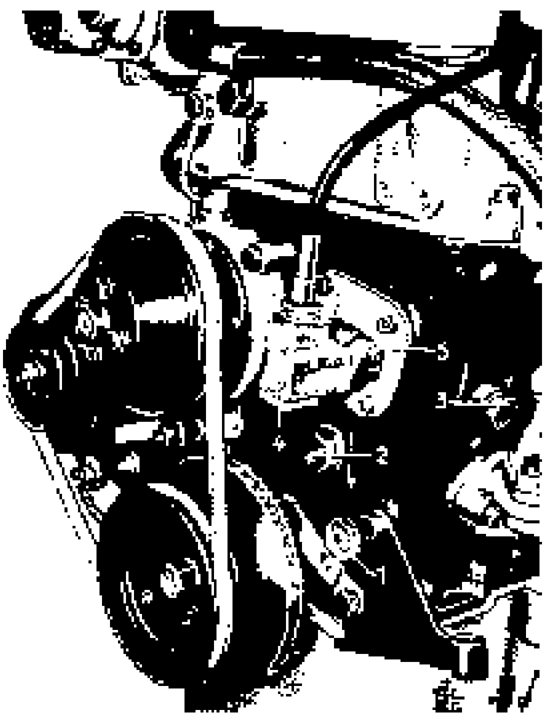


Fig. 01-4/53

1 Screw plug with pivot pin for chain guide
2 Screw plug for oil relief valve
3 Lock screw for chain drive
4 Angle drive for revolution counter
5 Flange bushing

III. Model 220 SE

On Model 220 SE the idling gear shaft drives not only the oil pump and the distributor but also the injection pump. The whole drive arrangement is shown in Fig. 01-4/54. The removal and installation procedures are as follows:

Removal:

1. Remove the injection pump, the venturi control unit, and the distributor. Unscrew the cylinder head cover and move the piston for the 1st cylinder to ignition TDC.

2. Unscrew the six hexagon socket screws on the distributor bearing (8), remove the bearing and pull out the helical gear (9) for the distributor drive (Fig. 01-4/54).

3. Unscrew the hexagon nut (21) at the front of the idling gear shaft (10) and remove the lock washer (22), the washer (23), the drive sleeve (18), the Woodruff key and the spacer sleeve (19).

4. Back off the screw plug (33) on the oil pump drive approximately 2 turns, unscrew the hexagon screw (35) and pry out the pressure piece (36) upward by inserting a screw driver between the screw plug (33) and the cover disk (32). Then pull out the helical gear (37).

5. Unscrew the screw plug (33) completely from the pressure piece (36) and remove the cover disk (32) and the rubber ring (34).

6. Unscrew the chain guide in the cylinder head, the hexagon screw on the camshaft sprocket and the chain tensioner. Then pull off the camshaft sprocket by means of Puller 187 589 01 33, paying attention to the compensating washer between camshaft and camshaft sprocket.

7. Unscrew the locking screw for the chain drive and tap out the idling gear shaft toward the back, removing the idling gear at the same time.

8. If the front and rear bearing bushings (11) and (12) and the bearing assembly (38) with the bearing bushing (40) have to be removed, remove the bearing bushings for the idling gear shaft by means of Puller 186 589 09 33 or tap them out with a suitable drift; after having removed the oil pan tap out the bearing assembly with the bushing for the helical gear from below with a suitable drift.

Checking:

9. Check the parts for wear, in particular the contact surface of the idling gear and of the front bearing bushing.

   The end play between the idling gear and the bearing bushing should be 0.05–0.12 mm. If the play exceeds 0.20 mm replace the worn parts. When replacing the idling gear, install one with a hardened check plate. The check plate turns with the idling gear, they are connected by a heavy dowel pin.

Installation:

10. Use a suitable drift to drive in the bearing bushings or the bearing assembly if previously removed, install the idling gear shaft from the rear, push on the idling gear and install the roller chain making sure that the Woodruff key is properly seated.

Note: On Model 220 SE the front bearing bushing has oil grooves on both end faces, whereas on other models the front bearing bushing has oil grooves only on the rear end face.

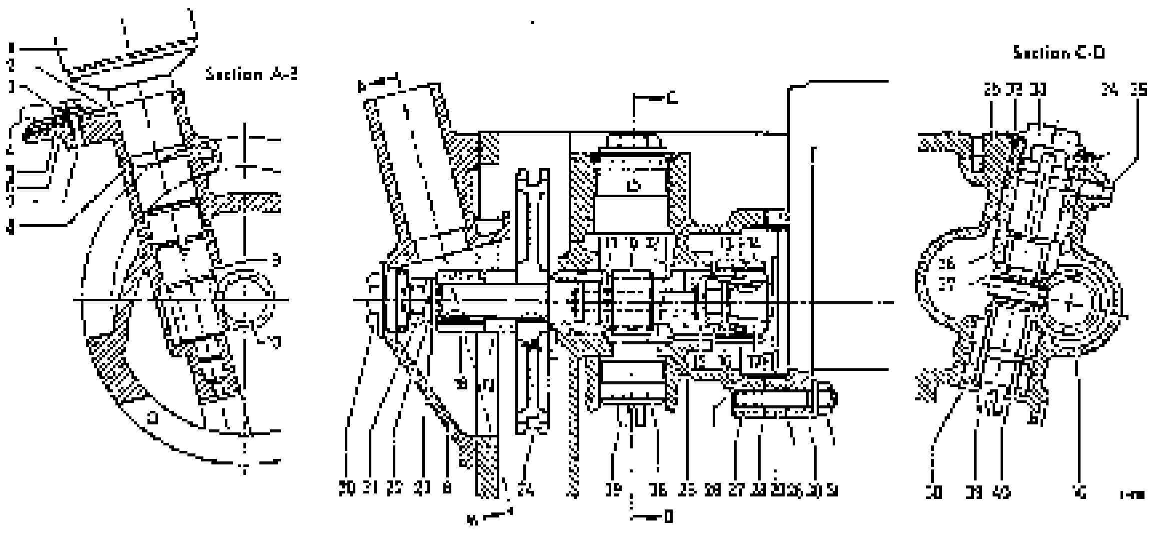


Fig. 01-4/54

1 Distributor	11 Bearing bushing, front	21 Hexagon nut	31 Hexagon nut and washer
2 Timing gear	12 Bearing bushing, rear	22 Lock washer	32 Cover disc
3 Spring washer	13 Coupling sleeve	23 Washer	33 Screw plug
4 Hand gear	14 Snap ring	24 Idling gear	34 Rubber ring
5 Cylindrical pin	15 Hexagon nut	25 Crankcase	35 Hexagon screw
6 Compensating disk	16 Lock washer	26 Bearing sleeve	36 Pressure piece
7 Hexagon screw	17 Follower	27 Stud bolt	37 Bearing bushing
8 Distributor bearing	18 Drive sleeve	28 Sealing flange	38 Bearing assembly
9 Helical gear	19 Spacer sleeve	29 Adjusting flange	39 Helical gear
10 Idling gear shaft	20 Screw plug and seal	30 Injection pump	40 Bearing bushing

11. Install the spacer sleeve (19), the drive sleeve (18), the washer (23), the lock washer (22) and screw on the hexagon nut (21), making sure that the Woodruff key for the drive sleeve is properly seated.

    Then tighten the hexagon nut (21), holding the idling gear shaft steady by inserting Serrated Wrench 621 589 00 08 in the serrations for the coupling sleeve (13).

    Check the end play of the idling gear shaft (0.05–0.12 mm).

12. Screw the distributor bearing (8) to the crankcase. Use a new gasket.

13. Check whether the piston for the 1st cylinder is at TDC. Then install the camshaft sprocket together with the chain, paying attention to the timing mark on the compensating disk and on the front camshaft bearing.

14. Install the chain tensioner and bleed it. Screw on the chain guide in the cylinder head.

15. Put on the cylinder head cover and screw it down, making sure that the rubber seal is properly seated.

16. Insert the helical gear (39) for the oil pump drive and the pressure piece (36). Tighten the stud screw (35) to secure the pressure piece. Check the end play by touch, pulling at the pin of the helical gear, the end play should be 0.1–0.8 mm.

17. Fit the rubber ring (34) and the cover disk (32) and screw in the screw plug (33).

18. Install the distributor and set the ignition.

19. Screw the locking screw for the chain drive and the screw plug (20) into the bearing of the distributor. Use new sealing rings.

20. Install the venturi control unit and the injection pump. Do not forget to check the adjustment of the control linkage (see Workshop Manual Passenger Car Models as from August 1959, Job No. 00-16).

H. Removal and Installation of Fuel Feed Pump

I. Models 180 a, 180 b, 190 SL, 220 a, 219, and 220 S

Repair procedures see Job No. 07-5, Section B

Removal and installation procedures for the fuel feed pump are the same as described for Model 190.

Subsequent Installation of a Dust-Proof Fuel Feed Pump

as an optional extra according to

SA 10 271 in Models 180 a and 180 b

SA 10 181 in Models 220 a, 219

SA 10 148 in Model 220 S

For countries with dusty and sandy terrain, a fuel pump with two dust filters in the lower part of the case is available in place of the normal fuel pump with a ventilation bore. The dust-proof pump Part No. 000 091 53 01 can be installed in place of the standard pump without further modification.

II. Model 220 SE

Model 220 SE has an electrically driven fuel feed pump which is installed in front of the left spare wheel trough (see Workshop Manual Passenger Car Models as from August 1959, Job Nos. 00-15 and 07-10).

I. Removal and Installation of Oil Filter

Cleaning and testing procedures see Job No. 18-5, Section E.

The removal and installation procedures for Models 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE are the same as described for Model 190. There are, however, differences in the shape and in the angle of inclination of the connecting flange which are important when the filter is being replaced.

Model 190 SL with three-point engine suspension has an oil filter case upper part Part No. 121 184 00 08 with an inclination of 7° 30'. The same model with four-point engine suspension has an oil filter case upper part Part No. 121 184 01 08 with an inclination of 13° 30'. As a result, the filter head is closer to the oil pan and cannot foul the support arm of the sub-frame for the rear engine mounting.

Never install an oil filter case upper part (Part No. 121 184 00 08) with an inclination of 7° 30' on Models with four-point engine suspension.

On Models 220 a, 219 and 220 S the 1st version connecting flange and also the gasket between the crankcase and the oil filter case have a different shape. The upper part of the case in 4-cylinder engines differs from that in 6-cylinder engines.

For rationalisation purposes the same oil filter case upper part that is used in Models 180 a, 190, and 190 SL is installed in Models 219 and 220 S with a crankcase whose left side wall is closed (without cylinder cover) and on all cars of Models 180 b and 220 SE.

On recent 4-cylinder engines for Models 180 a, 190, and 190 SL and all engines for Model 180 b oil filters are used which have only one fine filter element, whereas Models 219, 220 S, and 220 SE have oil filters with a strainer element and a fine filter element.

K. Removal and Installation of Oil Relief Valve in Crankcase

Cleaning and checking procedures see Job No. 18-5, Section C.

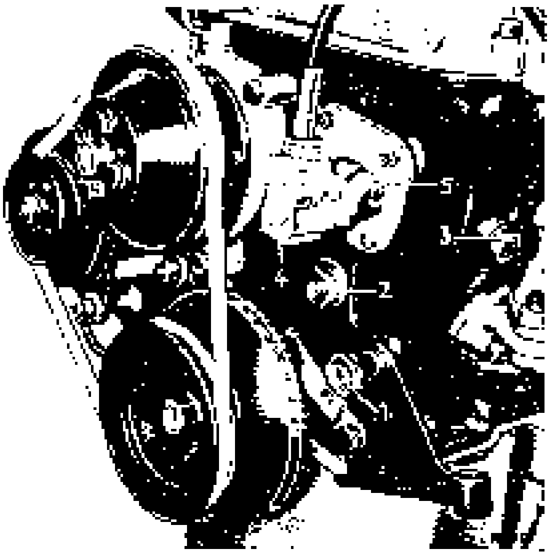


Fig. 01-4/55

Position of oil relief valve on 4-cylinder engines and 6-cylinder engines with closed left side wall

1 Screw plug with pivot pin for chain guide
2 Screw plug for oil relief valve
3 Locking screw for chain drive
4 Angle drive for revolution counter
5 Flange bushing

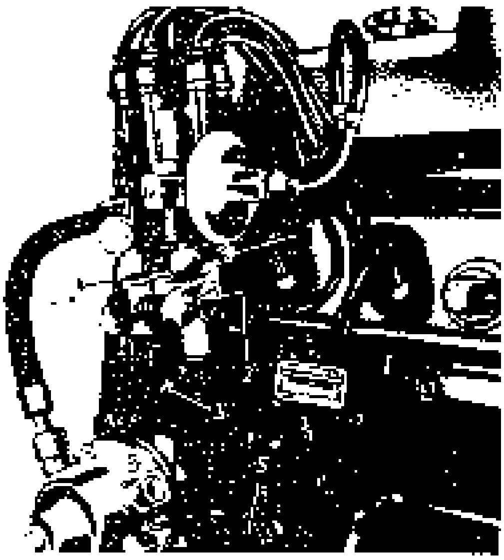


Fig. 01-4/56

Position of oil relief valve on 6-cylinder engines with cylinder cover on the left side

1 Cheese head screw for timing lever
2 Stud screw for distributor
3 Stud screw for distributor bearing
4 Timing lever
5 Oil relief valve

On Models 180 a, 180 b, 190 SL, 220 SE, and on Models 219 and 220 S with a crankcase with closed left side wall (without cylinder cover) the oil relief valve is on the end face of the crankcase and is covered by the screw plug (2) (Fig. 01-4/55).

On Models 220 a, 219, and 220 S whose crankcase has a cylinder cover on the left side, the oil relief valve (5) is screwed into the side of the crankcase without a screw plug (Fig. 01-4/56).

On all models the removal and installation procedures for the oil relief valve are the same as described for Model 190.

Always use a new sealing ring when installing the oil relief valve or the screw plug. The oil relief valve at the end face of the crankcase is installed without a sealing ring.

When the engine has run warm, the oil relief valve or the screw plug must be checked for mechanical tightness and must be retightened, if necessary.

L. Removal and Installation of Oil Pan

I. Models 180 a, 180 b, and 190 SL

Removal and installation procedures for the oilpan are exactly the same as described for Model 190.

II. Models 220 a, 219, and 220 S with Split Oil Pan

Removal:

1. Drain off the oil, remove the tie-rod and the steering shock absorber.

2. Unscrew the front engine brace (judder brace) from the oil pan and the front axle support (only if installed).

3. Unscrew the front part of the oil pan and remove it.

4. If the oil pan is removed only in order to remove the oil pump or to check the connecting rod bearings, the rear part of the oil pan need not be unscrewed (Fig. 01-4/57). If complete removal is necessary, first unscrew the cover plate for the clutch housing, then unscrew the two M 10 fixing screws fixing the clutch housing to the oil pan as well as the two long and two short fixing screws on the oil pan rear part and remove the oil pan.

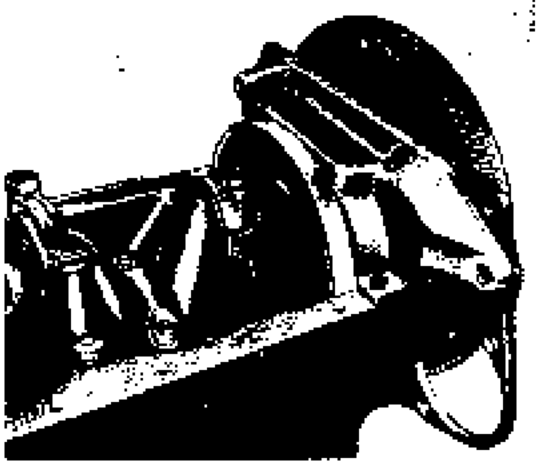


Fig. 01-4/57

Installation:

5. Check the fabric sealing ring in the oil pan rear part which serves to seal the crankshaft and, if necessary, replace it. Carefully press the sealing ring into the sealing ring retainer by means of a hammer handle and cut the ends off so that the ring projects appr. 0.2 mm at the separating surface. This is necessary in order to achieve sufficient contact pressure at the joints. Oil the fabric sealing ring, coat the separating surface of the oil pan rear part with sealing compound and screw it on.

6. Fit the rubber sealing ring for sealing the front and rear parts of the oil pan in the groove and lightly glue it in place in such a way that the ends project 1–2 mm and that the distance from the separating surface is the same on both sides. Apply sealing compound to the separating surface of the oil pan and also to the sealing surface for the front sealing ring, put on the oil pan and tighten the screws.

7. Fix the front engine brace (judder brace) to the front axle support and to the oil pan. If necessary, adjust the connecting rod to its correct length (see Job No. 22-2)

8. Screw on the cover plate for the clutch housing, screw in the two M 10 fixing screws and insert the oil dipstick.

9. Install the tie-rod and the steering shock absorber and top up the engine oil.

III. Models 219, 220 S, and 220 SE with One-Piece Oil Pan

On Model 219 as from Engine End No. 7501549 and on Model 220 S as from Engine End No. 7503461 the split oil pan was replaced by a one-piece oil pan. This one-piece oil pan cannot be removed with the engine installed in the vehicle. When the engine is removed, the removal and installation procedures for the oil pan are the same as described for Model 190.

Note: On Models 220 a, 219, and 220 S the split oil pan can be subsequently replaced by the one-piece oil pan without any modification.

With the introduction of the crankcase with closed left side wall (without cylinder cover) the front left hexagon socket screw for fastening the oil pan to the crankcase was moved outward 35 mm. This oil pan cannot be installed in engines of previous design.

M. Removal and Installation of Oil Pump

Repair procedures see Job No. 18-5, Section B.

Note: In the case of engines with a one-piece oil pan, the oil pump cannot be removed with the engine installed in the vehicle.

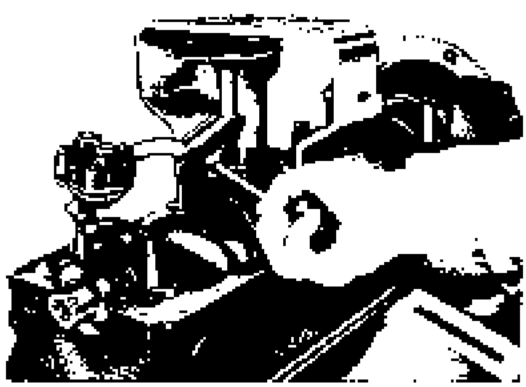


Fig. 01-4/58

I. Models 180 a, 180 b, and 190 SL

Removal and installation procedures for the oil pump are the same as described for Model 190.

II. Models 220 a, 219, 220 S, and 220 SE

The removal and installation procedures for the oil pump are basically the same as described for Model 190, but the oil pump suction pipe is fastened with a bracket to the second crankshaft bearing cap. Since, furthermore, the suction pipe is screwed to the oil pump housing and is not cast integral with it, care must be taken to ensure that the suction strainer is parallel to the bottom of the oil pan when the pump is being installed. If this is not the case, the suction pipe must be turned (Fig. 01-4/58).

N. Removal and Installation of Counterweight and Vibration Damper on Crankshaft

Repair procedures for the vibration damper see Job No. 03–5, Section I

I. Counterweight on Models 180 a, 180 b, and 190 SL

On Models 180 a, 180 b, and 190 SL a counterweight is mounted on the front crankshaft end as in the case of Model 190 (Fig. 01–4/59). Removal and installation procedures are the same as for Model 190.

On recent cars of Models 190 and 190 SL the counterweight with long hub has been replaced by a counterweight with a short hub and a spacer ring. As a result, the crankshaft is no longer sealed at the front by the hub of the counterweight, but by the spacer ring which has been installed in all cars of Models 180 a and 180 b and in all 6-cylinder engines (see Fig. 01–4/60).

The advantage of this modification is that when the sealing surface is worn only the spacer ring has to be replaced and not the whole counterweight.

The spacer ring Part No. 121 031 00 51 can also be installed subsequently; in this case, the counterweight with long hub Part No. 121 031 01 07 must be replaced by a counterweight with short hub Part No. 121 031 03 07.

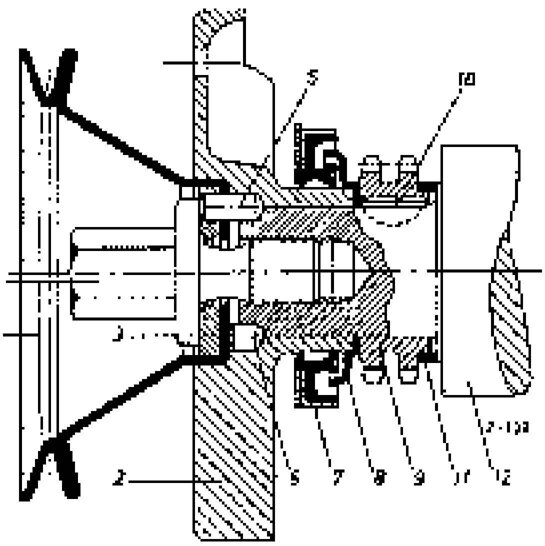


Fig. 01–4/59

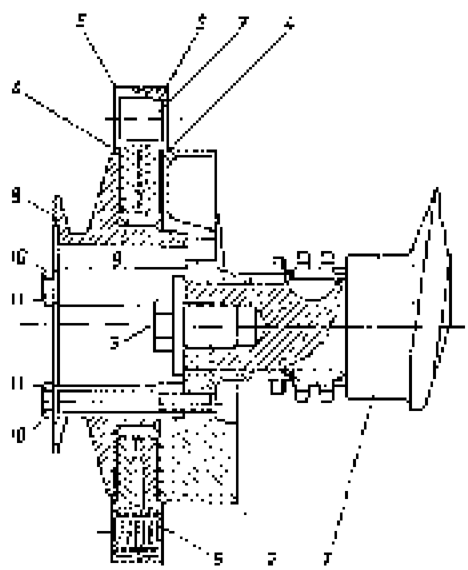
1 Pulley
2 Counterweight
3 Washer
4 Shoulder screw
5 Dowel pin
6 Dowel pin
7 Oil seal
8 Oil thrower
9 Crankshaft sprocket
10 Woodruff key
11 Compensating ring
12 Crankshaft

II. Counterweight and Vibration Damper on Models 220 a, 219, 220 S, and 220 SE

On Models 220 a, 219, 220 S, and 220 SE a vibration damper is installed between the counterweight (2) and the pulley (8) Fig. 01–4/60).

Fig. 01–4/60

1 Crankshaft
2 Counterweight
3 Shoulder screw
4 Control disk
5 Flywheel ring
6 Pressure spring
7 Shear block
8 Pulley
9 Contact ring on pulley
10 Spring washer
11 Hexagon screw



Removal:

1. If the vibration damper and the counterweight are removed with the engine in the vehicle, the radiator must be removed beforehand (see Job No. 50–1).

2. Unscrew the fan, release the tension of the fan belt at the belt tensioner and remove the belt.

3. Fit the two Clamps 187 589 04 31 over the flywheel rings and slightly compress the vibration damper (Fig. 01–4/61).

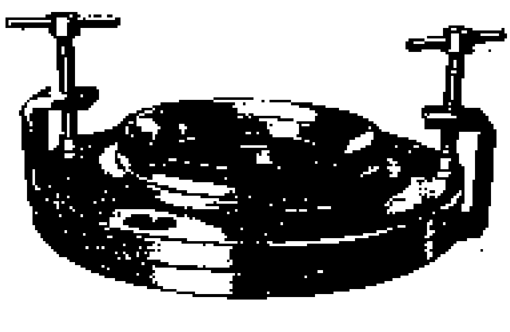


Fig. 01–4/61

4. Detach the connecting rod of the front engine brace, if installed. Then detach the front engine support at the rubber mountings and lift the engine at the front until the lower edge of the vibration damper is above the upper edge of the front axle support.

5. Unscrew the hexagon screws (11) for fastening the pulley and take of the pulley together with the vibration damper (Fig. 01–4/60).

6. Unscrew the wing nuts of both clamps evenly and disassemble the vibration damper. Check all parts and, if necessary, repair or replace them.

7. Unscrew the shoulder screw (3) which fixes the counterweight to the crankshaft, and pull the counterweight of the crankshaft, using Puller 000 589 17 33.

Note: If the counterweight has to be replaced, **remove the crankshaft and rebalance it together with the new counterweight and the flywheel** (see Job No. 03–5, Section G).

Installation:

8. Fit the counterweight (2) to the crankshaft extension pin and turn it until the bores for the dowel pins are lined up.

   Attention! The bores are slightly offset with respect to each other in order to prevent the counterweight from being installed incorrectly.

   Then drive in the two dowel pins. They must be seated firmly in the bores; if that is not the case, the bores must be bored and reamed to a diameter of 9.930–9.966 mm (10 ⌀ X9) with a maximum depth of 9 mm; use thicker dowel pins 10 ⌀ 8 × 8 DIN 7 (9.978–10.000 mm ⌀) (Fig. 01-4/62).

   Now firmly tighten the counterweight (2) on the crankshaft by means of the shoulder screw (3).

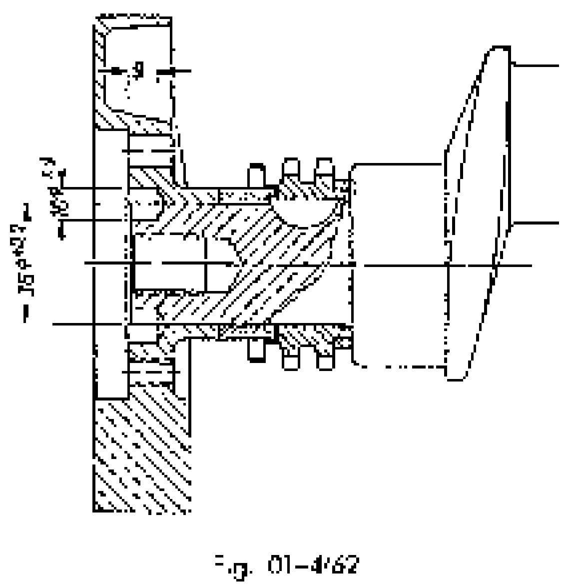


Fig. 01–4/62

9. Assemble vibration damper. Insert the 8 pressure springs and 2 shear rubbers into flywheel and clamp uniformly by means of the two clamps 187 589 04 31 (Fig. 01–4/61).

10. Place outer contact disk (4), the compressed flywheel rings (5) and the inner contact disk (4) onto contact ring (9) of the pulley and attach by means of hexagon screws (11) to counterweight. Use spring washers with hexagon screws. Then remove the two clamps from vibration damper.

11. Lower engine, attach front engine supports to rubber mountings and fasten connecting rod of engine brace. Attach fan belt and tighten, then mount fan.

12. Install radiator and top up with cooling water (refer to Job No. 50-1).

Q. Removal and Installation of Crankshaft with Counterweight and Flywheel

Repair procedures see Job No. 03-5, Sections A, B and C.

Removal and installation of the crankshaft for models 180 a, 180 b, 180 c, 190 SL, 220 a, 219, 220 S, 220 SE is the same as for model 190, except that the front seal of the crankshaft is no longer, as before, on the hub of the counterweight, but on a specially attached spacer ring (refer to Section N, page 01–4/47).

In addition, model 190 SL is provided as from engine end No. 65 00795 with a flywheel having a larger attaching flange. The bolt hole circle has been enlarged from 56 ± 0.2 mm to 78 ± 0.1 mm. For replacements, only crankshafts of the 2nd version with the matching flywheel will be available.

Instead of the former thrust washers fixing the crankshaft in axial direction, which are in part still used today, all our engines will in future be provided with a fitted bearing and collar in the cylinder crankcase (upper bearing shell section), and in some cases also in the crankshaft bearing cap (lower bearing shell section). (For details refer to Job No. 03–5, Section B.)

The bolts for the crankshaft bearing cap are now for all types uniformly assembled with spring washers B 12 DIN 127. For engines, where the second crankshaft bearing cap is used to attach the bracket for the oil pump, these bolts are assembled without spring washers.

P. Removal and Installation of Piston and Connecting Rods

Removal and Installation of pistons and connecting rods on models 180 a, 180b, 190 SL, 220 a, 219, 220 S and 220 SE is exactly the same as for model 190. In these models the pistons may be removed in upward direction.

In all models, with the exception of models 180 a and 180 b, pistons with extended skirt will be used (Fig. 01—4/63).

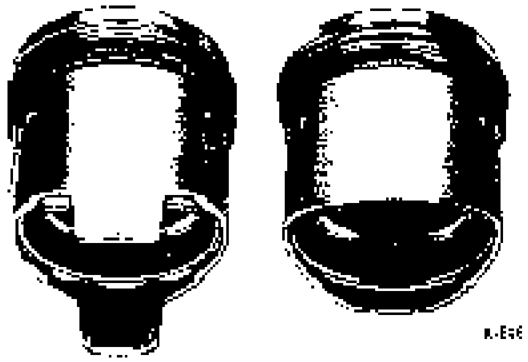


Fig. 01—4/63

Piston Shapes

Models 180 a, 190, 190 a, 190 SL, 220 a, 219, 220 S and 220 SE — Models 180 a, 180 b

The piston for model 220 SE has a piston pin bore of 24 mm dia. as compared with the piston for models 220 a, 219 and 220 S, which have a 22 mm dia. Since the reinforcement of the connecting rods at the piston boss of models 219 and 220 S the external dia. of the bushing is now also 27 mm, similar to model 220 SE, instead of 25 mm as before. The internal dia. of the bushing of models 219 and 220 S has remained the same.

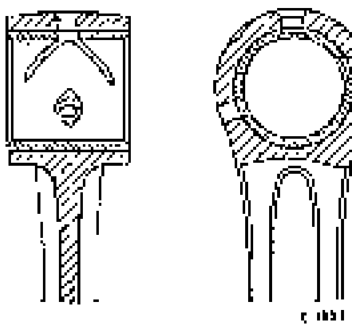


Fig. 01—4/63 a

Small End with Oil Holes

For connecting rods and pistons of models 180 a (from the beginning) and 190 SL the distance from the center bearing hole has been changed from 154 mm to 149 mm, the distance from center piston pin hole to piston head from 43 mm to 48 mm, and the diameter of the piston pin from 25 mm to 26 mm. The pressure oil hole to piston pin has been eliminated. Instead, the piston head is provided with three holes through which the splashed oil reaches the piston pins.

Connecting rods and pistons are installed in such a manner that the lower oil hole "a" at the connecting rod boss, or the holding lugs of the bearing shells, respectively, point towards the left, and the arrow on the piston head in the direction of driving.

Q. Disassembly and Reassembly of Crankcase

Disassembly and reassembly of cylinder crankcase for models 180 a, 190 SL, 220 a, 219, 220 S and 220 SE is substantially the same, since the various crankcases vary but slightly in construction.

On models 180 a and 190 SL fastening the right-hand cylinder cover holds simultaneously also the bearing block for the carburetor linkage relay lever, on type 190 SL in addition the bracket for the air suction pipe support. When mounting the cylinder cover watch out for proper length of bolts. The long M 6 × 18 screws are meant to attach the brackets.

For some time now, Models 180 a and 190 SL have been fitted with a crankcase on which both the left and the right side wall are closed, the cylinder covers which were previously used are no longer fitted.

The bearing bracket for the relay lever of the carburetor linkage in Model 180 a and the bracket for the air suction pipe support on Model 190 SL which were previously fastened to the crankcase together with the cylinder cover are now screwed directly to the crankcase.

The crankcase has 3 threaded holes M 6 and 1 threaded hole M 8 for this purpose.

On Models 180 a and 180 b the bearing bracket is fixed with 3 hexagon screws M 6×15 and the threaded bore M 8 is closed by a 10 mm hexagon screw with sealing ring.

On Model 190 SL the bearing bolt is screwed into the M 8 bore together with a sealing ring. The two front threaded bores M 6 are closed with two 10 mm hexagon screws with sealing rings. The third rear threaded bore M 6 remains open.

Liberally coat the threads of the screws and the surfaces of the sealing rings with sealing compound in order to ensure proper sealing of the water jacket space.

The closed crankcase was first used on

Model 180 a as from Engine End No. 85 07471
Model 190 as from Engine End No. 85 09140
Model 190 SL as from Engine End No. 85 01732

All cars of Model 180 b have the crankcase with closed side walls.

On Models 219 and 220 S a crankcase has been used for some time now, on which the left side is closed and is consequently no longer fitted with a cylinder cover.

This crankcase was first used on

Model 219 with standard clutch
as from Engine End No. N 85 00360

Model 219 with hydraulic automatic clutch
as from Engine End No. Z 85 00121

Model 220 S with standard clutch
as from Engine End No. N 85 00647

Model 220 S with hydraulic automatic clutch
as from Engine End No. Z 85 00283

All cars of Model 220 SE have a crankcase with the left side wall closed.

On Models 180 a, 190 SL, 220 a, 219, and 220 S the partition plate between crankcase and clutch housing has been reinforced from 5 mm to 6 mm in order to improve the centering of the clutch.

Note: All cars of Models 180 b and 220 SE have the 6 mm partition plate.

On Models 180 a, 190 SL, 219, 220 S, and 220 SE the length of the dowel pins top left in the crankcase for centering the partition plate and the clutch housing and the dowel pin top right in the crankcase for centering the partition plate were increased in diameter from 8 to 12 mm. All cars of Model 180 b have these thicker dowel pins. When installing a replacement engine or a new partition plate or a new clutch housing, it may be necessary to use shouldered dowel pins. For details see the tables below.

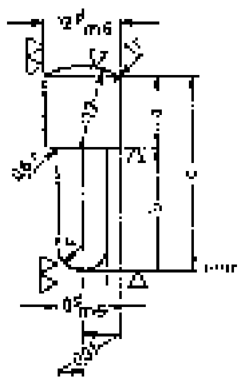


Fig. 01–4/64

8 ø m 6 = 8 $^{+0.024}_{+0.015}$
12 ø m 6 = 12 $^{+0.029}_{+0.018}$

Dowel Pin Crankcase - Partition Plate – Clutch Housing

Diameter of bore in			Part No.	Dimension		
Crankcase	Partition plate	Clutch housing		a	b	c
8	8	8	186 991 07 01	—	—	26
8	8	12	180 991 01 62	14	16	30
8	12	12	*)	11	19	30
12	8	8	180 991 03 62	19	11	30
12	12	8	180 991 02 62	13	17	30
12	12	12	180 991 00 62	—	—	34

*) If a partition plate and a clutch housing with 12 mm dowel pin bores is installed, a dowel pin must be made as shown in Fig. 01-4/64. Dowel Pin 180 991 02 62 can be used in an emergency.

Dowel Pin Crankcase – Partition Plate

Diameter of bore in		Part No.	Dimension		
Crankcase	Partition plate		a	b	c
8	8	186 991 08 01	—	—	16
8	12	180 991 04 62	11	11	22
12	8	180 991 04 62	11	11	22
12	12	180 991 01 62	—		20

R. Removal and Installation of Front Grease Seal for Crankshaft with Engine Installed in Vehicle

On Models 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE the removal and installation procedures for the front grease seal for the crankshaft are the same as described for Model 190. If the grease seal is being replaced, always check the spacer ring, or in older engines of Models 190 and 190 SL the hub of the counterweight to see whether the sealing surface for the grease seal is badly worn (see Figs. 01-4/59 and 01-4/60). If the sealing surface is badly worn the parts must be replaced.

S. Removal and Installation of Flywheel

Repair procedures see Job No. 03-5, Sections E to H.
On Models 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE the removal and installation procedures for the flywheel are the same as described for Model 190. The following points deserve attention:

On Models 190 SL, 219, and 220 S a spacer sleeve was installed on some cars between crankshaft and annular grooved bearing. On the present crankshafts the bore is not so deep and consequently the spacer sleeve is no longer necessary.

On Model 190 SL a flywheel with a larger attaching flange was installed as from Engine End No. 65 00795. The bolt hole circle was increased from 56 ± 0.2 mm to 78 ± 0.1 mm.

On Models 219 and 220 S with hydraulic automatic clutch the annular grooved bearing has been replaced by a centering ring for the journal of the clutch end plate in the crankshaft. On recent cars the centering ring is no longer fitted and the journal has been correspondingly increased in diameter.

On Models 219 and 220 S the flywheel has been changed and is now of the same design as on Models 180 a, 180 b, and 190 SL. The new flywheel can only be installed subsequently if the clutch (without drive plate) is replaced.

The flywheel fixing screws (stretch screws) are tightened with a torque of 6–6.5 mkg in the case of 4-cylinder engines and of 4–4.5 mkg in the case of 6-cylinder engines. The screws are not locked.

T. Removal and Installation of Roller Chain with Engine Installed in Vehicle

For Models 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE the removal and installation procedures for the roller chain are the same as described for Model 190.

If repair should be necessary, a chain with a jointing link (spare link) can be installed as a substitute for the endless chain. This enables the chain to be replaced without disassembling the engine.

When the engine is being overhauled, however, an endless chain should always be fitted if the chain has to be replaced.

On earlier cars of Model 180 a, a single roller chain was fitted. Later, as from Engine End No. 85 10924, this was replaced by a twin roller chain of the type used in the other models.

Testing and Repairing Engine

The test and repair procedures for the engines of Models 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE are basically the same as those described for Model 190.

The following pages contain only the deviations from the basic procedures and the tables listing the measurements necessary for testing and repairing the engine.

Crankcase and Cylinder Head

Job No.
01-5

A. Cleaning, Pressure-Testing and, if necessary, Surface-Grinding of Crankcase

For Models 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE these procedures are the same as described for Model 190.

Machining Dimensions for Crankcase

Model		180 a, 180 b, 190, 190 b, 190 SL	220 a and 219, 220 S with ε = 7.6:1	219, 220 S with ε = 8.7:1 and 220 SE
Total height		238.4—238.5	213.6—213.7	213.1—213.2
Permissible stock removal			0.5	
Permissible departure from plane	in a longitudinal direction		0.05	
	in a lateral direction		0	
Permissible departure from parallelity between upper and lower separating surface in a longitudinal direction			0.1	
Test pressure with air in hot water (70° C)			2 atm.	
Distance between piston bottom and separating surface − = piston recedes + = piston projects		+ 0.3–0.25	$-0.3\ ^{-0.25}_{-0.35}$	$+0.2\ ^{+0.25}_{-0.35}$

B. Boring and Honing of Cylinder Bores

For Models 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE these procedures are the same as described for Model 190.

Machining Dimensions of Cylinder Bores

Overhaul stage	180 a, 180 b 190, 190 b 190 SL	220 a, 219 220 S, 220 SE
Standard size	85.000 85.022	80.000 80.019
Intermediate stage	85.250 85.272	80.250 80.272
1st Overhaul stage	85.500 85.522	80.500 80.522
2nd Overhaul stage	86.000 86.022	81.000 81.022
3rd Overhaul stage	86.500	81.500

Machining Tolerances of Cylinder Bores

Models 180 a, 180 b, 190, 190 b, 190 SL, 220 a, 219, 220 S, and 220 SE

Permissible degree of out-of-round	0.013
Permissible conicity	0.013
Permissible departure of cylinder bores from vertical to crankshaft axis, calculated over total height of cylinder	0.05
Permissible roughness	0.003—0.005
Average depth of corrugation	max. 50% of roughness

The pistons must be so chosen that the difference in weight of the pistons in any one engine does not exceed 4 grams and that the running clearance is 0.04 mm.

C. Machining and Pressure-Testing of Cylinder Head

Machining Dimensions for Cylinder Head

Model		180 a, 180 b 190, 190 b 190 SL	220 a 219 220 S 220 SE
Total height		84.8—85.0	
Permissible stock removal		1	0.9
Permissible departure from plane	in a longitudinal direction	0.1	
	in a lateral direction	0	
Permissible departure from parallelity between upper and lower separating surface in a longitudinal direction		0.1	
Test pressure with air in hot water (70° C)		2 atm.	

For Models 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE this procedure is the same as described for Model 190.

After machining the cylinder head separating surface, remachine the valve seats in order to ensure that the minimum distance between valve head and cylinder head separating surface is maintained (see Section F).

Compression Ratio and Capacity of Compression Chamber

Model		180 a	180 b	220 a 219 [1] 220 S [1]	219 [2] 220 S [2]	220 SE	220 a [3] 219 [3] 220 S [3]	190 SL [4]	190 SL [5]
Compression ratio	maximum	7.0:1	7.25:1	7.8	9.0	8.8	7.1	8.8	9.2
	standard	6.8:1	7.0:1	7.6	8.7	8.7	6.8	8.5	8.8
	minimum	6.6:1	6.8:1	7.35	8.4	8.4	6.5	8.25	8.45
Total compression chamber capacity with cylinder head fitted in cm³		78.5—84.5	76—82	53.5—57.5	45.5—49.5	46.7—49.5	61.0—65.0	60.5—64.3	57.8—63.6
Compression chamber capacity in cylinder head with valves and spark plugs fitted in cc		70.3—71.3	68.5—69.5	44.3—45.3	36.4—37.4	36.4—37.4	51.2—52.2	51.7—53.7	49.0—51.5
Height of compression chamber in cylinder head		18 ± 0.3	18±0.3	18±0.3	18±0.3	18±0.3	18±0.3	18 ± 0.3	18 ± 0.3

[1] On Model 219 up to Engine End No. 75 04397, on Model 220 S up to Engine End No. 75 09333.
[2] On Model 219 with standard clutch as from Engine End No. N 75 00368, with hydraulic automatic clutch as from Engine End No. Z 75 00047.
On Model 220 S with standard clutch as from Engine End No. N 75 09034, with hydraulic automatic clutch as from Engine End No. Z 75 00008.
[3] Engines with lower compression as an optional extra, on Models 220 a and 219 according to SA 52051, on Model 220 S according to SA 10187.
[4] Up to Engine End No. 65 25200.
[5] As from Engine End No. 65 03994.

D. Checking and Replacing Valve Guides

For Models 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE this procedure is the same as described for Model 190.

On the first cars of Models 190 SL, 219, and 220 S shouldered valve guides were installed, which were later replaced by valve guides with a snap ring (to prevent axial displacement) of the type used on all cars of Models 180 a, 180 b, and 220 SE (Figs. 01—5/1 and 01—5/2). All cars of Model 220 a have shouldered valve guides as standard parts.

When repairs are carried out, the shouldered valve guides can without modification be replaced by valve guides with a snap ring.

On Model 220 SE the exhaust valve sealing system is the same as on the other models, but the inlet valve is sealed by a silicone sealing ring (see Fig. 01—4/25). For this reason, the top of the inlet valve guide has been redesigned (Fig. 01—5/3).

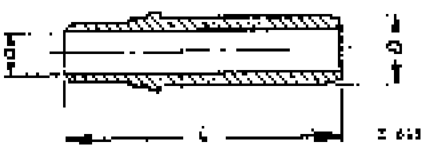


Fig. 01—5/1
1st Version with shoulder

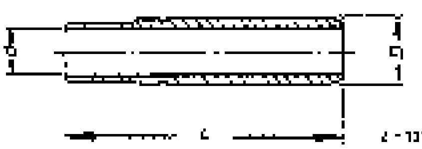


Fig. 01—5/2
2nd Version with snap ring

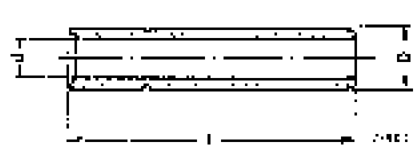


Fig. 01—5/3
Inlet valve guide Model 220 SE

Dimensions of Valve Guides and Bores in Cylinder Head

Model 180 a, 180 b, 190, 190 b, 190 SL, 220 a, 219, 220 S and 220 SE

Part No.	Overhaul stage	Color code	External diameter D	Internal diameter d Inlet	Internal diameter d Exhaust	Length L Inlet	Length L Exhaust	Bore in cylinder head	Force-fit oversize in cylinder head
Inlet 121 050 00 24 180 050 02 24 [1] Exhaust 121 050 16 24 [3]	Standard size	—	14.013 / 14.007	9.000 / 9.015	10.000 / 10.015	67 [2]	57	14.000 / 14.006	+ 0.007
		red	14.019 / 14.013					14.006 / 14.012	
		white	14.025 / 14.019					14.012 / 14.018	
Inlet 121 050 02 24 180 050 03 24 [1] Exhaust 121 050 22 24 [3]	1st Overhaul stage	red	14.225 / 14.207					14.200 / 14.218	
Inlet 121 050 03 24 180 050 04 24 [1] Exhaust	2nd Overhaul stage	white	14.425 / 14.437					14.400 / 14.418	

Note: The part numbers refer to valve guides with a snap ring.
[1] Inlet valve guide for Model 220 SE
[2] Length of inlet valve guide for Model 220 SE = 65.5 mm.
[3] The previous Exhaust Valve Guides 121 050 03 24 (standard size), 121 050 04 24 (1st overhaul stage), and 121 050 05 24 (2nd overhaul stage) with a length L = 58 mm can be used up.

Thrust Collars for Valve Springs

When installing the thrust collars, please note that in the case of shouldered valve guides thrust collars with a dimension a = 2.2+0.2 mm are installed, and in the case of valve guides with a snap ring, thrust collars with a dimension a = 1.1+0.2 mm (Fig. 01-5/4).

Under special circumstances thrust collars with the dimension a = 2.2+0.2 mm can be used for valve guides with a snap ring, **but on no account should thrust collars with the dimension a = 1.1+0.2 mm be used for shouldered valve guides.**

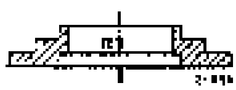


Fig. 01-5/4

Dimension a = 2.2+0.2 mm for shouldered valve guides
Dimension a = 1.1+0.2 mm for valve guides with a snap ring

In the case of inlet valve guides for Model 220 SE (injection engine) with sealing ring and sealing ring retainer, the thrust collars have been replaced by a plain washer (see Fig. 01-4/25).

E. Replacement of Valve Seat Rings

For Models 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE this procedure is the same as described for Model 190.

Inlet

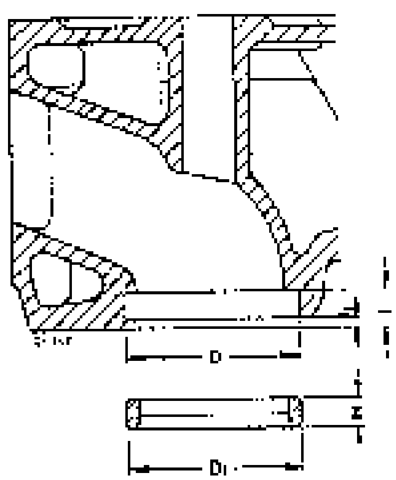


Fig. 01-5/5

Exhaust

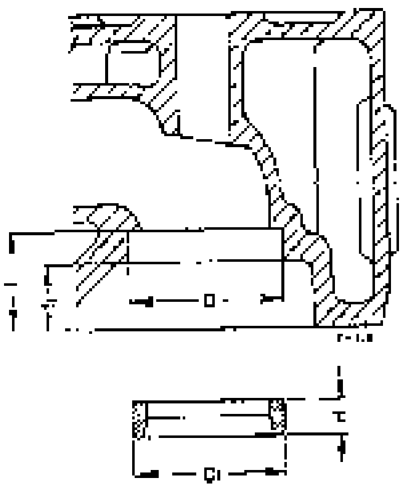


Fig. 01 5/6

Dimensions of Cylinder Head Bores and Valve Seat Rings

Valve seat rings		Inlet			Exhaust	
Model		180 a, 180 b, 190 SL	220 a and 219, 220 S with ε = 7.6:1	220 SE and 219, 220 S with ε = 8.7:1	180 a, 180 b, 190 SL	220 a, 219, 220 S, 220 SE
Part number	Standard size	121 053 02 45	180 053 24 31	180 053 25 31	121 053 05 37	180 053 27 31
	1st Overhaul stage	121 053 03 31	180 053 23 31	[illegible]	121 053 03 37	136 053 08 32
Base bore "D" in cylinder head	Standard size	48.000 / 48.016	44.000 / 44.016	43.000 / 43.016	42.000 / 42.016	39.000 / 39.015
	1st Overhaul stage	48.500 / 48.516	44.500 / 44.516	43.500 / 43.516	42.500 / 42.516	39.500 / 39.516
Diameter "D1" of valve seat ring	Standard size	48.106 / 48.090	44.150 / 44.140	43.120 / 43.090	42.100 / 42.090	39.100 / 39.090
	1st Overhaul stage	(49.300) [1] 48.600 / 48.590	(45.300) [1] 44.650 / 44.640	(44.300) [1] 43.600 / 43.590	(43.300) [1] 42.600 / 42.590	(40.300) [1] 39.600 / 39.590
Height "H" of valve seat ring	Standard size	8.00 / 7.91	6.80 / 6.71	7.70 / 7.61	9.50 / 9.41	9.00 / 8.91
	1st Overhaul stage	8.00 / 7.91	6.80 / 6.71	7.70 / 7.61	9.50 / 9.41	9.00 / 8.91
Depth in cylinder head	[illegible]	10.00 / 10.10	8.50 / 8.60	9.70 / 9.80	27.50 / 27.60	27.00 / 27.10
	[illegible]	2	1.2 / 1.7	1.2 / 1.3	17.70 / 18.30	18.00 / 18.30
Force-fit oversize of valve seat ring		0.074 to 0.100	0.124 to 0.150	0.074 to 0.100	0.074 to 0.100	0.074 to 0.100

[1] Rough-turned diameter. Re-turn or regrind the valve seat ring to make sure that the prescribed force-fit oversize is always maintained.

F. Machining Valve Seats in Cylinder Head

For Models 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE this procedure is the same as described for Model 190.

Machining Dimensions for Valve Seats in Cylinder Head

Model	180 a, 180 b, 190 190 b, 190 SL	220 a, 219 220 S, 220 SE
Valve seat width	1.25—1.75	1.25—2
Valve seat angle in cylinder head	90°—30'	
Permissible out-of-round of valve seat	0.05	
Backing-off of valve seat	120° or 150°, or with backing-off cutter minimum 0.1	

Permissible Depth of Valve Disk in Relation to Cylinder Head Separating Surface

Models 180 a, 180 b, 190, 190 b, 190 SL, 220 a, 219, 220 S, and 220 SE

for new valve seats				for reconditioned valve seats			
Minimum distance for new valves		for reground valves		for new valves		Maximum distance for reground valves	
Inlet	Exhaust	Inlet	Exhaust	Inlet	Exhaust	Inlet	Exhaust
0.8	16	1.3	16.8	1.8	17.2	2.3	18

Power Unit Assemblies

A. Grinding Crankshaft

For Models 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE this procedure is the same as described for Model 190.

Table of Crankshaft Grinding Overhaul Stages

Model	Overhaul stage	Crankshaft journals: Diameter of journals	Crankshaft journals: Width of journals at locating bearing	Crankpins: Crankpin diameter	Crankpins: Crankpin width
180 a, 180 b, 190, 190 b, 190 SL	Standard size	69.96 / 69.94	34.000 / 34.025	51.96 / 51.94	32.000 / 32.100
	1st Overhaul stage	69.71 / 69.69	34.000 / 34.025 to 34.700 *) / 34.725	51.71 / 51.69	32.000 to 32.300
	2nd Overhaul stage	69.46 / 69.44		51.46 / 51.44	
	3rd Overhaul stage	69.21 / 69.19		51.21 / 51.19	
	4th Overhaul stage	68.96 / 68.94		50.96 / 50.94	
220 a, 220 S, 219, 220 SE	Standard size	59.96 / 59.94	30.000 / 30.021	47.96 / 47.94	30.000 / 30.084
	1st Overhaul stage	59.71 / 59.69	30.000 / 30.021 to 30.700 *) / 30.725	47.71 / 47.69	30.300 to 30.000
	2nd Overhaul stage	59.46 / 59.44		47.46 / 47.44	
	3rd Overhaul stage	59.21 / 59.19		47.21 / 47.19	
	4th Overhaul stage	58.96 / 58.94		46.96 / 46.94	

*) in steps of 0.1 mm, according to the available check plates

The tolerances given in the above table for the various overhaul stages must on no account be exceeded, and it goes without saying that all journals and pins must be ground to the same overhaul stage. Make sure that the fillet radii (2.5–3 mm) on the crankshaft journals and crankpins are strictly adhered to.

Machining Tolerances of Crankshaft

Model		180 a 180 b 190 190 b 190 SL	219 220 a 220 S 220 SE
Permissible out-of-round tolerance of crankshaft journals and crankpins		0.005	
Permissible conicity of crankshaft journals and crankpins		0.01	
Permissible misalignment of crankpins with regard to crankshaft journals, related to bearing length		0.01	
Permissible run-out of center crankshaft journal with crankshaft supported on the outside journals		0.02	
Permissible lateral deflection of locating journal		0.015	
Permissible radial deflection of flywheel flange related to the crankshaft journals		0.02	
Permissible lateral deflection of flywheel flange related to the crankshaft journals, measured at external diameter		0.01	0.012
Fillet radii on the crankshaft journals and crankpins		2.5—3	
Hardness of crankshaft journals and crankpins	Scleroscope hardness	68—74	70—74
	Rockwell hardness	55—61	57—61
Permissible unbalance of crankshaft		15 cmg *)	

*) The crankshaft is balanced together with the front counterweight and the flywheel.

B. Re-Bedding of Crankshaft

The procedure for models 180 a, 180 b, 180 c, 190 SL, 220 a, 219, 220 S and 220 SE is the same as for model 190.

Bearing Play of Crankshaft

Models 180 a, 180 b, 180 c, 190, 190 b, 190 SL, 220 a, 219, 220 S and 220 SE

Radial¹)	End Play of locating bearing²)
0.045–0.060	0.09–0.236*

¹) The above radial play for new engines is obtained by proper selection of crankshafts and bearing shells, with a bearing play of 0.05 mm the goal. This radial play should be definitely maintained also during repairs.
²) During repairs, an end play of 0.30 mm is permitted.

Diameter of Crankshaft Bearings with Bearing Shell Halves Fitted

Model	Standard	Overhaul Stages I	II	III	IV
180 a, 180 b, 180 c, 190, 190 b, 190 SL	69.99 / 70.02	69.74 / 69.77	69.49 / 69.52	69.24 / 69.27	68.99 / 69.02
220 a, 219, 220 S, 220 SE	59.99 / 60.02	59.74 / 59.77	59.49 / 59.52	59.24 / 59.27	58.99 / 59.02

Base Bore in Crankcase

Model	180, 180 b, 180 c, 190, 190 b, 190 SL	220 a, 219, 220 S, 220 SE
Housing bore	74.000–74.019	67.000–67.019
Perm. out-of-round of base bore	0.01	
Perm. conicity of base bore	0.01	
Crush of bearing shell halves	+ 0.01	

Thickness of Check Plates on Locating Bearing

Model	Standard	Overhaul Stages I	II	III	IV	V	VI	VII
180 a, 180 b, 190, 190 b, 190 SL	1.980 / 1.965	2.030 / 2.015	2.080 / 2.065	2.130 / 2.115	2.180 / 2.165	2.230 / 2.215	2.280 / 2.265	2.330 / 2.315
220 a, 219, 220 S, 220 SE	2.980 / 2.965	3.030 / 3.015	3.080 / 3.065	3.130 / 3.115	3.180 / 3.165	3.230 / 3.215	3.280 / 3.265	3.330 / 3.315

To fix crankshaft in axial direction the engines were provided with a shouldered locating bearing, as well as with check plates. The check plates are fastened to the second crankshaft bearing cap on both sides with heavy dowel pins (Fig. 03–5/1).

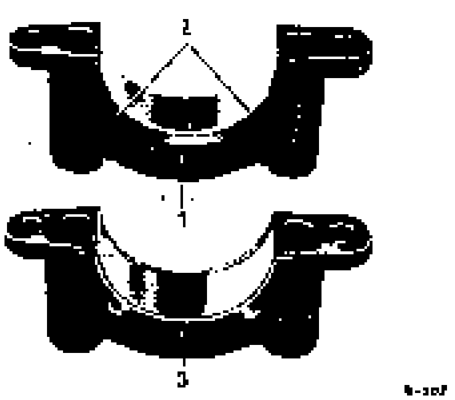


Fig. 03–5/1

1 Crankshaft bearing cap 2 Heavy dowel pin 3 Check plates

Here, the heavy dowel pins may not project more than 1.5 mm from the hole. They should be sufficiently withdrawn with regard to the check plate that any contact with the crankshaft is made impossible.

When repairs are made, and the crankshaft bearings are replaced, the former, and now still partially used check plates are replaced on all our engines by a shouldered locating bearing in the cylinder crankcase (upper bearing shell half) and in part also in the crankshaft bearing cap (lower bearing shell half). For the overhaul stages these shouldered bearings – bearing shell halves also as to width – are supplied in oversizes for refinishing to the specified end play.

C. Reconditioning and Re-bushing of Connecting Rods

This work for models 180 a, 180 b, 180 c, 190 SL, 220 a, 219, 220 S and 220 SE is the same as for model 190.

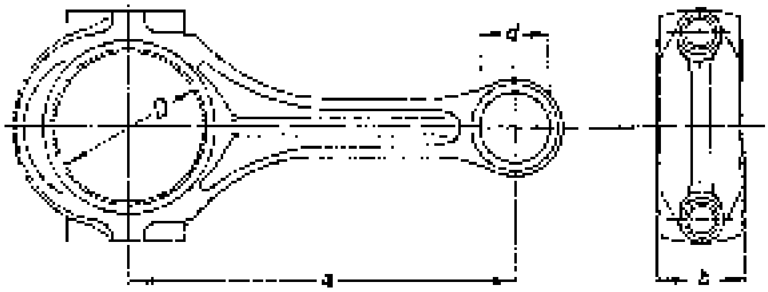


Fig. 03–5/3

Bearing Play Values For Connecting Rod

Model	Radial Play¹)	End Play	
		when new	after repairs
180 a, 180 b, 180 c, 190, 190 b, 190 SL	0.045–0.060	0.120–0.259	up to 0.5
220 a, 219, 220 S, 220 SE	0.045–0.060	0.110–0.227	

¹) The stated radial play with new engines is produced by proper selection of crankshaft and bearing shells, trying for a bearing play of 0.05 mm. When repairing, this radial play should by all means be adhered to.

Diameter of Conrod Bearings with inserted Bearing Shell Halves Fitted

Model	Standard	Overhaul Stages			
		I	II	III	IV
180 a, 180 b, 180 c, 190, 190 b, 190 SL	51.99 / 52.02	51.74 / 51.77	51.49 / 51.52	51.24 / 51.27	50.99 / 51.02
220 a, 219, 220 S, 220 SE	47.99 / 48.02	47.74 / 47.77	47.49 / 47.52	47.24 / 47.27	46.99 / 47.02

Dimensions of Connecting Rod

Model		180 a, 180 b, 180 c, 190, 190 b, 190 SL	220 a and 219, 220 S 1st Version	219, 220 S 2nd Version and 220 SE
Base bore D		55.600 / 55.619	54.000 / 54.019	
Base bore d¹)	Standard Size	28.000 / 28.021	25.000 / 25.021	27.000 / 27.021
	Overhaul Stage	28.500 / 28.521	25.500 / 25.521	27.500 / 27.521
Perm. out-of roundness of base bore		0.01		
Perm. conicity of base bore		0.01		
Crush of bearing shell halves		≈ 0.03		
Distance "a" from center of bore to center of bore²)		153.95 / 154.05	134.95 / 135.05	
Width of connecting rod "b"		31.880 / 31.941	29.890 / 29.857	
Perm. difference in weight between connecting rod assemblies in any one engine		5 g		
Perm. departure from axial parallelity for a length of 100 mm		0.03		
Perm. longitudinal distortion for a length of 100 mm		0.1		

¹) The base bore "d" for models 190 c and 190 SL as from engine No. 121928003001 = 29.000–29.021 mm.
²) Distance a for models 190 c and 190 SL as from engine No. 121 928003001 = 148.95–149.05 mm.

Dimensions of Piston Pin Bushing

Model	O. D.		I. D.	
	Standard Size	Overhaul Stage	Rough-turning Dimensions	Final Dimensions¹)
180 a, 180 b, 190, 190 b, 190 SL	28.048 / 28.035	28.548 / 28.535	24.500 / 24.552	25.007 / 25.013
180 c, 190 SL²)	29.108 / 29.070	29.608 / 29.570	25.735 / 25.633	26.012 / 26.018
220 and 219, 220 S 1st Version	25.046 / 25.035	25.540 / 25.535	21.500 / 21.552	22.007 / 22.013
219, 220 S 2nd Version	27.048 / 27.035	27.548 / 27.535	21.500 / 21.552	22.007 / 22.013
220 SE	27.048 / 27.035	27.548 / 27.535	23.500 / 23.552	24.007 / 24.013

¹) Tolerance subdivisions of final-turned piston pin bushing, refer to page 03-5/7
²) 190 SL as from engine design 121.928

For model 220 SE the connecting rod eyes are larger and the I. D. and O. D. of the pressed-in bushings are 2 mm larger. For reasons of standardization models 219 and 220 S are now also provided with heavier connecting rods, with the O. D. of the bushings also increased by 2 mm, while the I. D. remains the same.

D. Fitting Pistons, together with Rings, into Cylinders

This work is for models 180 a, 180 b, 190 c, 190 SL, 220 a, 219, 220 S and 220 SE the same as for model 190.

Similar to model 190, models 190 SL, 220 a, 219, 220 S and 220 SE are provided with full-skirt autothermic pistons (so-called slipper pistons) with extended skirt. Models 180 a and 180 b on the other hand have full-skirt autothermic pistons without extended skirt (Fig. 03-5/4).

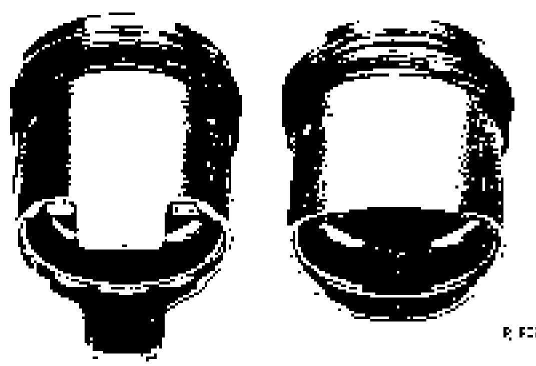


Fig. 03-5/4

Piston for models 180 c, 190, 190 b, 190 SL, 220 a, 219, 220 S and 220 SE — Piston for models 180 a and 180 b

Pistons Available for Overhaul Stages

Model	Piston Dia				
	Standard	Intermediate Stage	I. Overhaul Stage	II. Overhaul Stage	III. Overhaul Stage
180 a, 180 b, 180 c, 190 b, 190 SL	84.96–84.98	85.21–85.23	85.46–85.48	85.96–85.98	86.46–86.48
220 a, 219, 220 S, 220 SE	79.96–79.98	80.21–80.23	80.46–80.48	80.96–80.98	81.46–81.48

Piston Ring with Gap and Groove Clearance

<table>
<tr><th colspan="2">Piston Rings</th><th>180 a, 180 b</th><th>180 c, 190, 190 b
190 SL</th><th colspan="2">220 a, 219, 220 S</th><th>220 SE</th></tr>
<tr><td colspan="2">Groove I</td><td colspan="2">Compression ring
10 F 85/77.6 × 2 Cr S
001 037 30 16</td><td colspan="2">Compression ring[1]
10 F 80/73 × 2 Cr S
001 037 57 16</td><td>Compression ring
10 F 80/73 × 2 Cr S
001 037 57 16</td></tr>
<tr><td colspan="2">Groove II</td><td colspan="2">Tapered compr. ring
11 F 85/77.6 × 2.5
001 037 43 16</td><td colspan="2">Tapered compr. ring
11 F 80/73 × 2.5
KE 54 N 277</td><td>Tapered compr. ring
11 F 80/73 × 2.5
KE 54 N 277</td></tr>
<tr><td colspan="2" rowspan="2">Groove III</td><td rowspan="2">Stepped oil control ring
30 F 85/77.6 × 3
KE 54 N 273</td><td colspan="3">Novix stepped ring with F 3 S expander</td><td rowspan="2">Tapered compr. ring
15 80/73 × 3
KE 54 N 277</td></tr>
<tr><td>85 × 3 T – 16
Nova
000 037 00 17</td><td colspan="2">80 × 3 T – 16 Nova[2]
000 037 10 17</td></tr>
<tr><td colspan="2" rowspan="2">Groove IV</td><td colspan="4">Novix slotted ring with F 5 S expander</td><td rowspan="2">Wide channel oil control ring with Goetze expander spring
80/73.4 × 5
001 037 79 18</td></tr>
<tr><td colspan="2">85 × 5 T – 17 Nova
000 037 27 16</td><td colspan="2">85 × 5 T – 17 Nova
000 037 30 18</td></tr>
<tr><td rowspan="4">Gap</td><td>Groove I</td><td colspan="2">0.55–0.70</td><td colspan="2">0.55–0.70</td><td>0.55–0.70</td></tr>
<tr><td>Groove II</td><td colspan="2">0.45–0.60</td><td colspan="2" rowspan="2">0.30–0.45</td><td rowspan="2">0.30–0.45</td></tr>
<tr><td>Groove III</td><td colspan="2">0.30–0.45</td></tr>
<tr><td>Groove IV</td><td colspan="2">0.25–0.40</td><td colspan="2">0.25–0.40</td><td>0.25–0.40</td></tr>
<tr><td rowspan="4">Groove clearance</td><td>Groove I</td><td colspan="2" rowspan="4">0.035–0.062</td><td rowspan="4">Mahle
0.035–0.052</td><td rowspan="3">Nüral
0.030–0.057</td><td rowspan="2">0.045–0.072</td></tr>
<tr><td>Groove II</td></tr>
<tr><td>Groove III</td><td>0.035–0.062</td></tr>
<tr><td>Groove IV</td><td>0.035–0.062</td><td>0.045–0.072</td></tr>
</table>

[1] Height of compression ring of former Mahle piston 2.5 mm.
[2] Height of stepped ring of former Nüral piston 3.5 mm.

Note: The designations of pistons and piston rings refer to the standard size, while the gap and groove clearances of the rings apply to all overhaul stages.

To maintain piston pin clearance or overlap, pistons and piston pins having the same color code should be used.

Color Code for Associated Piston Pins and Pistons

Pistons pins, connecting rods and pistons	Color code	Piston pin O.D.	Bore of piston pin bushing	Running	Bore in piston	
					Nüra	Mahle
180 a, 180 b, 190, 190 b, 190 SL	black	24.997 / 24.994	25.007 / 25.010	0.010–0.016	24.994 / 24.997	24.994 / 24.997
	white	25.000 / 24.997	25.010 / 25.013		24.997 / 25.000	24.997 / 25.000
180 c, 190 SL¹)	black	25.997 / 25.994	26.012 / 26.015	0.015–0.021	—	25.994 / 25.997
	white	26.000 / 25.997	26.015 / 26.018		—	25.997 / 26.000
220 a, 219, 220 S	black	21.997 / 21.994	22.007 / 22.010	0.010–0.016	21.994 / 21.997	21.992 / 21.995
	white	22.000 / 21.997	22.010 / 22.013		21.997 / 22.000	21.995 / 21.998
220 SE	black	23.997 / 23.994	24.007 / 24.010	0.010–0.016	—	23.992 / 23.995
	white	24.000 / 23.997	24.010 / 24.013		—	23.995 / 23.998

¹) 190 SL as from engine design 121.920.

E. Replacement of Starter Rim Gear

For models 180 a, 180 b, 180 c, 190 SL, 220 a, 219, 220 S and 220 SE with standard clutch and for models 219, 220 S and 220 SE with hydraulic-automatic clutch procedure is the same as for model 190. However, the flywheel for models 219, 220 S and 220 SE with hydraulic-automatic clutch is designed as a disk (Fig. 03–5/5). On this flywheel the ring gear is mounted to project uniformly on both sides. Then, the runout of clamping face B should be checked over a diameter of 200 mm. It should not exceed 0.05 mm.

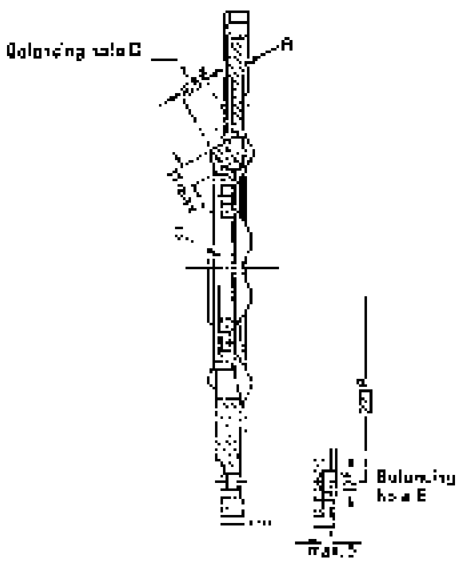


Fig. 03-5/5

Flywheel for hydraulic-automatic clutch

B = Clamping face for hydraulic-automatic clutch
C = Clamping face for crankshaft

Following attachment of a new ring gear on models 220 a, 219, and 220 S having a flywheel acc. to Fig. 03–5/7 the ring gear requires six thread holes for attachment of the clutch. First drill six holes of 6.7 mm dia. accurately centered with holes in flywheel, then chamfer and cut 8 mm threads (M 8).

F. Grinding of Clutch Face of Flywheel

For models 180 a, 180 b, 180 c, 190 SL and 220 a as well as for models 219, 220 S and 220 SE with standard clutch this procedure is the same as for model 190.

Fig. 03–5/6 shows the flywheel for model 190, 1st version and for model 190 SL, 2nd version. The 1st Version of model 190 SL differs from the 2nd version only by its attaching flange (refer to section H).

Fig. 03–5/7 shows the flywheel for models 220 a and 219, 220 S, 1st version.

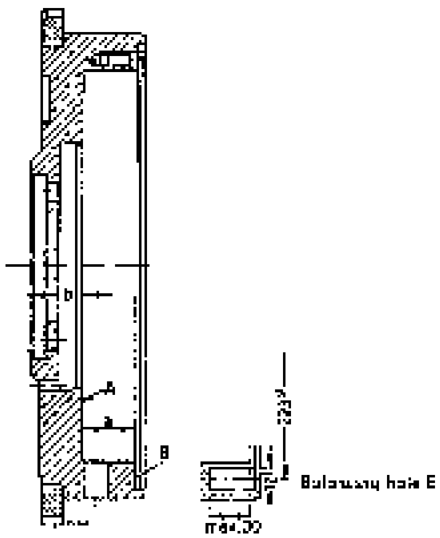


Fig. 03–5/6

190 1st version
190 SL 2nd version
as from engine end No. 65 00795

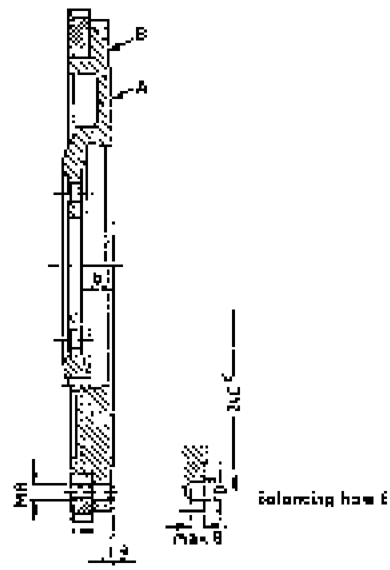


Fig. 03–5/7

220 a as well as 219
and 220 S, 1st version

A = Clutch Face, B = Clutch fixing surface

When grinding or finish-turning the clutch face A, surface B must be remachined by the same amount.

With model 180 c and models 219, 220 S with a compression ratio ε = 8.7:1 the flywheels were standardized as to their shape (Fig. 03–5/8). This type of flywheel is also provided with a fitted recess for perfect centering of the clutch. In addition, the front flange side is provided with "humps" for balancing the flywheel.

The flywheel for model 220 SE is similar in shape, though its dimensions are larger (Fig. 03–5/9).

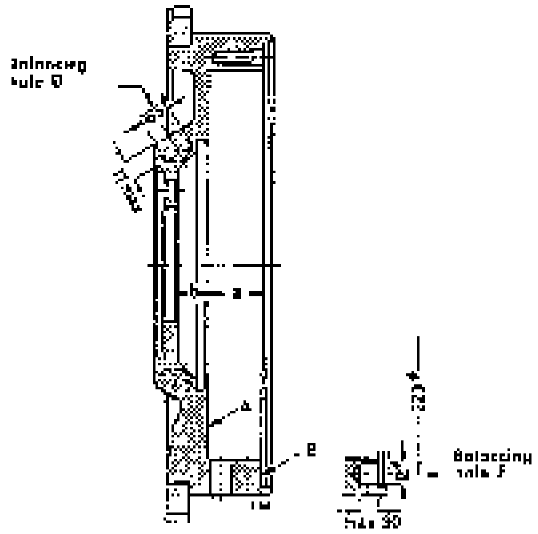


Fig. 03-5/8

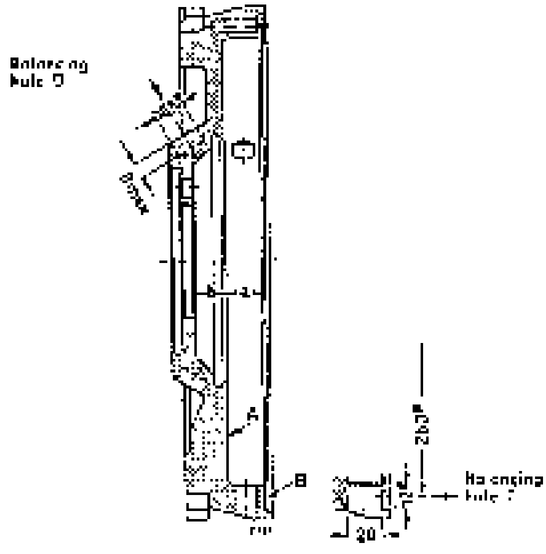


Fig. 03-5/9

220 SE (Injection engine)

180 a, 180 b, 190 b	as from 1st engine
190	2nd Version as from Engine End No. 75 13562
190 SL	3rd Version as from Engine End No. 75 01363
219	2nd Version as from Engine End No. 75 04073
220 S	2nd Version as from Engine End No. 75 08467

A = Clutch face, B = Clutch fixing surface

When the clutch face A is reground or finish-turned, the surface B must be re-machined by the same amount.

On models with hydraulic automatic clutch the flywheel carries the ring gear and has the primary member of the hydraulic clutch attached to it (see Fig. 03-5/5). On these models the mechanical clutch is attached to the drive plate.

Dimensions for Re-Machining Flywheel

Model		190 SL 1st Version	180 a, 180 b, 190, 190 b and 190 SL 2nd, 3rd V.	220 a and 219, 220 S 1st V.	219, 220 S 2nd V.	220 SE
Distance "a" between clutch face and clutch fixing surface (see Figs. 03-5/6 to 03-5/9).		29±0.1	29±0.1	0.2—0.3	29±0.1	19.4±0.1
Distance "b" between clutch face and flywheel attaching flange (see Figs. 03-5/6 to 03-5/9).	new	18	12.5	16	16	16
	after repairs up to	17	11.5	15	15	15
Permissible lateral deflection of fitted flywheel				0.05		

G. Dynamic Balancing of Crankshaft with Counterweight and Flywheel

For Models 180 a, 180 b, 190 SL, 220 a, 219, 220 S and 220 SE the dynamic balancing procedure is the same as for Model 190. The crankshaft is balanced together with the mounted counterweight and the flywheel. A maximum unbalance of 15 cmg is permissible.

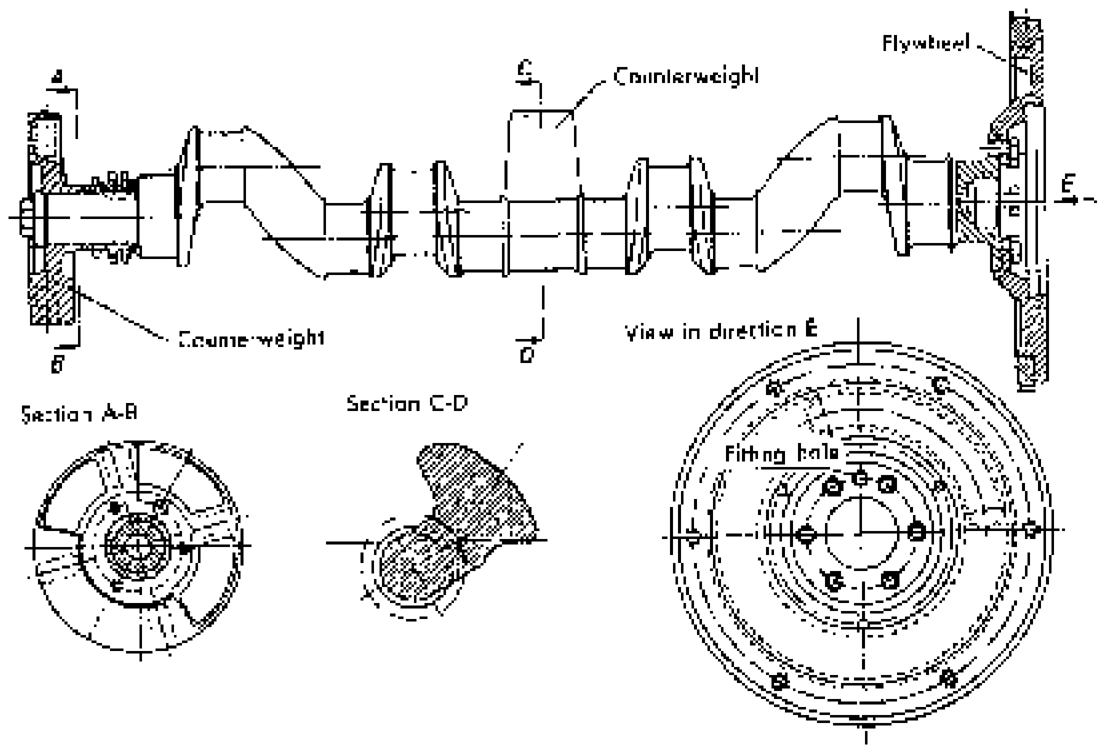


Fig. 03-5/10
Crankshaft for Model 220 a and Models 219 and 220 S with flywheel 1st version

1. Drill the balancing holes at the circumference on the front counterweight of the crankshaft in a radial direction using a 14 mm ⌀ drill (Fig. 03-5/10). The maximum bore depth is 30 mm.

2. If an abnormal degree of unbalance of the crankshaft is found in cars of Models 220 a, 219, 220 S and 220 SE, it is permissible under certain circumstances to drill balancing holes also into the center counterweight using a 14 mm ⌀ drill and not exceeding a depth of 35 mm.

3. The dimensions of the balancing holes on the flywheel are listed in the table below. See also Figs. 03-5/5 to 03-5/9. If two holes have to be drilled side by side, the distance between bore hole centers should be 22 mm.

Note: To facilitate production the flywheels of the design used today have "humps" on the engine side into which the balancing holes are drilled at an angle of 30° (Figs. 03-5/5, 03-5/8, and 03-5/9). This can only be done on a special drilling machine and in repair shop work the balancing holes must be drilled as described above.

Balancing Holes for Flywheels

Model	Hole circle diameter for balancing hole E	Drill diameter	Maximum bore depth
180 a, 180 b, 190, 190 b, 190 SL	223	12	30
220 a as well as 219 and 220 S 1st Version	240	16	8
219 and 220 S 2nd Version	223	12	30
219 and 220 S with hydraulic automatic clutch	223	12	5
220 SE	250	12	20

H. Static Balancing of New Flywheel

For Models 180 c, 180 b, 190 SL, 220 a, 219, 220 S and 220 SE the static balancing procedure for the flywheels is the same as for Model 190.

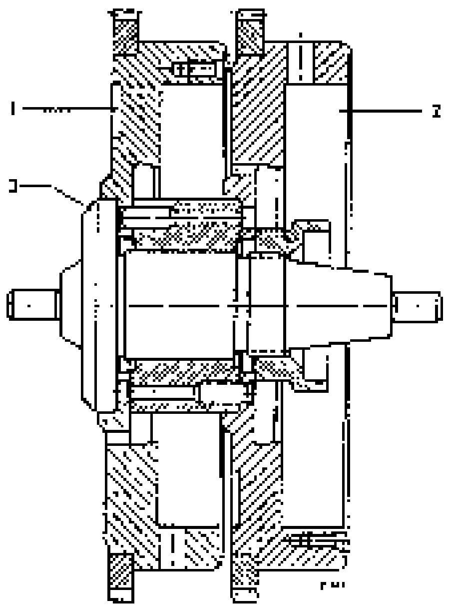


Fig. 03-5/11

1 Old flywheel
2 New flywheel
3 Arbor Fixture 180 589 00 27

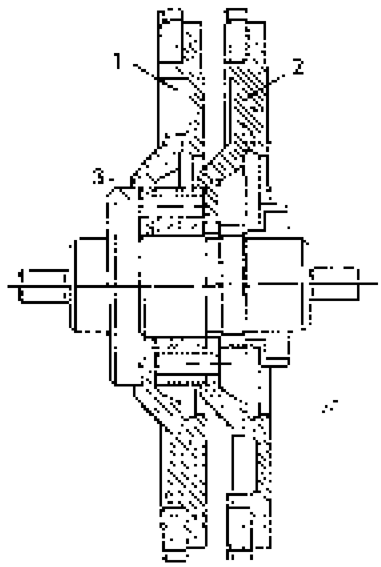


Fig. 03-5/12

1 Old flywheel
2 New flywheel
3 Arbor Fixture 187 589 02 27

Use Arbor Fixture 180 589 00 27 (Fig. 03-5/11) for the static balancing of flywheels in Models 180 a, 180 b, 190 SL as well as Models 219, 220 S 2nd version and 220 SE; for the flywheels of Model 220 a as well as Models 219, 220 S 1st version and 219 and 220 S with hydraulic automatic clutch use Arbor Fixture 187 589 02 27 (Fig. 03-5/12).

The 2nd version flywheel can be installed subsequently on Model 220 a as well as on Models 219 and 220 S with the 1st version flywheel, if the clutch is replaced (without drive plate). However, the 2nd version flywheel must be statically balanced with the 1st version flywheel which has been removed.

The early engines of Model 190 SL have a flywheel with a recess of 75 mm diameter and a bolt hole circle of 56 mm diameter. Because of its smaller recess and bolt hole circle, this flywheel cannot be replaced by a 2nd or 3rd version flywheel when repairs are carried out; it can only be replaced by another 1st version flywheel. Make a suitable arbor fixture for balancing the new flywheel.

Note: For Model 190 SL only crankshafts with a recess of 98 mm diameter and a bolt hole circle of 78 mm diameter, together with a counterweight and a 3rd version flywheel are supplied as replacement parts.

I. Repair of Vibration Damper

Models 220 a, 219, 220 S and 220 SE

For removal, disassembly, reassembly and installation procedures see Job No. 03-4, Section N, II.

1. After disassembling the vibration damper, check all parts for wear.
   The shear blocks (7) should always be replaced if they have been in use for some time. Scored or cracked contact disks (4) should also be replaced.

2. Check the pressure springs (6) according to the table below.

3. Carefully smooth down the friction surfaces of the flywheel rings (5), the counterweight (2) and the pulley (8) using emery cloth No. 50. If the friction surfaces are badly worn, the affected part must be replaced.

4. If the contact ring (9) shows spot-like scorings which are due to rapid oscillating movements of the flywheel rings (5) the pulley with the mounted contact ring must be replaced.

External diameter mm	Wire gage mm	Free length mm	Length mm	Under load kg
17.5	3.5	27.3	19	20±1.5

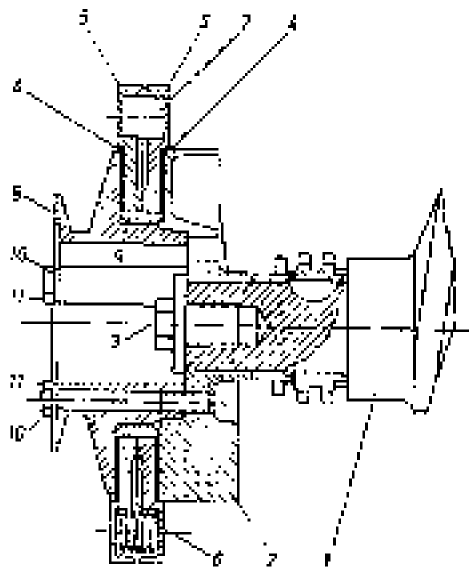


Fig. 03-5/13

1 Crankshaft
2 Front counterweight
3 Shoulder screw
4 Contact disk
5 Flywheel ring
6 Pressure spring
7 Shear block
8 Pulley
9 Contact ring
10 Spring washer
11 Fixing screw

Engine Timing

Change: Model 180 c and chain tensioner 3rd and 4th version added.

A. Testing and Grinding Valves

This procedure is for models 180 a, 180 b, 180 c, 190 b, 190 SL, 220 a, 219, 220 S and 220 SE the same as for model 190.

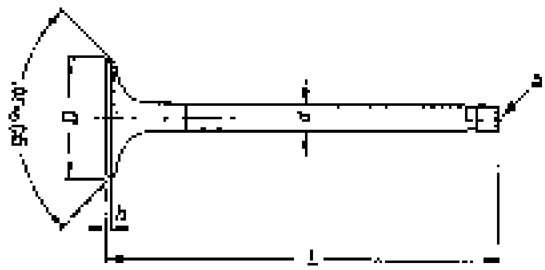


Fig. 05–5/1

Dimensions of Valves

Model	Valve head dia. D	Stem dia. d	Length L	Height "h" of valve head[1] when new	Height "h" of valve head[1] machining limit	Valve seat angle	Hardness at valve stem tip a
Inlet Valve							
180 a, 180 b, 180 c 190, 190 b 190 SL	44.2 / 44.1	8.970 / 8.940	128	1.5	1	90° ± 30'	HRc 55
220 a, 219 220 S, 220 SE	39.2 / 39.1						
Exhaust Valve							
180 a, 180 b, 180 c[1]) 190, 190 b[1])	37.2 / 37.1		112.75	2.25			HRc 55
190 SL[2])	37.25 / 36.95		112.70	2.35–2.55			HRc 50
220 a 219 (ε = 7.6:1)	35.2 / 35.1	9.950 / 9.928	112.75	2.25	1.5	90° ± 30'	HRc 50
219[3]) 220 S 220 SE[2])	35.25 / 34.95		112.70	2.35–2.55			HRc 50

[1]) Refer also to Fig. 05–5/2 and 05–5/3. [2]) Sodium-cooled [3]) At a compression ratio ε = 8.7:1.

Note: Permissible run-out between valve stem and valve cone max. 0.03 mm.

Inlet valve

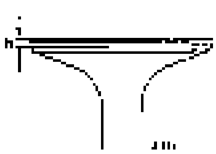


Fig. 05–5/2

Exhaust valve

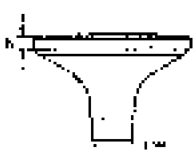


Fig. 05–5/3

Sodium cooled exhaust valves (Fig. 05–5/3) have been installed as standard parts on model 190 SL as from engine end No. 6502311, on model 219 as from engine end No. 7504348, and on 220 S and 220 SE as from 1st engine.

Observe safety regulations when scrapping sodium-cooled valves (refer to Job No. 01–4, Section C).

B. Testing Valve Springs

The inner and outer valve springs of models 180 a, 180 b, 180 c, 190 b, 190 SL, 220 a, 219, 220 S and 220 SE are the same as for model 190.

The wear limit for the final load given in the table is 10 %.

Testing Table for Valve Springs

Model 180 a, 180 b, 180 c, 190, 190 b, 190 SL, 220 a, 219, 220 S and 220 SE

	External Diameter mm	Wire gage mm	Free length mm	Length load depressed mm	kg	Length under final load mm	kg
Inner spring	20.7	2.6	42	34.2	8.9	25.7	18.6^{+1}_{-1}
Outer spring	30.5	4	47	36.4	23.1	29.9	$45.9^{+4.5}_{-2.2}$

C. Sealing Valve Stem

The valve stem sealing system for models 180 a, 180 b, 190 b, 190 SL, 220 a, 219 and 220 S is the same as for model 190.

While on model 220 SE the valve stem seal for the exhaust valves are also similar, the inlet valves are sealed with a silicone sealing ring (4), which is held against the valve guide by means of the sealing ring retainer (3) and the inner valve spring (4). (Fig. 05–5/4).

Hardened or cracked silicone sealing rings should be replaced. The same applies for sealings rings which have been compressed too hard. When new, the distance between the sealing ring retainer (3) and the washer (2) should be approx. 1 mm.

For models 180 c and 190 SL with further modified valve timing, refer to valve sealing Fig. 01–4/20 c and d.

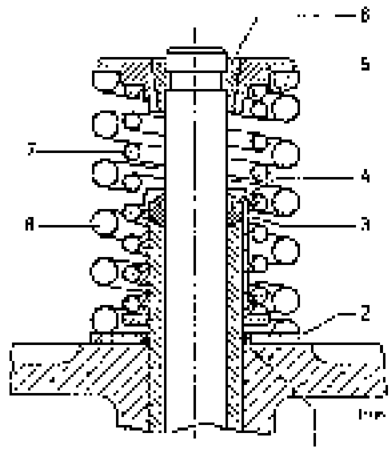


Fig. 05–5/4

Valve Stem Sealing at Inlet Valve Model 220 SE

1 Snap ring
2 Washer
3 Sealing ring retainer
4 Sealing ring (silicone)
5 Valve spring retainer
6 Valve cone half
7 Inner valve spring
8 Outer valve spring

D. Grinding of Camshaft

For models 180 a, 180 b, 180 c, 190 b, 190 SL, 220 a, 219, 220 S and 220 SE regrinding of the camshaft is similar to model 190. Four-cylinder engines have a camshaft with three bearing surfaces, 6-cylinder engines have four.

When regrinding the 1st bearing journal only a max. of 0.1 mm may be ground off the end thrust surface of shoulder "b" (Fig. 05–5/5). The same amount as ground off at shoulder "b" should be ground off at surface "a", so that the dimension 34 H 8 (34.000 to 34.039 mm) is definitely maintained. Otherwise the end play of the camshaft and with it the deviation from the sprocket wheel alignment is too large. Lateral deflection at surface "c" should not exceed 0.01 mm.

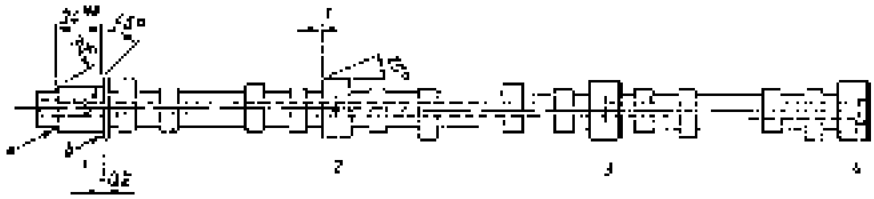


Fig. 05–5/5

Camshaft of a 6-cylinder engine

Prior to regrinding the camshaft of model 220 a, 219, 220 S and 220 SE the cover (2) which seals the oil passage, should be removed and the oil transfer tube (1) should be pulled out of the camshaft (Fig. 05–5/6).
Following the grinding of the camshaft the oil holes should be cleaned well and blown-out. Then, if previously removed, the oil transfer tube is returned into the oil passage and the aperture at the rear end of the camshaft is closed with a new sealing cover.

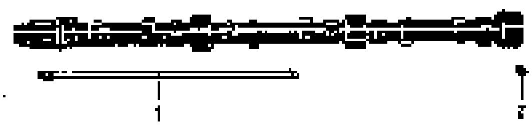


Fig. 05–5/6

1 Oil transfer tube 2 Sealing cover

Bearing Play of Camshaft

Models 180 a, 180 b, 180 c, 190, 190 b, 190 SL, 220 a, 219, 220 S and 220 SE

Radial play	End play
0.025–0.045	0.050–0.129

Grinding Dimensions of Camshaft and Camshaft Bearing Measurements

Model	Overhaul Stage	1st Bearing		2nd Bearing		3rd Bearing	
		Shaft	Bearing	Shaft	Bearing	Shaft	Bearing
180 a 180 b 190 SL	Standard size	34.975 / 34.959	35.000 / 35.016	44.975 / 44.959	45.000 / 45.016	45.975 / 45.959	46.000 / 46.016
	Intermediate Stage	34.875 / 34.859	34.900 / 34.916	44.875 / 44.859	44.900 / 44.916	45.875 / 45.859	45.900 / 45.916
	1st Overhaul Stage	34.725 / 34.709	34.750 / 34.766	44.725 / 44.709	44.750 / 44.766	45.725 / 45.709	45.750 / 45.766
		1st Bearing		2nd and 3rd Bearing		4th Bearing	
220 a 219 220 S 220 SE	Standard size	34.975 / 34.959	35.000 / 35.016	44.975 / 44.959	45.000 / 45.016	45.975 / 45.959	46.000 / 46.016
	Intermediate Stage	34.875 / 34.859	34.900 / 34.916	44.875 / 44.859	44.900 / 44.916	45.875 / 45.859	45.900 / 45.916
	1st Overhaul Stage	34.725 / 34.709	34.750 / 34.766	44.725 / 44.709	44.750 / 44.766	45.725 / 45.709	45.750 / 45.766

For Model 180 c, 190 c and 190 SL with further modified valve timing the 2nd and 3rd camshaft bearing have the same diameter (refer to following table). The 1st bearing has the same dia. as above.

180 c, 190 c 190 SL		Standard Size	Intermediate Stage	1st Overhaul Stage
Diameter	of shaft	48.975 / 48.959	48.875 / 48.859	48.725 / 48.709
	of bearing	49.000 / 49.016	48.900 / 48.916	48.750 / 48.766

The Brinell Hardness HB or scleroscope hardness of bearing journals, cam base circle, cam nose and lifting flank are for models 180 a, 180 b, 180 c, 190 b, 190 SL, 220 a, 219, 220 S and 220 SE the same as for models 190.

	Brinell hardness HB in kg/mm²	Scleroscope hardness
Bearing journal and cam base circle	217–248	36–40
Cam nose and lifting flank	minimum 500	minimum 64

E. Re-Bedding of Camshaft

New camshaft bearing should be installed only with cylinder head in position, screwed-down with the prescribed tightening torque. The work can also be done easily with the engine mounted in vehicle. Procedure for models 180 a, 180 b, 180 c, 190 b, 190 SL, 220 a, 219, 220 S and 220 SE is the same as for model 190.

F. Testing of Chain Tensioner

Testing of the chain tensioner for models 180 a, 180 b, 180 c, 190 b, 190 SL, 220 a, 219, 220 S and 220 SE is the same as for model 190. Figs. 05–5/7 to 05–5/8 show the 1st, 2nd, 3rd and 4th version; the table below shows which version was installed for the individual models.

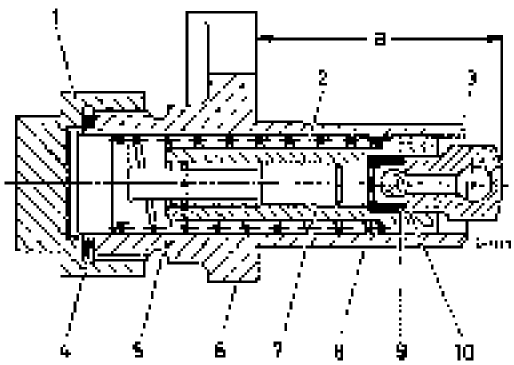


Fig. 05–5/7

1st Version

1 Cover cap
2 Pressure pin
3 Head
4 Sealing ring
5 Dowel pin
6 Chain tensioner housing
7 Pressure sleeve
8 Pressure spring
9 Ball retainer
10 Steel ball

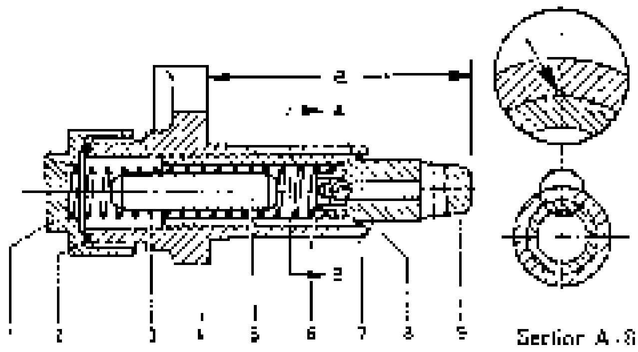


Fig. 05–5/8

2nd Version

1 Cap nut
2 Sealing ring
3 Pressure spring
4 Housing
5 Pin
6 Ball
7 Snap ring
8 Box
9 Pressure pin

Chain Tensioner 1st Version

Model	Part No.	Dimension "a" with disassembled chain tensioner
180 a 190 190 SL	121 050 03 11	58
220 a 219 220 S	180 050 03 11	52

Chain Tensioner 2nd Version

Model	Part No.	Dimension "a" with disassembled chain tensioner
180 a, 180 b 190, 190 b 190 SL	621 050 00 11	58
219 220 S 220 SE	180 050 05 11	52

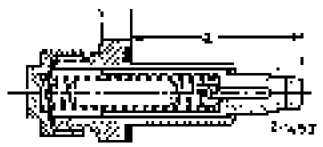


Fig. 05–5/8

3rd Version

1) The chain tensioner 3rd version is functionally similar to the 2nd version, however, the chain tensioner housing is provided with an annular groove and the seal between the chain tensioner and the cylinder crankcase is a rubber ring, which eliminates the former sealing shim (flange seal).

2) The chain tensioner 4th version (for 4-cyl. engines with further modified valve timing) differs from the 3rd version only by the stronger pressure spring. This chain tensioner is identified by a red dot on the cap nut.

Chain Tensioner 3rd Version

Model	Installed as from Engine End No.	Part No.	Dimension "a" with disassembled chain tensioner (refer to illustration)
180 b	017 323	121 050 04 11	58
190 b	015 336		
190 SL	018 423		
220 SE CA and CpA	001 059 000 240	180 050 06 11	52

Chain Tensioner 4th Version

Model	Installed as from Engine End No.	Part No.	Dimension "a"
180 c	000 013	121 050 05 11	59
190 c	000 341		
190 SL	000 027		

Pressure Spring for Chain Tensioner

Model	Pressure spring Part No.	External Diameter	Wire gage	Free Length	Length under load: depressed mm.	depressed kg	under final load mm.	under final load kg
180 a1), 190 2), 190 SL3)	121 993 02 01	15.6	1.1	118	44	1.85	38	1.9–2.05
180 a4), 190 5), 190 SL6), 180 b, 190 b, 219 7), 220 S 8), 220 b, 220 Sb, 220 SE, 220 SEb	621 993 06 01	11.5	1.0	124	50	1.85	44	1.9–2.05
180 c, 190 c, 190 SL11)	621 993 02 01	11.3	1.3	93	50	4.2	44	4.5–5.3
219 9), 220 S 10)	180 993 05 01	15.4	1.0	200	45	1.55	39	1.65–1.7

1) Installed on 180a up to engine end No. 8503800.
2) Installed on 190 up to engine end No. 5503700.
3) Installed on 190 SL up to engine end No. 5503980.
4) Installed on 180a as from engine end No. 8503801.
5) Installed on 190 as from engine end No. 5503701.
6) Installed on 190 SL as from engine end No. 5503981.
7) Installed on 219 as from engine end No. 8510851.
8) Installed on 220 S as from engine end No. 6522593.
9) Installed on 219 up to engine end No. 8510850.
10) Installed on 220 S up to engine end No. 6522592.
11) with further modified valve timing

1st Version

Disassembly and reassembly of chain tensioner is the same as for the 1st version of model 190 (refer to Workshop Manual Model 190).

2nd, 3rd and 4th Version

Disassembly:

1. Unscrew cap nut (1) (Fig. 05–5/8).
2. Remove pressure spring (3), pin (5) ball retainer (6), ball (8) and pressure pin (9) from housing (4).
3. Clean all parts thoroughly and check for wear, replace if required. The radial play of the pressure pin (9) in housing (4) is 0.05–0.06 mm.

Reassembly:

4. Place pressure pin (9) into housing (4). Insert ball (8), ball retainer (6) as well as spring (3) with pin (5) into pressure pin (9). Screw-on cap nut (1) with sealing ring (2) and tighten, making sure that pressure spring presses on cap nut.
5. Fill chain tensioner with oil, bleed and test.

G. Repair of Tension Sprocket and Tension Bearing

This procedure for models 180 a, 180 b, 180 c, 190 b, 190 SL, 220 a, 219, 220 S and 220 SE is the same as for model 190. Dimensions and tolerances of the individual parts are also the same.

Model 220 SE has an additional guide sprocket (7) which is supported in cylinder head (Fig. 05–5/9).

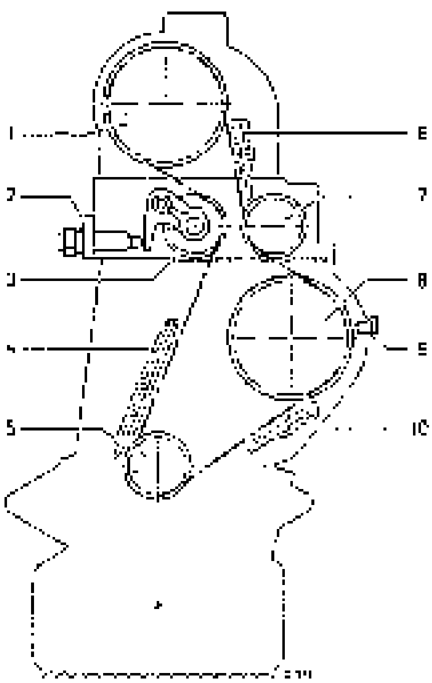


Fig. 05–5/9

Chain Drive for Model 220 SE

1 Camshaft timing gear
2 Chain tensioner
3 Tension sprocket
4 Long chain guide
5 Crankshaft timing gear
6 Short chain guide
7 Guide sprocket
8 Intermediate wheel
9 Lock screw
10 Short chain guide

To remove the pivot pin for the guide sprocket screw an M 8 screw into the threaded bore. If two spacer rings (4) are fitted, make sure when pulling the pivot pin out **that the spacer rings do not fall into the crankcase.**

Note: The spacer rings (4) are installed as standard parts only in the engines of Type 127.982 (Model 220 SEb) and Type 127.983 (Model 220 SE Convertible and Coupé with 120 HP).

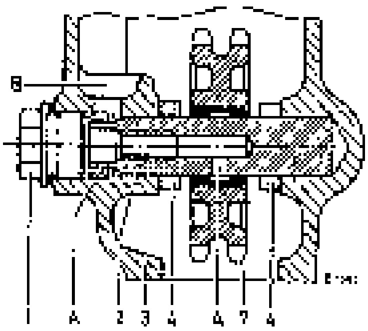


Fig. 05–5/10

1 Screw plug
2 Pivot pin
3 Cylinder head
4 Spacer ring
7 Guide sprocket
A Bores for lubrication of guide sprocket
B Oil pipe with oil bore

The following table contains the measurements necessary for checking the pivot pin and the bore in the guide sprocket.

Guide Sprocket

Model 220 SE

Diameter of pivot pin	Bore in guide sprocket	Radial play
15.984 / 15.973	16.000 / 16.018	0.016—0.045

If the bushing in the guide sprocket is worn, it should be pressed out and a new bushing with a rough-turned bore pressed in.

Before pressing in a new bushing, set up the guide sprocket in the bore and lightly re-finish the teeth at their circumference (permissible eccentricity 0.02 mm). After re-finishing the teeth, press in the new bushing and then again set up the guide sprocket, this time with a chuck adapter griping the circumference of the teeth and finish-turn the bore of the bushing (16.000 to 16.018 mm).

Maximum run-out of guide sprocket when set up on mandrel, measured at the circumference 0.02 mm.

Maximum eccentricity of guide sprocket, measured at the circumference 0.07 mm.

If the pivot pin shows signs of wear, it must be replaced.

H. Testing of Rocker Arm and Rocker Arm Mounting

For Models 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE this procedure as well as the dimensions and tolerances of the individual parts are the same as described for Model 190.
On earlier models the rocker arms were secured by sheet-metal spring clamps, whereas on recent models only spring steel wire clamps were fitted. When repairs are carried out, use only spring steel wire clamps Part No. 180 055 00 93. If the old rocker arm blocks are not being replaced, they must be provided with a notch to secure the spring clamp as shown in Fig. 05–5/11. The notch must correspond exactly to the dimensions given overleaf in order to ensure that the clamp is tensioned sufficiently and engages properly.

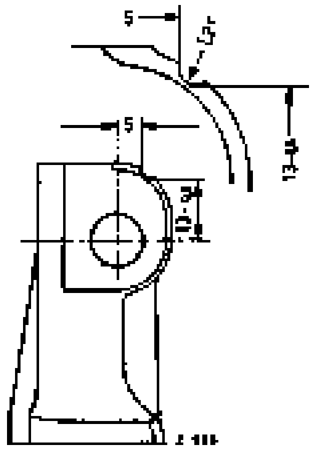


Fig. 05–5/11

Note: On Models 220 S and 220 SE the length of the rocker arm shafts is 153 mm for the 1st version and 159 mm for the 2nd version. The projecting ends of the 2nd version shafts prevent the spring clamps from jumping off the rocker arm shafts at high engine speeds. If complaints are received, the 1st version can be replaced without any modification by the 2nd version (Part No. 180 055 08 05) on Models 219, 220 S, and 220 SE.

Description of Carburetors

I. Downdraft Carburetor for Models 180, 180 a and 180 b

Models 180 and 180 a

A. General

Models 180 and 180 a are equipped with a Solex downdraft carburetor Type 32 PICB. This carburetor has a suction canal with a diameter of 32 mm and a central air entry. The starter mechanism, the idle system, the main carburetion system as well as the accelerating pump work essentially on the same principles as the double-downdraft carburetor (Fig. 07-0/1).

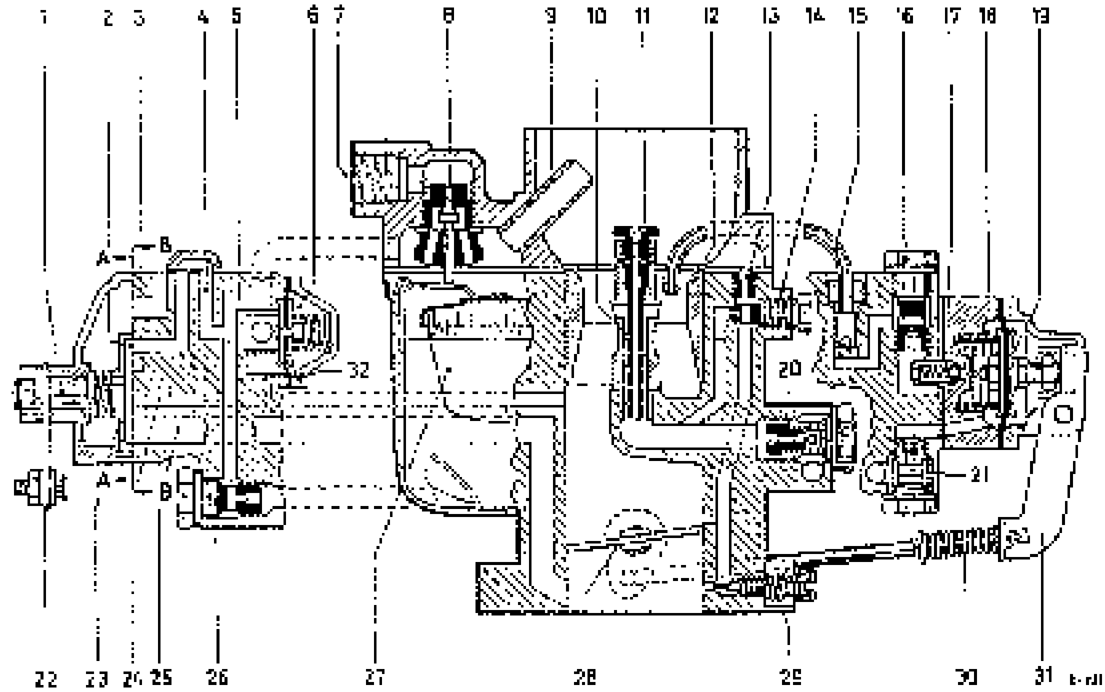


Fig. 07-0/1

Solex Carburetor Type 32 PICB

1 Starter rotary slide valve
2 Graded intake bore in starter flange for fuel canal (4)
3 Graded intake bore in starter flange for fuel jet (26)
4 Fuel canal to starter system
5 Air canal from starter air valve to fuel canal (4)
6 Starter air valve
7 Fuel-line connection in carburetor cover
8 Float needle valve
9 Vent tube for float chamber
10 Mixing tube holder with mixing tube
11 Air correction jet
12 Air horn
13 Idle air jet
14 Idle fuel jet
15 Injection tube
16 Pump jet
17 Ball valve
18 Diaphragm spring
19 Pump diaphragm
20 Main jet plug with main jet
21 Ball valve
22 Starter lever
23 Starter air bore in starter rotary slide valve
24 Additional air canal
25 Starter mixture canal
26 Starter fuel jet
27 Float
28 Throttle valve
29 Idle mixture adjustment screw
30 Connecting rod with pressure spring
31 Pump arm
32 Vacuum canal for starter air valve

B. Starter Mechanism

The starter mechanism of the carburetor works in two stages on the rotary slide valve principle. The starter mechanism is actuated by a bowden cable with a pull knob on the instrument panel. If the starter knob is pulled right out, the starter mechanism is set to the "cold-start position". If the starter knob is pressed in about halfway, the starter mechanism is set to the "warm-up position". If the starter knob is pressed in completely, the starter mechanism is out of operation.

Connecting the choke control is described in Job No. 30-6

a) Cold Start Position

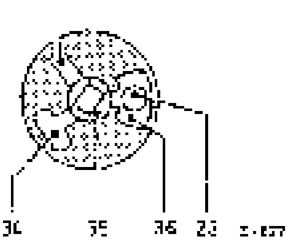
(Starter knob pulled right out)

In this position of the starter mechanism the bore (23) in the starter rotary slide valve is in the center of the starter mixture canal (25) in the starter flange of the carburetor housing.

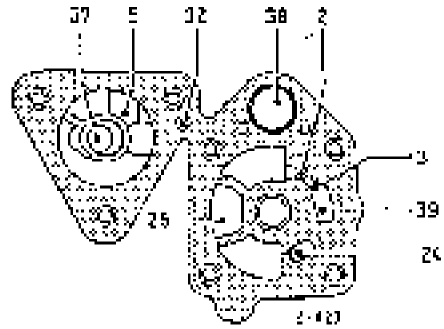
In the 1st phase of the cold start the partial vacuum obtaining in the suction tube exerts an influence on the starter system via the starter mixture canal (25) when the engine is being started. As a result fuel from the float chamber is drawn into the fuel canal (4) through the starter fuel jet (26). A certain amount of air enters at the same time through the notch in the carburetor cover which connects up with the float chamber; as a result a kind of pre-mixture is present in the fuel canal (4) leading to the starter rotary slide valve.

The notch is designed above all to prevent fuel from being drawn up by the siphon effect when the starter mechanism is inoperative and if the starter rotary slide valve should have a slight leak.

The pre-mixture enters the chamber (33) of the starter rotary slide valve through the graded bore (2) of the fuel canal (4) [Figs. 07-0/1 and 07-0/2].



Starter rotary slide valve



Starter flange of carburetor housing

Fig. 07-0/2

2 Graded bore of fuel canal (4)
4 Graded intake bore in starter flange for fuel jet (26)
5 Air canal from starter air valve to fuel canal (4)
23 Starter air bore in starter rotary slide valve
24 Additional air canal
25 Starter mixture canal
32 Vacuum canal for starter air valve
33 Chamber in starter rotary slide valve
34 Chamber in starter rotary slide valve
35 Mixing chamber in starter rotary slide valve
36 Cavity in starter rotary slide valve
37 Air canal from float chamber to starter air valve
38 Starter air valve
39 Fuel slot in starter flange

At the same time air is drawn from the suction canal of the carburetor via the canal (24) into the chamber (34) of the starter rotary slide valve. This additional air combines with the pre-mixture in the mixing chamber (35) of the starter rotary slide valve. From the mixing chamber this fuel-air mixture passes into the cavity (36) of the starter rotary slide valve. There it mixes with the air which comes via the starter air canal (38) through the starter air bore (23) in the starter rotary slide valve which acts as a starter air jet. Through the starter mixture canal (25) this mixture now passes into the suction canal of the carburetor where it combines with the air streaming through the throttle valve gap to produce the finished starting mixture. Fig. 07-0/3 shows the mode of action of the starter mechanism during the 1st phase when the engine is being started.

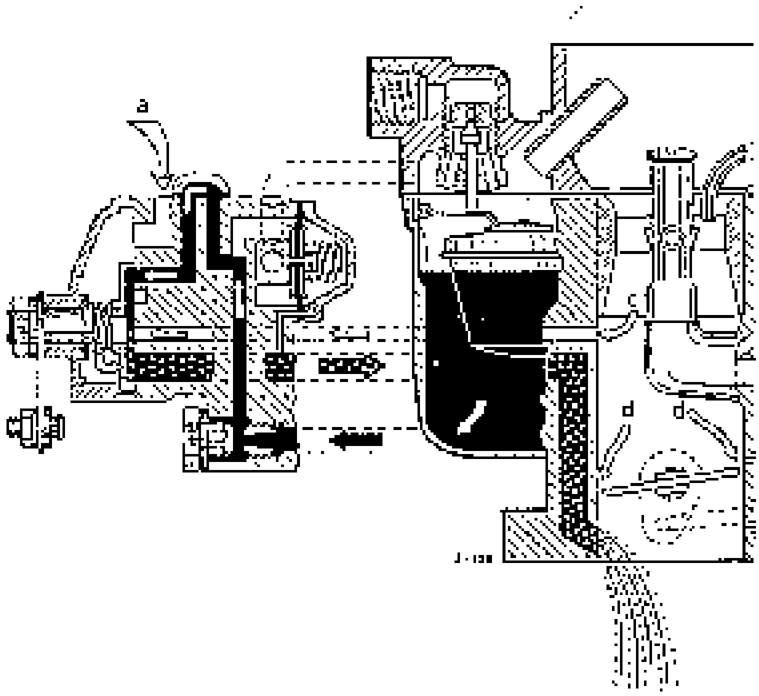


Fig. 07-0/3

Cold start — Phase 1
When starting the engine
(Starter air valve closed)

a) Starter air entry
c) Additional air entry from suction canal
d) Main air entering through throttle valve gap

As soon as the engine has started, the 2nd phase of the cold start begins. The increase in engine speed brings about an effective partial vacuum beneath the throttle valve. This partial vacuum exerts a pull on the spring-loaded side of the diaphragm of the starter air valve (6) via the vacuum canal (32) (see Fig. 07-0/4).

Due to the partial vacuum effect the starter air valve opens and admits more air to the starter system from the float chamber via the air canal (5) and the fuel canal (4). This additional air immediately leans out the starting mixture after the engine has started, thus ensuring the proper running conditions for the engine. Fig. 07-0/4 shows the mode action of the starter mechanism after the engine has started.

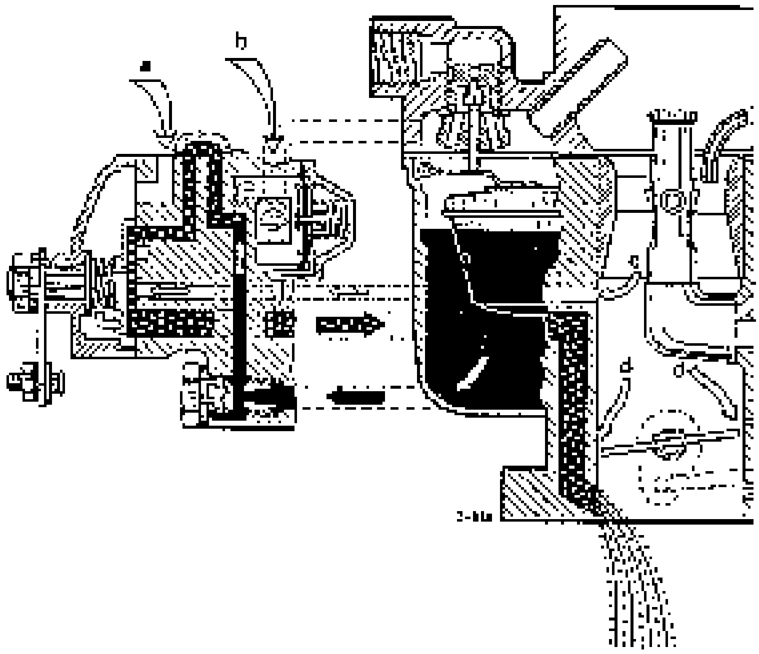


Fig. 07-0/4

Cold start — Phase 2
After the engine has started
(Starter air valve opened)

a) Starter air entry
b) Additional air entry via the starter air valve
c) Additional air entry from suction canal
d) Main air entering through throttle valve gap

b) Warm-Up Position

(Starter knob pushed halfway in)

As soon as the engine has warmed up a little, the starter knob can be pushed in halfway. As a result, the starter rotary slide valve is turned toward the right via the starter lever (22); the chamber (22) of the slide valve is now opposite the slot (39) of the starter flange (see Fig. 07-02). Since the chamber (33) is no longer connected with the fuel canal (4) by the bore (2), but only by the fine-graded bore (3), the amount of fuel admitted is greatly decreased and the start mixture is leaned out further. Fig. 07-0/5 shows the mode of action of the starter mechanism during warming-up.

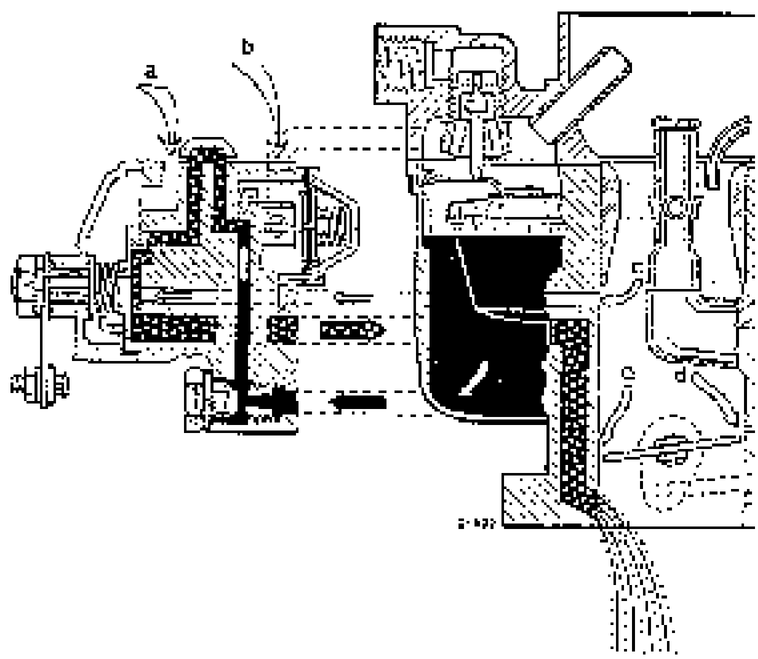


Fig. 07-0/5

Warm-up position
(Starter air valve open)

a) Starter air entry
b) Additional air entry via the starter air valve for attenuating the start mixture
c) Additional air entry from suction canal
d) Main air entering through throttle valve gap

c) Driving Away with Starter Knob Pulled Out

When the car is driven away with the starter knob pulled out, the partial vacuum in the suction canal is transferred upward by the opening of the throttle valve. As a result, the supply of start mixture from the canal (25) decreases. This is compensated for by the start mixture drawn in via the additional air canal (24) so that the supply of start mixture to the engine remains unaffected.

If as a result of quick acceleration from low engine speed the throttle valve is opened still further, the partial vacuum suddenly drops. The starter air valve (6) which had opened immediately the engine started now closes again so that the starter system produces a rich start mixture for the change-over just as it did at starting. As soon as the engine reaches sufficient speed, the starter air valve, actuated by the partial vacuum which is increasing again, once more opens and leans out the start mixture. By this automatic action of the starter air valve the cold engine is supplied with a correctly proportioned start mixture suitable for all conditions and a satisfactory change-over to the main carburetion system is ensured when the starter knob is pulled. Fig. 07-0/6 shows the mode of action of the starter mechanism when the car is being driven away.

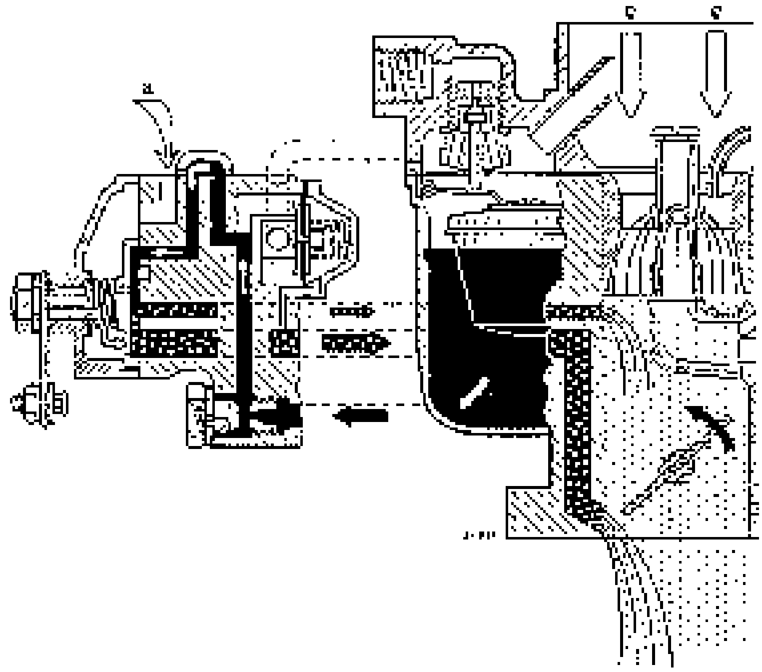


Fig. 07-0/6

Change over with starter mechanism in action
(Starter air valve closed)

c) Starter air entry
e) Main air supply

Note: As a rule the car should be driven away with the starter mechanism in the "warm-up position". However, at very low temperatures the car can be driven away with the starter mechanism in the "cold-start position".

d) Starter Mechanism Inoperative

(Starter knob pushed right in)

When the starter knob is pushed right in, the starter rotary slide valve is turned to the right to a point where both the graded bore (2) and the slot (39) in the starter flange are completely covered. The starter mixture canal (25) is also closed. The starter system is now put out of action. In order to prevent fuel from being drawn from the starter system, when the starter mechanism is inoperative, but if the starter rotary slide valve is not quite tight, a notch as described in Section a) has been made in the carburetor cover. This notch connects the float chamber with the fuel canal (4). For that reason only air and no fuel can be drawn in from the starter system, when a slight leakage is present in the starter rotary slide valve.

C. Idle System

The idle system of the carburetor consists of the idle fuel jet, the idle air jet and the idle mixture adjustment screw.

a) Idle – Phase 1

The fuel which is drawn in via the idle fuel jet (14) is mixed with the air from the idle air jet (13), forming a mixture which passes into the idle canal (40). In the idle position a further supply of air for the idle mixture enters through the by-pass bores (42) above the throttle valve and then passes into the suction canal through the idle mixture bore (41) and combines with the air streaming through the throttle valve gap to form the final idle mixture (Fig. 07-0/7).

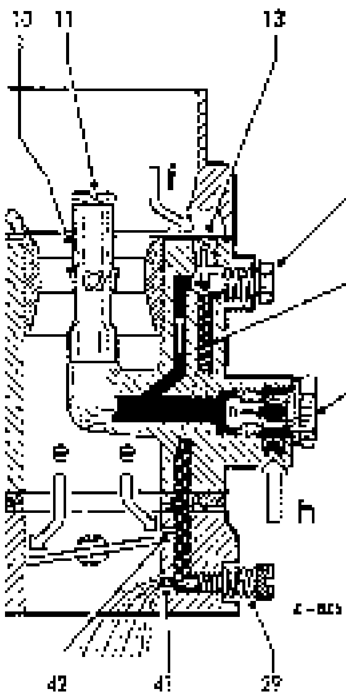


Fig. 07-0/7

Idle — Phase 1

e) Main air supply
f) Entry of idle air
h) Fuel feed

10 Mixing tube holder with mixing tube
11 Air correction jet
13 Idle air jet
14 Idle fuel jet
20 Main jet plug with main jet
29 Idle mixture adjustment screw
40 Idle canal
41 Idle mixture bore
42 By-pass bores

The cross-section of the idle mixture bore (41) can be varied by moving the idle mixture adjustment screw (29). When the idle mixture adjustment screw is slackened, the mixture is enriched.

The idle speed is adjusted by means of the idle adjustment screw on the throttle valve lever (see Job No. 01-3, Section K).

b) Idle – Phase 2

When the throttle valve is being slightly opened, idle mixture flows through both the idle mixture bore (41) and the by-pass bores (42). The by-pass bores now serve to ensure a proper change-over to the main carburetion system (Figs. 07 0/7 and 07 0/8).

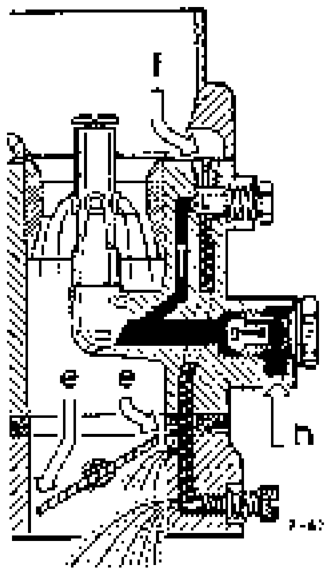


Fig. 07-0/8

Idle — Phase 2
(Throttle valve slightly open)

e) Main air supply
i) Entry of idle air
h) Fuel feed

Note: a) In the suction canal of the carburetor at the same height as the by-pass bores, but offset to one side there is a further bore which leads to a threaded union in the carburetor housing and takes the distributor vacuum line.

b) The carburetor for Model 180 a as from Engine End No. 8506159 has a bore on the carburetor flange which serves as a connection for a vacuum test guge and which is closed with a grub screw.

D. Main Carburetion System

In its standard form the downdraft carburetor Type 32 PICB has a float chamber with float and float needle valve in the carburetor cover. The float chamber is ventilated by the tube (9) in the carburetor cover. The carburetor parts for the main carburetion system are the air horn, the main jet and the air correction jet with mixing tube (see Fig. 07-0/1).

From the float chamber the fuel flows via the main jet screwed into the main jet plug (20) into the mixing tube holder (10). If the throttle valve is opened still further, that is beyond the idle position phase 2, the partial vacuum which has moved further upward causes fuel to be drawn through the outlet bores of the mixing tube holder and this fuel is mixed with the air entering through the air intake branch in the carburetor cover.

When the fuel level in the mixing tube holder decreases as a result of the increasing partial vacuum, i. e. at higher engine speed, compensating air enters through the air correction jet (11) which, through the small bores in the mixing tube mixes with the fuel flowing through the main jet. With increasing engine speed the proportion of air in the mixture increases so that overenrichment of the fuel-air mixture is prevented and an almost uniform proportion of fuel to air is ensured over the whole speed range (Figs. 07-0/7 and 07-0/9).

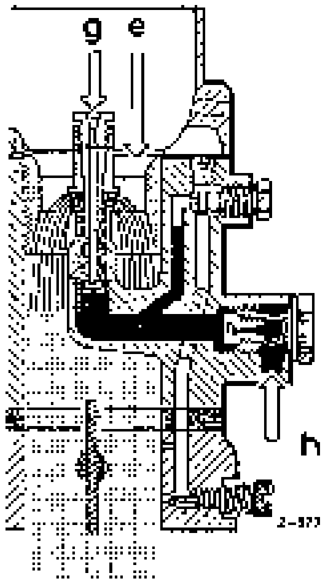


Fig. 07-0/9

Main carburetion system
(throttle valve in full-load position)

e) Main air supply
g) Entry of compensating air
h) Fuel feed

E. Accelerating Pump

The accelerating pump No. 73 is a so-called "mixture enriching" pump which means that in the upper load range the fuel-air mixture is enriched via the pump system. In contrast to the "neutral" pumps this "mixture enriching" pump has a ball valve (17) which permits an enrichment of the fuel-air mixture only in the upper load range of the engine. The ball valve is actuated by the pump diaphragm via the throttle valve shaft, the connecting rod and the pump arm. In the upper load range the tip of the diaphragm pin (19) keeps the ball valve (17) open. In relation to the degree of vacuum obtaining in the air horn, additional fuel is drawn in from the pump system via injection tube (15) when the ball valve is open, and the fuel-air mixture is thus enriched.

The enrichment delivery point varies with the individual carburetor types (see Section F).

The main purpose of the accelerating pump, however, is to spray extra fuel into the mixing chamber of the suction cone when the accelerator pedal is depressed, in order to achieve a smooth speed build-up and good acceleration.

Pump arm (31) of the accelerating pump is connected with the throttle valve shaft by means of connecting rod (30). With the throttle valve closed, diaphragm (19) is pushed outward by the diaphragm spring (18). Since the pump chamber is connected with the float chamber by way of ball valve (21), it is filled with fuel.

When operating the accelerator pedal connecting rod (30) will move pump arm (31). The pump arm will then push the diaphragm inwards so that the fuel in front of the diaphragm is injected by way of ball valve (17), pump jet (16), the ball valve in the injection tube holder (15) and finally the injection tube itself.

During the injection, ball valve (21), which operates as a check valve is closed. When the accelerator pedal moves back, diaphragm spring (18) will push diaphragm (19) back. Now, ball valve (21) operates as a through-way valve while the ball valve in the injection tube holder (15) operates as a check valve and prevents the penetration of air from the carburetor suction canal into the pump system (Fig. 07-0/10).

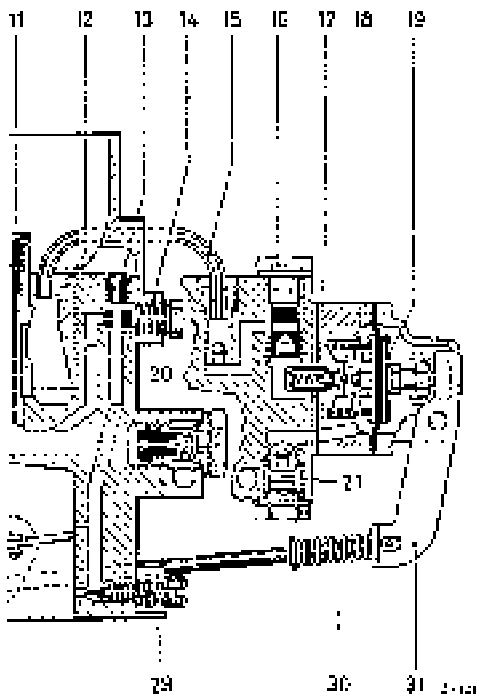


Fig. 07-0/10

11 Air correction jet
12 Air horn
13 Idle air jet
14 Idle fuel jet
15 Injection tube
16 Pump jet
17 Ball valve
18 Diaphragm spring
19 Pump diaphragm
20 Main jet plug with main jet
21 Ball valve
29 Idle mixture adjustment screw
30 Connecting rod
31 Pump arm

The injection amount for the carburetor of Model 180 should be 0.7–1.0 cc/stroke, and for the carburetor of Model 180 a 0.9–1.2 cc/stroke. The addition of shims between the pump arm and the cotter pin in the connecting rod will change the injection amount within narrow limits only, because this will simultaneously change the enrichment delivery point of the fuel/air mixture via the pump system. Replace pump diaphragm, if required. However, a test should be made previously as to whether the connecting rod and the pump arm moves without obstructions. In addition, the position of the cotter pins in the connecting rod should be checked. (Refer to Note of Section F). Following the installation of a new diaphragm or the adjustment of the injection amount the enrichment delivery point should be checked (refer to Job No. 01–3, Section H).

F. Technical Specifications of Solex Downdraft Carburetor Type 32 PJCB

Carburetor		Model 180	Model 180 a
Air horn "K"		25	26
Main jet "Gg"		0125	0150
Air correction jet "a"		200	205
Mixing tube "s"		10	1
Mixing tube holder (reserve)		5.5	5.0
Idle fuel jet "g"		55	50
Idle air jet "u"		1.5	1.5
Acceleration pump		No 73 (enriching)	
Injection amount cc/stroke		0.7–1.0	0.9–1.2
Pump jet "Gp"		50	60
Injection tube		low (not graded)	high (0.5 graded)
Beginning of mixture enrichment via pump system		Throttle valve angle 27°–33°	36°–40°
Pump diaphragm	Bolt length mm	$21.0^{+0.75}_{-0.1}$	20.5 ± 0.1
	Plate dia mm	22	
Starter fuel jet "Gs"		180	
Starter air bore in rotary slide valve of starter, mm Ø		5.5	
Float needle valve		1.5	2.0
Float weight (Float of nylon) g		5.7	
Fuel level mm		16–20	
Angle of inclination of throttle flap		8°	
Bore in throttle valve, mm Ø		—	2.5
By-pass bores, mm Ø		1.1/1.1	1.2/1.0

Note: Carburetor for Models 180 and 180 a

a) The length of the pump diaphragm bolt is measured from the dome against which the pump arm rests to the tip of the pin actuating the ball valve in the accelerating pump (Fig. 07–0/10 a).

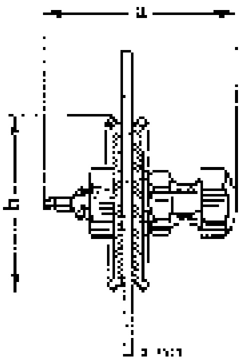


Fig. 07–0/10 c

a) Bolt length
b) Plate diameter

b) Position of cotter pins in connecting rod.

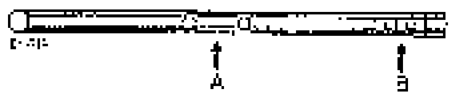


Fig. 07–0/10 b

A Cotter pin of pressure spring
B Cotter pin of pump arm

	Pump diaphragm installed			
	Bolt length 21 mm Diaphragm plate ⌀ 22 mm	Bolt length 19.0 mm Diaphragm plate ⌀ 16 mm	Bolt length 20.5 mm Diaphragm plate ⌀ 16 mm	Bolt length 20.5 mm Diaphragm plate ⌀ 22 mm
Cotter pin A	left cotter-pin hole	right cotter-pin hole	left cotter-pin hole	
Cotter pin B	center cotter-pin hole			
Shim between pump arm and cotter pin B	—		1 mm	[illegible]

c) The injection amount of the accelerating pump is measured with the throttle valve in the **idle position,** whereas the enrichment delivery point is checked with the throttle valve **completely closed.**

Carburetor for Model 180 a

c) Up to Engine End No. 85 14427 the carburetor was equipped with a mixing tube holder (reserve) 5.5 and an air correction jet "a" 230.

As from Engine End No. 85 14428 a mixing tube holder (reserve) 5.3 and an air correction jet "a" 220 have been installed.

e) Up to Engine End No. 8515851 the carburetor was equipped with an air correction jet "a" 220 (see "d" as from Engine End No. 8514428), a pump jet "Gp" 70, an injection tube "low" (0.5 graded) and a pump diaphragm with a bolt length of 19.0±0.1 mm and a plate diameter of 16 mm. In the case of carburetors with this type of pump diaphragm the enrichment begins at a throttle valve angle of 55°–60°. As from Engine End No. 8515852 an air correction jet "a" 210, a pump jet "Gp" 60, an injection tube "high" and a pump diaphragm with a bolt length of 20.5±0.1 mm have been installed (enrichment delivery point at 40°–44° throttle valve angle).

f) From Engine End No. 8515852 to Engine End No. 8516090 the carburetor was equipped with an air correction jet "a" 210. As from Engine End No. 8516091 an air correction jet "a" 205 has been installed.

g) As from Engine End No. 9504458 (as from Carburetor No. 1398 489) the plate of the pump diaphragm has been enlarged from 16 mm diameter to 22 mm diameter and the enrichment delivery point has been changed from 40°–44° to 36°–40° throttle valve angle.

h) If complaints are received about jerky running of the car under partial load or about uneven speed build-up, the carburetor can be modernized subsequently provided, however, that it has a mixing tube holder (reserve) 5.3. The mixing tube holder should only be replaced under very special circumstances and only by an experienced mechanic. A suitable sleeve, together with a stud bolt M 6, a hexagon nut and a washer should be used to press off the mixing tube holder. When fitting the new mixing tube holder make sure that it is properly seated and fits tightly in the carburetor housing. When installing a new pump diaphragm, check the injection amount of the accelerating pump and the enrichment delivery point (see Job No. 01–3, Section H).

i) The mixing tube holder (reserve) 5.3 (installed as a standard part as from Engine End No. 8514428) is marked with the number 5.3 stamped in the side.

Carburetor for Model 180

k) Up to Engine End No. 3504026 a brass float weighing 12.5 g was fitted. A nylon float has been installed as a standard part as from Engine End No. 3504027.

Model 180 b, 180 c

A. General

The engines of models 180 b and 180 c are provided with a Solex Downdraft Carburetor 34 PJCB

Carburetor 34 PJCB has a suction canal dia. of 34 mm.

The starter mechanism, the idle system and the main carburetion system are the same as for the downdraft carburetor 32 PJCB (up to now installed in model 180 c). For model 180 c the mixing tube holder is provided with a polyamide ball, which prevents the fuel in the float housing from flowing back when the vehicle is heavily braked and thereby prevents stalling of the engine. In addition, model 180 c is provided with a float needle valve having a cut-off tip.

The acceleration pump used for carburetor 34 PJCB is a so-called "neutral" pump (carburetor 32 PJCB has a strengthening or enriching pump). With a neutral acceleration pump the engine is able to take in additional fuel by way of the injection tube (15) and bore (17) from the pump system at partial load and at full load, depending on the vacuum in the air horn, without operating the accelerating pump (Fig. 07–0/10 c).

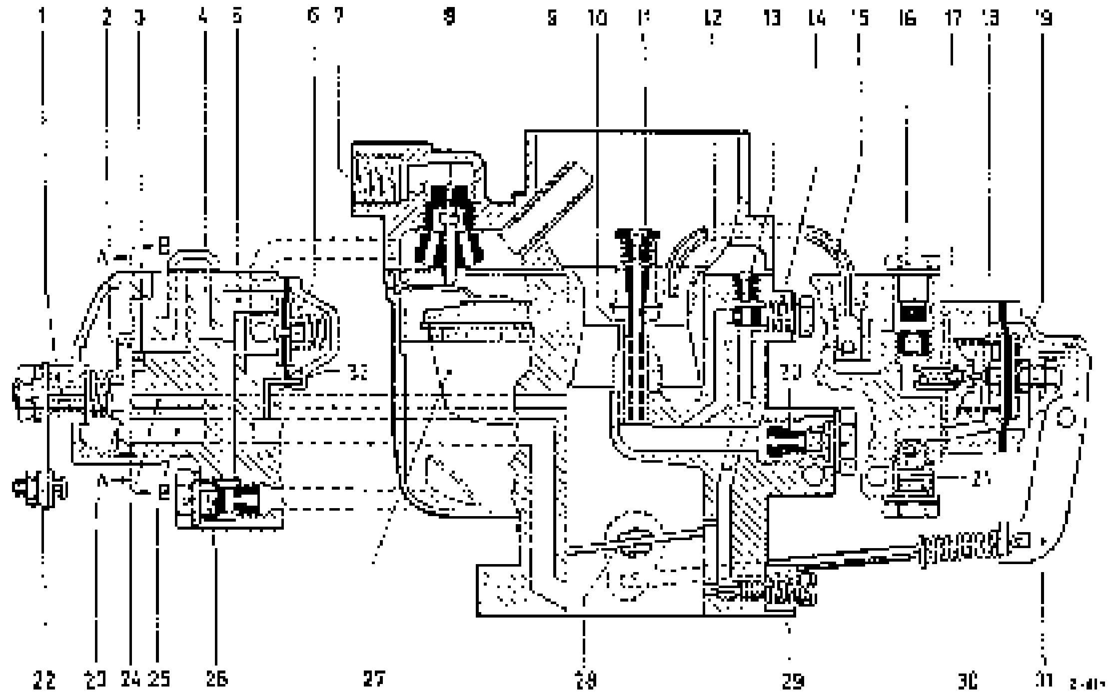


Fig. 07–0/10 c

Solex Carburetor 34 PJCB

1 Starter rotary slide valve
2 Graded intake bore in starter flange for fuel canal (4)
3 Graded intake bore in starter flange for fuel slot
4 Fuel canal to mixing system
5 Air canal from starter air valve to fuel canal (4)
6 Starter air valve
7 Fuel line connection in carburetor cover
8 Float needle valve
9 Vent tube for float chamber
10 Mixing tube holder with mixing tube
11 Air correction jet
12 Air horn
13 Idle air jet
14 Idle fuel jet
15 Injection tube
16 Pump jet
17 Bore
18 Diaphragm spring
19 Pump diaphragm
20 Main jet plug with main jet
21 Ball valve
22 Starter lever
23 Starter air bore in starter rotary slide valve
24 Additional air canal
25 Starter mixture canal
26 Starter fuel jet
27 Float
28 Throttle valve
29 Idle mixture adjustment screw
30 Connection rod with pressure spring
31 Pump arm
32 Vacuum canal for starter air valve

B. Technical Specifications of Solex Downdraft Carburetor Model 34 PJCB

Carburetor	Model 180 b	Model 180 c
Air horn "K"	28	
Main jet "Gg"	0150	0145
Air correction jet "a"	195	180
Mixing tube "s"	1	49
Mixing tube holder (reserve)¹)	5.5	
Idle fuel jet "g"	55	
Idle air jet "u"	1.0	
Accelerating pump	No. 72 (neutral)	
Injection amount cc/stroke	1.0–1.2	0.7–1.0
Pump jet "Gp"	50	80
Injection tube	high (0.5 graded)	
Pump Diaphragm plate dia. mm	22	
Position of cotter pins in connecting rod to accelerating pump (Fig. 07-0/10 d)	"c" and "e"	"b" and "e"
Starter fuel jet "Gs"	180	
Starter air bore in starter rotary slide valve	5.5	4
Float needle valve	2.0¹)	
Float weight (float of nylon) g	5.7	
Fuel level mm	16–18	
Angle of inclination of throttle valve	8°	
By-pass bore mm ⌀	1.2/1.2	
Stabilizing hole	1.5	

¹) Model 180 c with polyamide ball valve.
¹) Model 180 c with float needle valve having cut-off tip

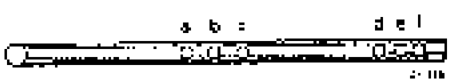


Fig. 07-0/10 d

Connecting rod of accelerating pump

II. Double Downdraft Carburetor for Models 220 a and 219

A. General

Models 220 a and 219 have a Solex double downdraft carburetor Type 32 PAATI. To all intents and purposes the double downdraft carburetor combines two separate carburetors in one housing. It has two 32 mm diameter suction canals each with its own main carburetion system and idle system. The accelerating pump and the starter mechanism, however, supply both suction canals of the carburetor together. The float chamber and the air intake occupy a central position (Fig. 07-0/11).

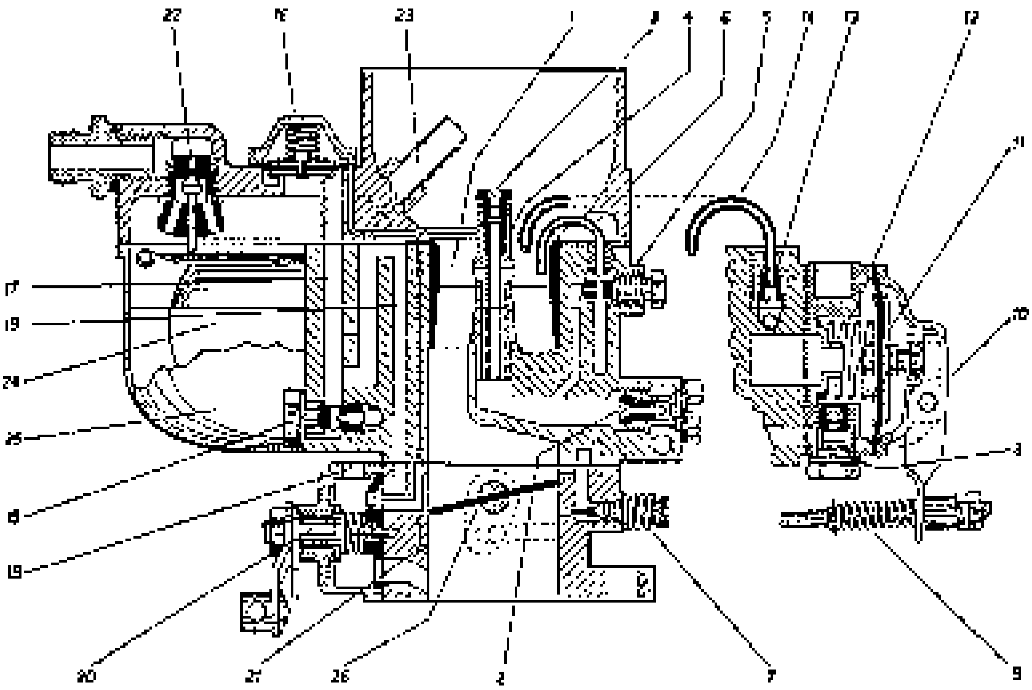


Fig. 07-0/11

Solex Carburetor Type 32 PAATI

1 Air horn
2 Main jet plug with main jet
3 Air correction jet
4 Mixing tube holder with mixing tube
5 Idle fuel jet
6 Idle suction tube
7 Idle mixture adjustment screw
8 Ball valve
9 Connecting rod with pressure spring and adjusting nuts
10 Pump arm
11 Pump diaphragm
12 Diaphragm spring
13 Fuel jet in injection tube
14 Injection tube
15 Starter fuel jet
16 Starter air valve
17 Air canal from starter air valve to fuel canal (18)
18 Fuel canal to starter system
19 Starter air horn
20 Starter rotary plate valve
21 Vacuum canal for starter air valve
22 Float needle valve
23 Vent tube for float chamber
24 Float
25 Float chamber
26 Throttle valve

Note: a) Fig. 07-0/11 shows the 1st version carburetor without grey cast-iron flange on the throttle valve section. The 2nd version carburetor with grey cast-iron flange has been installed in Model 220 a as a standard part as from Engine End No. 4502815.

b) The new version of the carburetor for Model 219 (installed as a standard part as from Engine End Nos. 10-9501619 and 11-9500384) (as from Solex Carburetor No. 3 908 566) has idle air jets instead of the idle suction tubes shown above (for details see Section F).

B. Starter Mechanism

The starter mechanism of the carburetor works in two stages on the rotary slide valve principle. The starter mechanism is actuated by a bowden cable with a pull knob on the instrument panel. If the starter knob is pulled right out, the starter mechanism is set at the "cold-start position". If the starter knob is pressed in about halfway, the starter mechanism is set at the "warm-up position". If the starter knob is pressed in completely, the starter mechanism is inoperative. Connecting the choke control is described in Job No. 30-6.

a) Cold-Start Position

(Starter knob pulled right out)

When the starter mechanism is in this position, the aperture (34) in the starter rotary slide valve (20) is in the center of the starter mixture canal (30) in the starter flange of the carburetor housing.

In the 1st phase of the cold start the partial vacuum obtaining in the suction tube exerts an influence on the starter system via the starter mixture canal (30) when the engine is being started. As a result fuel from the float chamber is drawn into the fuel canal (18) through the starter fuel jet (15). A certain amount of air enters at the same time through the notch in the carburetor cover which connects up with the float chamber; as a result, a kind of pre-mixture is present in the fuel canal (18) leading to the starter rotary slide valve.

The notch is designed primarily to prevent fuel from being drawn up by the siphon effect when the starter mechanism is inoperative and if the starter rotary slide valve should have a slight leak.

Through a graded bore in the fuel canal (18) the pre-mixture enters the starter mixing chamber (27) behind the rotary slide valve via the fuel slot (28) in the starter flange and the graded bore (33) in the slide valve (Figs. 07-0/12 and 07-0/13).

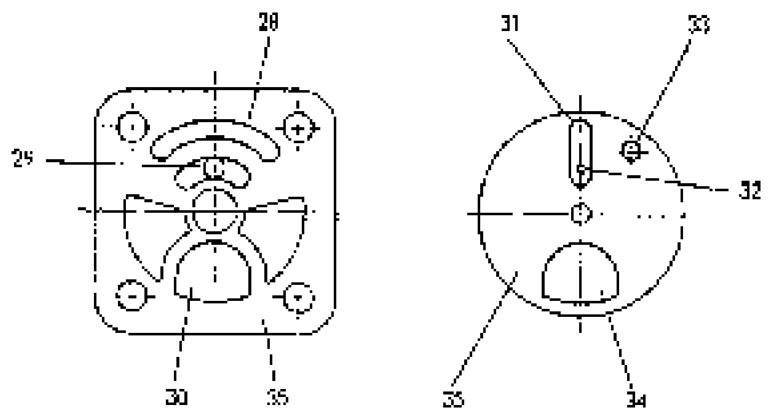


Fig. 07-0/12

Starter flange of carburetor housing

28 Fuel slot in starter flange for fuel canal (18)
29 Canal for additional air
30 Starter mixture canal
31 Chamber in starter rotary slide valve
32 Graded bore in starter rotary slide valve

Starter rotary slide valve

33 Graded fuel intake bore in starter rotary slide valve
34 Aperture in starter rotary slide valve for starter mixture canal (30)
35 Sealing surface

At the same time air is drawn from the suction canals of the carburetor through the canal (29). In the chamber (31) of the starter rotary slide valve this additional air mixes with the pre-mixture which enters the starter mixing chamber (27) via the graded bore (32) in the starter rotary slide valve. Here the mixture combines with the pre-mixture entering through the graded bore (33) in the starter rotary slide valve and the air entering through the starter air bore (19) in the starter housing which acts as a starter air jet. The fuel-air mixture which is now formed passes through the aperture (34) in the starter rotary slide valve and the starter mixture canal (30) into the two suction canals of the carburetor and together, with the air streaming through the throttle valve gap forms the final start mixture. Fig. 07-0/13 shows the mode of action of the starter mechanism phase 1 when the engine is being started.

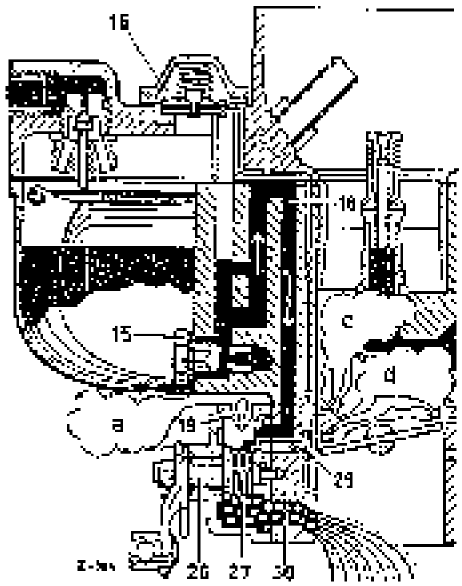


Fig. 07-0/13

Cold start — phase 1
When starting the engine
(Starter air valve closed)

a) Starter air entry
c) Additional air entry from suction canals
d) Main air entering through throttle valve gap

15 Starter fuel jet
16 Starter air valve

18 Fuel canal
19 Starter air bore
20 Starter rotary slide valve
27 Starter mixing chamber
29 Canal for additional air
30 Starter mixture canal

As soon the engine has started, the 2nd phase of the cold start begins. The increase in engine speed brings about an effective partial vacuum beneath the throttle valves. This partial vacuum exerts a pull on the spring-loaded side of the diaphragm of the starter air valve (16) via the vacuum canal (21) (see Fig. 07-0/14).

As a result of the partial vacuum effect the starter air valve (16) opens and admits more air into the starter system from the float chamber via the air canal (17) and the fuel canal (18). This additional air immediately leans out the start mixture after the engine has started, thus ensuring the proper running conditions for the engine. Fig. 07-0/14 shows the mode of action of the starter mechanism after the engine has started.

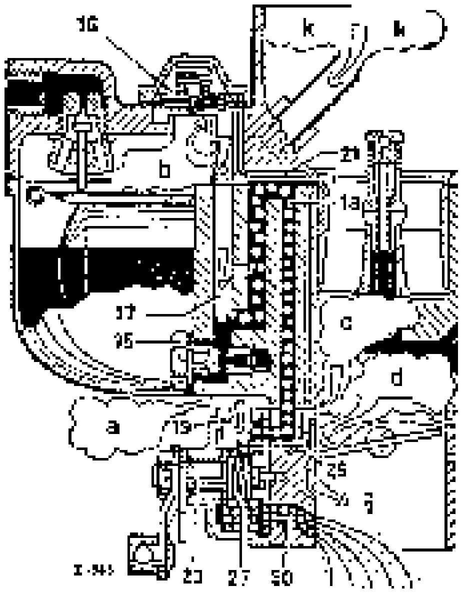


Fig 07-0/14

Cold start — phase 2
After the engine has started
(Starter air valve opened)

a) Starter air entry
b) Additional air entry via the starter air valve
c) Additional air entry from suction canals
d) Main air entering through throttle valve gap
i) Partial vacuum
k) Air entry into float chamber
15 Starter fuel jet
16 Starter air valve
17 Air canal from starter air valve to fuel canal (18)
18 Fuel canal
19 Starter air bore
20 Starter rotary slide valve
21 Vacuum canal to starter air valve
27 Starter mixing chamber
29 Canal for additional air
30 Starter mixture canal

b) Warm-Up Position

(Starter knob pushed halfway in)

As soon as the engine has warmed up a little, the starter knob can be pushed in halfway. As a result, the starter rotary slide valve is turned toward the right via the starter lever; the graded bore (33) in the slide valve is covered by the sealing surface (35) on the starter flange (see Fig. 07-0/12). Since the starter mixing chamber (27) is no longer connected with the fuel canal (18) by the bore (33), but only by the fine-graded bore (32) in the starter rotary slide valve, the amount of fuel admitted is greatly decreased and the start mixture is leaned out further. Fig. 07-0/15 shows the mode of action of the starter mechanism during warming-up.

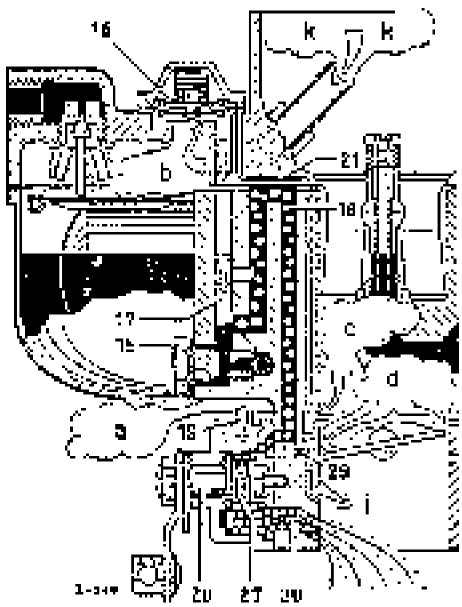


Fig. 07-0/15

Warm-up position
(Starter air valve opened)

a) Starter air entry
b) Additional air entry via the starter air valve
c) Additional air entry from suction canals
d) Main air entering through throttle valve gap
i) Partial vacuum
k) Air entry into float chamber
15 Starter fuel jet
16 Starter air valve
17 Air canal from starter air valve to fuel canal (18)
18 Fuel canal
19 Starter air bore
20 Starter rotary slide valve
21 Vacuum canal to starter air valve
27 Starter mixing chamber
29 Canal for additional air
30 Starter mixture canal

c) Driving Away with Starter Knob Pulled Out

When the car is driven away with the starter knob pulled out, the partial vacuum in the suction canals is shifted upward by the opening of the throttle valves. As a result, the supply of start mixture from the canal (30) decreases. This is compensated for by the start mixture drawn in via the additional air canal (29) so that the supply of start mixture to the engine remains unaffected.

If as a result of quick acceleration from low engine speed the throttle valves are opened still further, the partial vacuum suddenly drops. The starter air valve (16), which had opened as soon as the engine started, now closes again, so that the starter system produces a rich start mixture for the change-over just as it did at starting. As soon as the engine reaches sufficient speed, the starter air valve, actuated by the partial vacuum which is increasing again, once more opens and leans out the start mixture. By this automatic action of the starter air valve the cold engine is supplied with a correctly proportioned start mixture suitable for all conditions and a satisfactory change-over to the main carburetion system is ensured when the starter knob is pulled. Fig. 07-0/16 shows the mode of action of the starter mechanism when the car is being driven away.

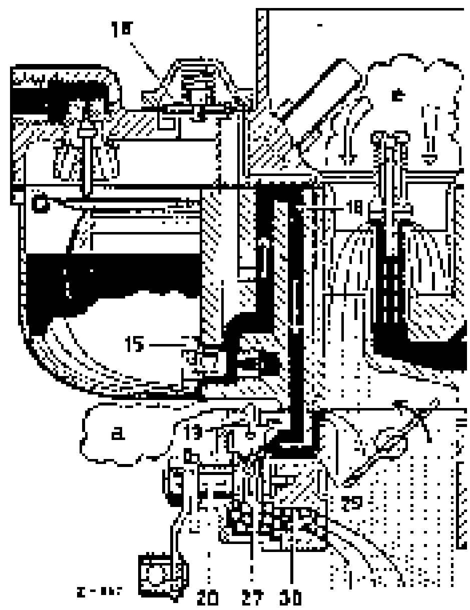


Fig. 07-0/16

Change-over with starter mechanism in action (Starter air valve closed)

a) Starter air entry
b) Main air supply

15 Starter fuel jet
16 Starter air valve
18 Fuel canal
19 Starter air bore
20 Starter rotary slide valve
27 Starter mixing chamber
29 Conn. for additional air
30 Starter mixture canal

Note: As a rule the car should be driven away with the starter mechanism in the "warm-up position". However, at very low temperatures the car can be driven away with the starter mechanism in the "cold-start position".

d) Starter Mechanism Inoperative

(Starter knob pushed right in)

When the starter knob is pushed right in, the starter rotary slide valve is turned to the right to a point where both the graded bore (33) and the graded bore (32) and the fuel slot (31) in the starter rotary slide valve are completely covered (see Fig. 07-0/12). The starter mixture canal (30) is also closed. The starter system is now out of action.

In order to prevent fuel from being drawn from the starter system, when the starter mechanism is inoperative, but if the starter rotary slide valve is not quite tight, a notch as described in Section c) has been made in the carburetor cover. This notch connects the float chamber with the fuel canal (18). For that reason only air and no fuel can be drawn in when there is a slight leak in the starter rotary slide valve.

C. Idle System

Each of the suction canals of the carburetor has its own separate idle system. For this reason the carburetor has two idle fuel jets, two idle suction tubes (or idle air jets) and two idle mixture adjustment screws.

a) Idle – Phase 1

The fuel which is drawn in via the idle fuel jet (5) is mixed with the air from the idle suction tube (6) (or the idle air jets), forming a mixture which passes into the idle canal (36). In the idle position a further supply of air for the idle mixture enters through the by-pass slot (37) (or the by-pass bores) above the throttle valve and then passes into the suction canal through the idle mixture bore (38) and combines with the air streaming through the throttle valve gap to form the final idle mixture (Fig. 07-0/17).

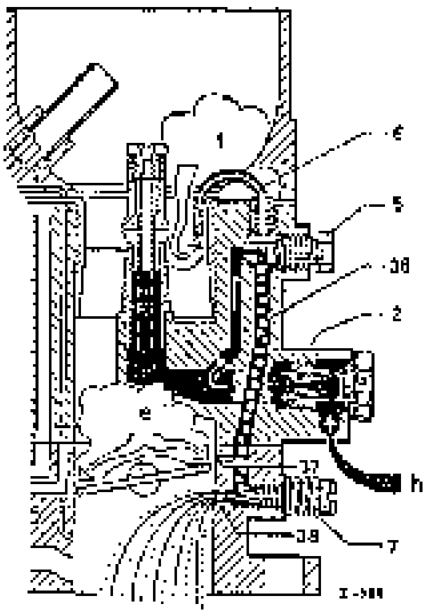


Fig. 07-0/17

Idle — phase 1

e) Main air supply
f) Entry of idle air
h) Fuel feed

2 Main jet plug with main jet
5 Idle fuel jet
6 Idle suction tube
7 Idle mixture adjustment screw
36 Idle canal
37 By-pass slot
38 Idle mixture bore

The cross-section of the idle mixture bores can be varied by means of the idle mixture adjustment screws (7). The idle mixture is leaned out when the idle mixture adjustment screw is turned in and is enriched when it is backed out.

The idling speed is adjusted by means of the idle adjustment screw on the throttle valve lever (see Job No. 01-3, Section K).

b) Idle – Phase 2

When the throttle valve is being slightly opened, idle mixture emerges both through the idle mixture bore (38) and the by-pass slot (37) (or the by-pass bores). The by-pass openings now serve to ensure a proper change-over to the main carburetion system (see Fig. 07-0/17).

Note: a) Up to Engine End Nos. 10 95 01618 and 11 95 0083 the carburetor had two idle suction tubes and a by-pass slot in each suction canal. As from Engine End Nos. 10 95 01619 and 11 95 00384 the carburetor has two idle air jets and in each suction canal two by-pass bores and a compensating bore below the air horn (see Section F).

b) In the right-hand suction canal of the carburetor at the same height as the by-pass slot or the by-pass bores as the case may be, but slightly offset to one side, there is a bore which leads to the threaded union on the throttle valve housing and which serves as a connection for the vacuum line to the distributor.

c) Recent carburetors have a bore on the carburetor flange for the connection of a vacuum tester; the bore is closed by a grub screw.

D. Main Carburetion System

The working principles of the main carburetion system are the same on the Solex double-downdraft carburetor Type 32 PAATI as on the single downdraft carburetor.

In its standard form the double downdraft carburetor has a float and a float needle valve in the carburetor cover. The float chamber is ventilated through the tube (23) in the carburetor cover. For each of the carburetor suction canals there is an air horn, a main jet and a mixing tube holder with mixing tube and air correction jet (see Fig. 07–0/11).

From the float chamber the fuel flows into the mixing tube holder (4) through the main jet screwed into the main jet plug (2). If the throttle valve is opened beyond the idle position, phase 2, the partial vacuum moves upward and fuel is drawn from the outlet bores of the mixing tube holder and mixes with the air entering through the air intake branch of the carburetor cover.

When the vacuum effect increases at higher engine speeds the fuel level in the mixing tube holder decreases and compensating air enters through the air correction jet (3) and passes through the small bores in the mixing tubes and combines with the fuel flowing through the main jet to form a mixture. With increasing engine speed the proportion of air in the mixture increases so that overenrichment of the fuel-air mixture is prevented and the engine receives a more or less uniform mixture over the whole speed range (Fig. 07–0/18).

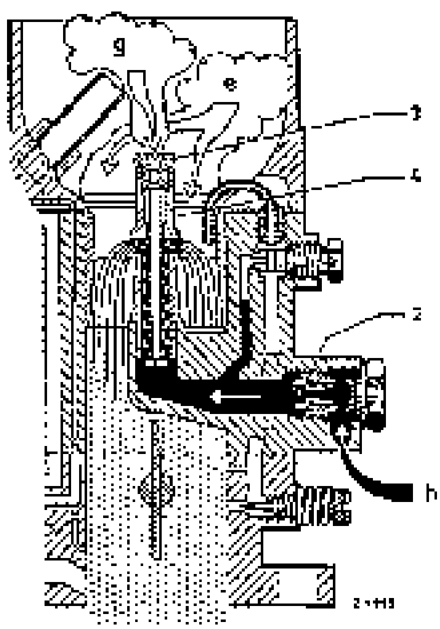


Fig. 07–0/18

Main carburetion system
(Throttle valve in full-load position)

e) Main air entry
g) Entry of compensating air
h) Fuel feed

2 Main jet plug with main jet
3 Air correction jet
4 Mixing tube holder with mixing tube

E. Accelerating Pump

The accelerating pump No. 92 is a so-called "neutral" pump, i. e. the engine can draw in fuel from the pump system via the injection tubes according to the degree of depression prevailing in the suction tube.

The main purpose of the accelerating pump, however, is to spray extra fuel into the mixing chambers of the suction canals when the accelerator pedal is depressed, in order to achieve a smooth speed build up and good acceleration.

The pump arm (10) of the accelerating pump is connected to the throttle valve shaft by the adjustable connecting rod (9). When the throttle valves are closed, the diaphragm (11) is pressed outward by the diaphragm spring (12). Since the pump chamber is connected to the float chamber via the ball valve (8), it is filled with fuel.

When the accelerator pedal is depressed, the pump arm (10) is moved by the connecting rod (9). During this operation the pump arm presses the diaphragm inward so that the fuel in front of the diaphragm is injected via the two ball valves located below the bracket for the injection tubes (14), via the fuel jets (13) and the injection tubes.

During the injection the ball valve (8), which operates as a check valve, is closed. When the accelerator pedal is released, the diaphragm spring (12) presses the diaphragm (11) back. The ball valve (8) now operates as a through-way valve, whereas the ball valves below the bracket for the injection tubes (14) operate as check valves and prevent air from the carburetor suction canals from entering the pump system. (Fig. 07-0/19)

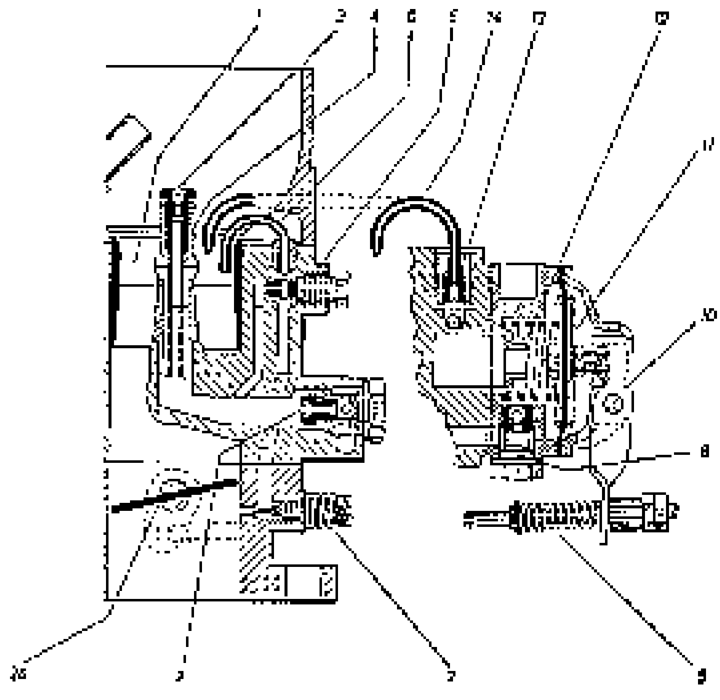


Fig. 07-0/19

1 Air horn
2 Main jet plug with main jet
3 Air correction jet
4 Mixing tube holder with mixing tube
5 Idle fuel jet
6 Idle suction tube
7 Idle mixture adjustment screw
8 Ball valve
9 Connecting rod with pressure spring and adjusting nuts
10 Pump arm
11 Pump diaphragm
12 Diaphragm spring
13 Fuel jet in injection tube
14 Injection tube
20 Throttle valve

Note: a) Instead of the conventional pump jets the double downdraft carburetor is provided with fuel jets (13) in injection tubes (14).

b) This version of the neutral accelerating pump carries no plate valve as a stop for the diaphragms.

Extra fuel from the pump system, in accordance with the vacuum in the air horns, is effected without operating the pump arm of the accelerating pump.

The injection amount for both injection tubes should be 1.3–1.5 cc/stroke together. Changes can be made by setting the adjusting nuts on connecting rod (9). Turning the nuts down will increase the pump stroke and thereby the injection amount, turning the nuts out will decrease stroke and amount.

The nuts may be tightened only to the point where pump arm (10) lifts from the diaphragm, because otherwise the injection will not start immediately when the throttle valves open. A change of the fuel jets (13) in the injection tubes (14) would not change the injection amount, but only the period of the injection. The connecting rod and the pump arm should move without sticking.

For adjustment of injection amount on the accelerating pump refer to Job No. 07–3, Section H

F. Technical Specifications of Solex Double Downdraft Carburetor Type 32 PAATI

Carburetor	Models 220 a and 219 (up to engine end No. 10 9501518 and 11-9500383)	Model 219
Air horn "K"	24	
Main jet "Gg"	0130	0125
Air correction jet "a"	170	165
Mixing tube "s"	0	
Mixing tube holder (reserve)	4.8	
Idle fuel jet "g"	47.5	50
Idle suction tube	1.8	—
Idle air jet "u"	—	1.1
Accelerating pump	No. 72 (neutral)	
Injection amount cc/stroke	1.3–1.5	
Fuel jet in injection tube	0.5	
Injection tube	raw (0.5 graded)	
Starter fuel jet "Gs"	150	
Starter air bore in starter housing, mm ⌀	5.5	
Float needle valve	2.0	
Float weight (float of nylon) g	7.2	
Fuel level mm	13–15	15.5–17.5
Angle of inclination of throttle valves	8°	
Bore in throttle valves, mm ⌀	1.5	
By-pass slots mm	0.9 × 3.45	—
By-pass bores mm ⌀	—	1.25 and 0.7
Stabilizing hole, mm ⌀	—	1.5

Note: Model 220 a up to engine end No. 55 05553 with a float of brass having a weight of 2[illegible] g.
Float of nylon has been installed as a standard part as from engine end No. 55 05552

III. Compound Downdraft Carburetor for Model 220 S

A. General

Model 220 S is equipped with two Solex compound downdraft carburetors Type 32 PAITA which are built on the same principles as the carburetor used in Model 190 (Fig. 07-0/20)

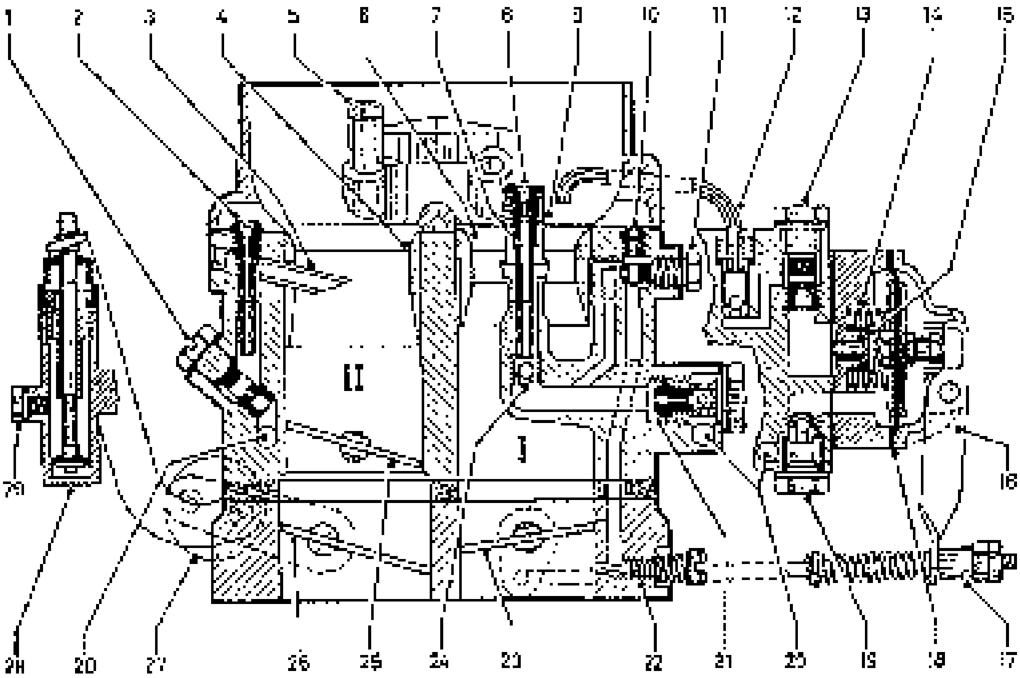


Fig. 07-0/20

Solex Carburetor Type 32 PAITA
I Stage 1 II Stage 2

1 Main jet of Stage 2
2 Air correction jet with mixing tube of Stage 2
3 Discharge tube to main carburation system Stage 2
4 Air horn of Stage 2
5 Float chamber vent tube
6 Air horn of Stage 1
7 Mixing tube of Stage 1
8 Air correction jet of Stage 1
9 Mixing tube holder
10 Idle air jet
11 Idle fuel jet
12 Injection tube
13 Pump jet
14 Diaphragm spring
15 Plate valve with horn
16 Pump arm
17 Connecting rod with pressure spring and adjusting nuts
18 Pump diaphragm
19 Ball valve
20 Fuel feed
21 Main jet plug with main jet of Stage 1
22 Idle mixture adjustment screw
23 Throttle valve of Stage 1
24 Ball valve in mixing tube holder
25 Throttle valve of Stage 2
26 Vacuum valve
27 Counterweight with lever
28 Oil check-connector for vacuum valve
29 Plug and filter screw

The carburetor for Model 220 S differs from the carburetor of Model 190 in the following details:

a) The carburetor jets etc. (see Section E).

b) The height of the carburetor cover from the separating surface to the upper edge of the air intake branch is 33 mm in the carburetor for Model 220 S and 43 mm in the carburetor for Model 190.

c) In the carburetor for Model 220 S the tube (5), cast integral with the carburetor cover and ventilating the float chamber, is not graded (see Fig. 07-0/20).

d) Recent models have a bore in the carburetor flange for the connection of a vacuum tester; this bore is closed with a grub screw.

B. Arrangement and Function of Throttle Valves

The actuating linkage for the throttle valves of stages 1 and 2 has been modified (Fig. 07-0/21). However, the arrangement and the function of the throttle valves correspond to the description given in Workshop Manual Model 190.

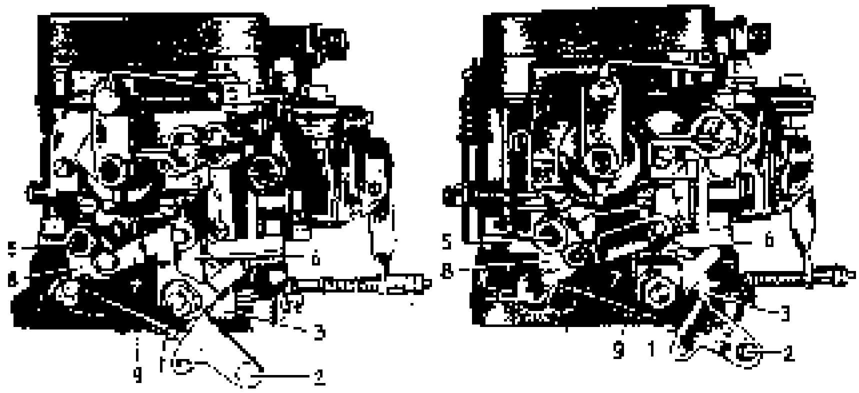


Fig. 07-0/21

1st Version

1 Throttle valve of Stage 1
2 Throttle valve lever
3 Abutment
4 Idle adjustment screw
5 Throttle valve shaft of Stage 2

2nd Version

6 Relay lever
7 Relay arm
8 Drag lever
9 Tension spring

The carburetors with the 1st version of the actuating linkage were installed as a standard part up to Engine End Nos N 85 04580 and Z 85 01748. The carburetors with the 2nd version of the actuating linkage have been installed as a standard part as from Engine End Nos N 85 04581 and Z 85 01749.

C. Starter Mechanism

On Model 220 S, as from Engine End Nos N 75 11273 and Z 75 00522 carburetors with a three-stage starter mechanism were installed. In the cold start position (starter knob pulled right out) and in the warm-up position (starter knob pushed halfway in) the functioning of the starter mechanism is as described in the Model 190 Workshop Manual.

In the new third position, warm-up position II (starter knob pushed in about 3/4 of the way), the engine receives in addition to the idle mixture an additional mixture from the starter system when the normal running temperature has not yet been reached; this additional mixture ensures satisfactory idling of the engine even at this stage. When the engine is warming up, warm-up position I (starter knob pushed in about halfway) may cause overenrichment of the mixture; by using warm-up position II (starter knob pushed in about 3/4 of the way) the starter mechanism can now remain operative until the engine has reached the working temperature of at least 70° C. This is of particular advantage in cars with a hydraulic automatic DB clutch, since when a gear is engaged, the shift surge is so strong that the idling speed may decrease and cause the engine to stall. Furthermore, the shift surge is slightly larger when the oil in the hydraulic automatic clutch is cold than when it has warmed up to operating temperature.

Warm-Up Position II

(Starter knob pushed in about ¾ of the way)

When the engine is warmed up, but if the idling speed with the starter mechanism inoperative is still too low, the starter knob can be pushed in about ¾ of the way. As a result, the starter rotary slide valve is turned toward the right as seen from warm-up position 1. The chamber (19) of the slide valve is now opposite the second part (26) of the split fuel slot in the starter flange on the carburetor housing. Since this second part of the slot is connected to the first part (22) of the fuel slot only by a very fine graded bore, the amount of fuel passed from the starter mechanism is decreased still further (Fig. 07-0/22).

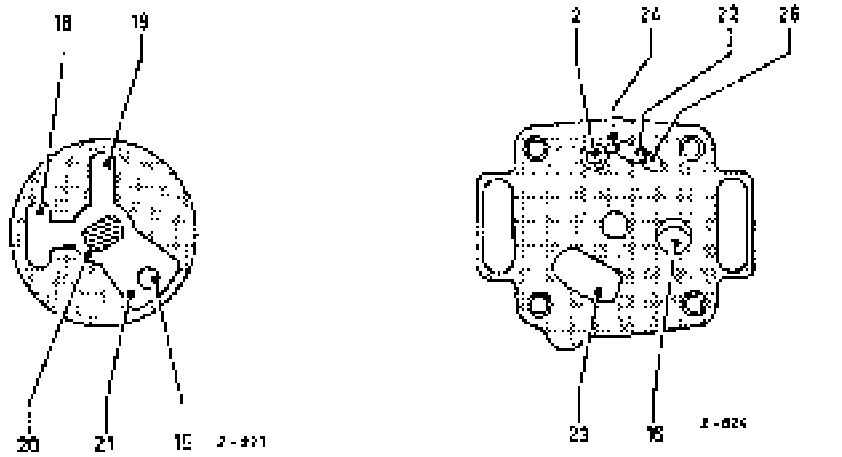


Fig. 07-0/22

Starter rotary slide valve

Starter flange of carburetor housing

2 Graded bore of fuel canal
15 Starter air bore in starter rotary slide valve
16 Graded bore of additional air canal
18 Chamber in starter rotary slide valve
19 Chamber in starter rotary slide valve
20 Mixing chamber in starter rotary slide valve
21 Cavity in starter rotary slide valve
22 Fuel slot, part 1
23 Starter mixture canal
24 Graded intake bore for fuel slot
26 Fuel slot, part 2

D. Scavenging Device for Fuel System

a) General

On Model 220 S a scavenging device for the fuel system can be installed as an optional extra. Even at high outside temperatures and when driving in a line of traffic, this scavenging device prevents the formation of vapor bubbles in the fuel system. The scavenging device consists mainly of the return valve (3) on the front carburetor which is connected to the fuel tank by the hose (7) and the fuel return line (12).

The fuel return valve is actuated mechanically by the pump arm (9) of the accelerating pump (8). When the return valve is open, the excess fuel runs back into the fuel tank through the return valve and the return line. This fuel circulation cools the fuel line and prevents the formation of vapor bubbles.

With the carburetor linkage in the idle position and the throttle valves slightly open, the valve pin of the return valve, which is fitted with a sealing cone, is pressed outward by the pressure spring so that the bore remains open for the fuel flow. When the throttle valves are opened further, the pump arm (9) by overcoming the elastic force, presses the valve pin far enough in to close the bore to the passage of fuel and thus interrupts the scavenging process (see Fig. 07-0/23).

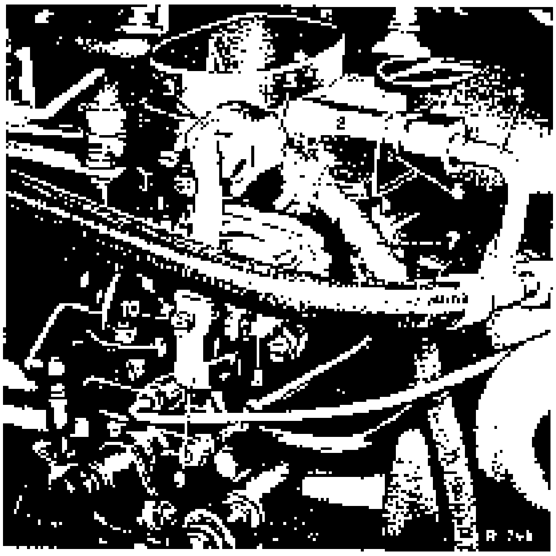


Fig. 07-0/23

1 Fuel pressure line
2 Connector on carburetor cover
3 Fuel return valve
4 Fiber gaskets
5 Ring connector
6 Threaded union
7 Hole for fuel return line
8 Accelerating pump
9 Pump arm
10 Adjusting screw and lock nut

The return mechanism is adjusted by means of the adjusting screw (10) on the pump arm with the throttle valve of Stage I completely closed. In this position there must still be a valve travel of 0.4–0.6 mm (see Fig. 07-0/24).

b) Subsequent Installation of Scavenging Device

1. Disconnect and remove the fuel pressure line at the fuel feed pump and at the carburetors.
2. Remove the carburetor cover of the front carburetor. Unscrew the float needle valve and the threaded union for the fuel pressure line.
3. Drill through the front part of the connector (2) on the carburetor cover which was hitherto closed, using a 7 mm diameter drill, and tap an M 12×1.5 thread (Fig. 07-0/24).
4. Clean the carburetor cover and carefully remove all chips.
5. Fit the carburetor cover and screw the threaded union (6) for the fuel pressure line into the front connection of the carburetor cover. If necessary, use a new fiber sealing ring (see Fig. 07-0/25).
6. Screw the fuel return valve (3) with fiber sealing rings (4) and ring connector (5) into the side connection hitherto used for the fuel pressure line and tighten (see Fig. 07-0/24).

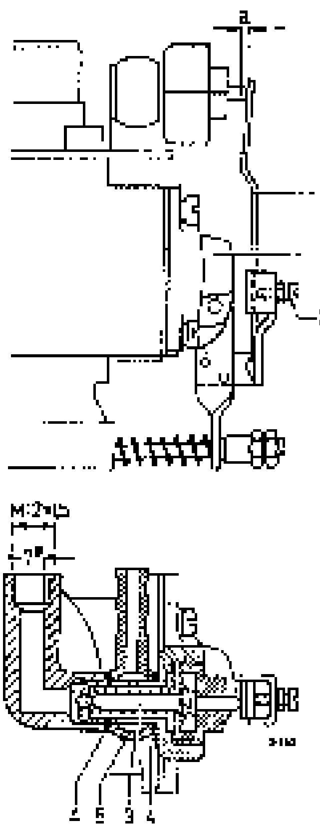


Fig. 07–0/24

a) Travel of fuel return valve

3 Fuel return valve
4 Fiber sealing rings
5 Ring connector
8 Accelerating pump
9 Pump arm
10 Adjusting screw and lock nut

7. Slide the hose (7) of the fuel return line onto the ring connector (5) and fasten with a hose clip (see Fig. 07–0/25).

8. Connect the new fuel pressure line (1) (Fig. 07–0/25).

9. Unscrew the accelerating pump (8) and remove the cover taking care not to damage the pump diaphragm. After carefully tapping out the shaft remove the pump arm (see Fig. 07–0/24).

10. Install the new pump arm (9) and drive in the shaft. Screw the cover to the accelerating pump making sure that the pump diaphragm is correctly positioned. Screw the accelerating pump to the carburetor.

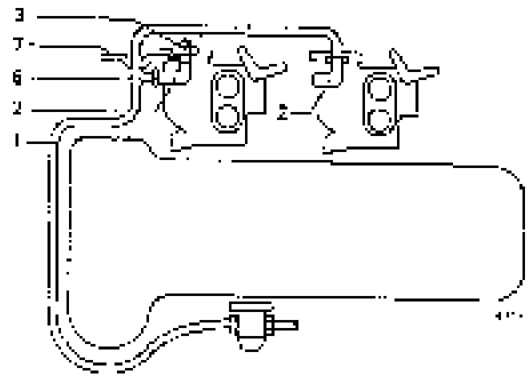


Fig. 07 0/25

1 Fuel pressure line
2 Connections at carburetor cover
3 Fuel return valve
5 Threaded union
7 Hole for fuel return line

If necessary, use a new rubberised fabric gasket (see Fig. 07–0/24).

11. Remove the extension for the filler neck of the fuel tank. As shown in Fig. 07–0/26 drill a 9.5 mm diameter hole into the filler tube (14) of the extension and braze the union (11) D 6 DIN 7613 for connecting the fuel return line.

12. Fit the front part (12) of the fuel return line onto the chassis base panel along the propeller shaft cover and fasten it with six fixing clips using oval head tapping screws and spring washers (Fig. 07–0/27).

Note: a) When fitting the front part of the fuel return line make sure that there is enough space for the front end of the line between the right longitudinal member of the chassis and the subframe. Fasten the line to the longitudinal member in such a way that it cannot be damaged by the movements of the subframe.

b) In order to avoid damage to the fuel return line (12) grind down the welding seam along the longitudinal member over a length of approx. 10 cm (see Fig. 07–0/27).

13. Slide the hose (7) onto the fuel return line (12) and fasten with a hose clip.

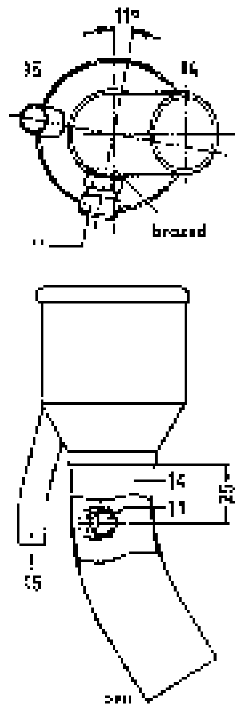


Fig. 07–0/26

11 Fuel return line union
14 Fuel filler tube
15 Pipe for air vent line

14. Fit the rear part (13) of the fuel return line above the chassis cross member and connect to the front part (12) of the line. Then fasten the line (13) to the chassis base panel by three fixing clips using oval head tapping screws and spring washers (see Fig. 07–0/27).

15. Install the extension of the fuel tank filler neck making sure that the hoses and the upper and lower parts of the rubber cuff are correctly positioned. Connect the fuel return line.

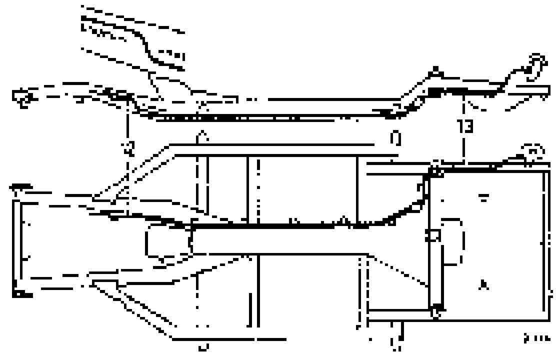


Fig. 07-0/27

12 Fuel return line (front part)
13 Fuel return line (rear part)

16. Adjust the injection amount of the accelerating pump (see Job No. 01-3, Section H).

17. Detach the spring-loaded push rod at the throttle valve lever of the front carburetor. Then back off the idle adjustment screw until the throttle valve of stage 1 is completely closed. Turn in the adjusting screw (10) on the pump arm until the return valve is completely closed. Then back the adjusting screw out again until the valve pin of the return valve has travelled the specified distance "a" of 0.4–0.6 mm. Then lock the adjusting screw with the hexagon nut (Fig. 07-0/24).

18. Check the basic adjustment of the carburetor linkage and adjust the idle (see Job No. 01-3, Section K).

List of Parts

Number required	Designation	Part No. or DIN designation
1	Fuel return valve with ring connector	000 070 10 46
1	Pump arm	000 070 13 21
1	Fuel pressure line	180 070 11 32
1	* Fuel return line (front part)	180 470 00 72
1	* Fuel return line (rear part)	180 470 01 72
9	* Fixing clips	1×8 DIN 72571
9	* Spring washers	B 5 DIN 137
9	* Oval head tapping screws	B 4.2×9.5 DIN 7981
1	* Fuel hose	B 8×12×480 DIN 73379
2	* Hose clips	S 15/9 Zy N 283 a
1	* Union	D 6 DIN 7613

Note: In some engines the fuel return valve (without ring connector), the pump arm and the fuel pressure line have already been installed as standard parts.

In these cases only the fuel return line has to be installed subsequently in order to make the scavenging device complete. For this purpose the parts marked with an asterisk and a ring connector (Part No. 000 990 19 88) are required.

E. Technical Specifications of Solex Compound Downdraft Carburetor Type 32 PAITA

Details of the Carburetor	Model 220 S	
	Stage 1	Stage 2
Air horn "K"	23	27
Main jet "Gg"	0125	0130
Air correction jet "a"	200	190 c with mixing tube
Mixing tube "s"	44	..
Mixing tube holder with polyamide ball valve (reserve)	5.7	—
Idle fuel jet "g"	47.5	.
Idle air jet "u"	1.8	.
Idle air bore	1.5	..
Accelerating pump	No. 841 (neutral)	
Injection amount cc/stroke	1.1—1.3	
Pump jet	80	
Injection tube	high (0.5 graded)	
Starter fuel jet	100	
Starter air bore in starter rotary slide valve	3.0	
Float needle valve	2.0	
Float weight (float made of nylon) g	7.3	
Fuel level mm	19—21	
Angle of inclination of throttle valves	8°	17°
Angle of inclination of vacuum valve	—	170
By-pass bores	1.15/1.15	—
Filling capacity of oil shock-absorber Engine oil SAE 10 W cm³	—	approx. 1.2

Note: a) As from Engine End No. N 65 05174 and Z 65 02038 the carburetors have been equipped with a mixing tube holder (reserve) 5.7. Up to Engine End Nos N 65 05173 and Z 65 02037 a mixing tube holder (reserve) 5.5 was installed.

b) As from Engine End No. 65 03594 the idle air jet "u" 1.8 has been installed as a standard part. Up to Engine End No. 65 03593 an idle air jet "u" 1.2 was used. The carburetors on these engines should always be subsequently equipped with an idle air jet "u" 1.8.

IV. Compound Cross-Draft Carburetor for Model 190 SL

A. General

Model 190 SL is equipped with two Solex carburetors Type 44 PHH. These horizontal compound carburetors are also known as cross-draft carburetors and have been developed for sports cars with high maximum speeds. They incorporate the latest advances in carburetor design (Figs. 07-0/28 and 07-0/29).

Solex Carburetor Type 44 PHH

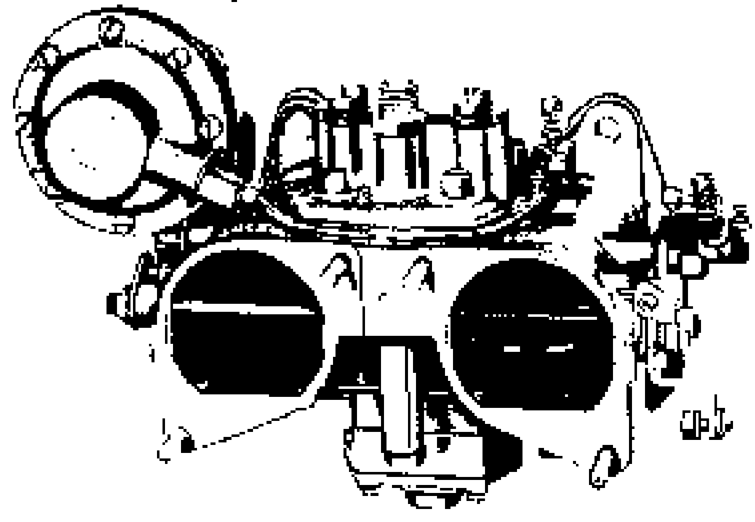


Fig. 07–0/28

Air suction tube side

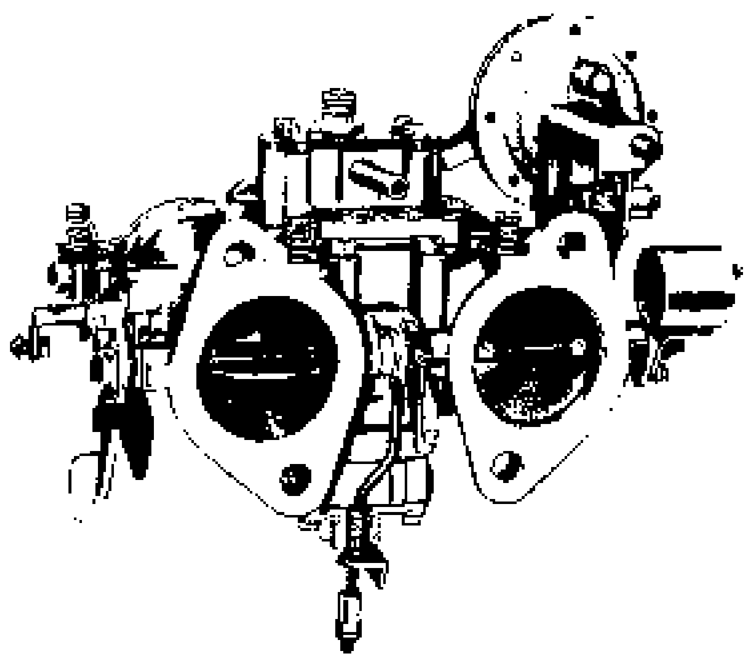


Fig. 07–0/29

Engine side

Two versions of this carburetor have been installed in cars of Model 190 SL. The 1st version has a sand-cast carburetor housing (installed up to Engine End No. 55 00708) and the 2nd version has a die-cast carburetor housing (installed as from Engine End No. 55 00709). The two versions of the carburetor work on the same principle (Figs. 07-0/30 and 07-0/31).

The subsequent installation of die-cast carburetors is described in Job No. 01-4.

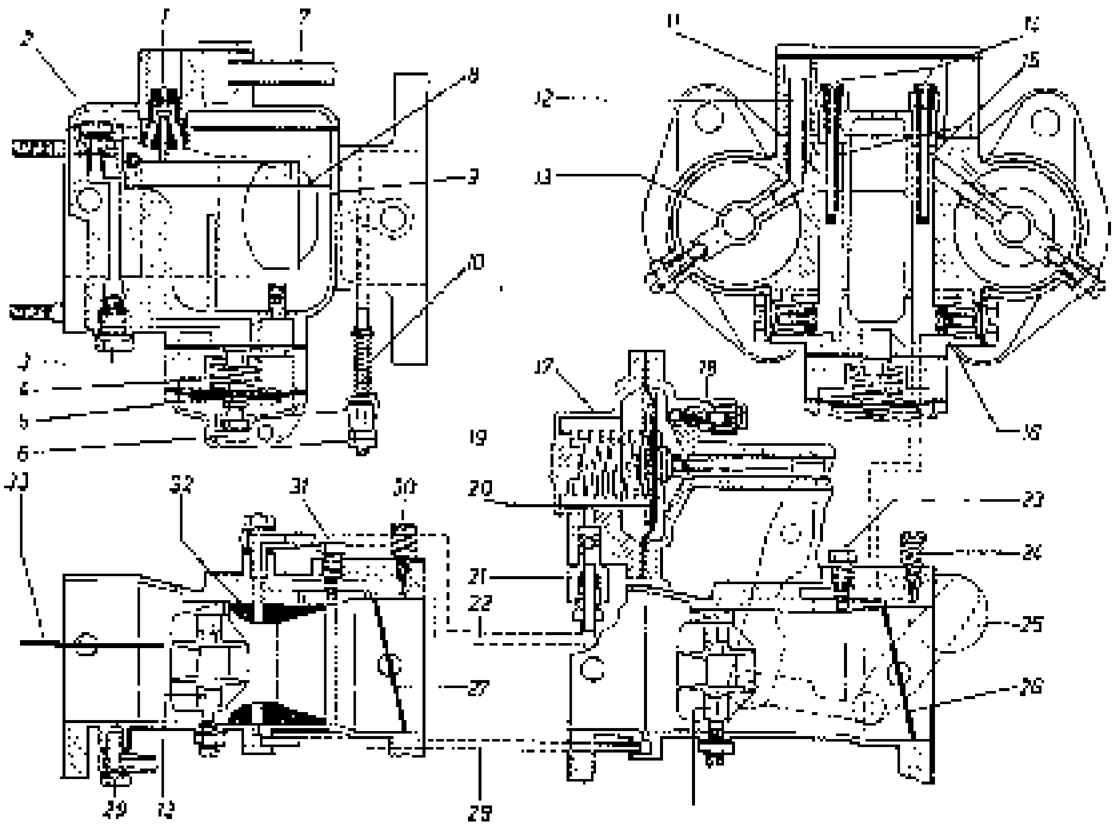


Fig. 07-0/30

Salex Carburetor Type 44 PHH

(Die-cast carburetor)

I Stage 1 II Stage 2

1 Float needle valve
2 Pump jet
3 Ball valve for accelerating pump
4 Diaphragm spring
5 Pump diaphragm
6 Pump cover
7 Connection for fuel overflow line and float chamber ventilation
8 Float
9 Float chamber
10 Connecting rod with pressure spring and adjusting nuts
11 Carburetor cover
12 Overflow control line
13 Diffuser
14 Air correction jets
15 Mixing tubes
16 Main jet plug with main jets
17 Vacuum box
18 Ball valve (safety valve on atmospheric side)
19 Diaphragm spring
20 Diaphragm
21 Ball valve (safety valve on vacuum side)
22 Vacuum line
23 Idle fuel jet of stage 2
24 Idle mixture adjustment screw of stage 2
25 Throttle valve shaft of stage 2 with counterweight
26 Throttle valve of stage 2
27 Throttle valve of stage 1
28 Fuel suction line
29 Union for fuel outlet line
30 Idle mixture adjustment screw of stage 1
31 Idle fuel jet of stage 1
32 Air horn
33 Choke valve

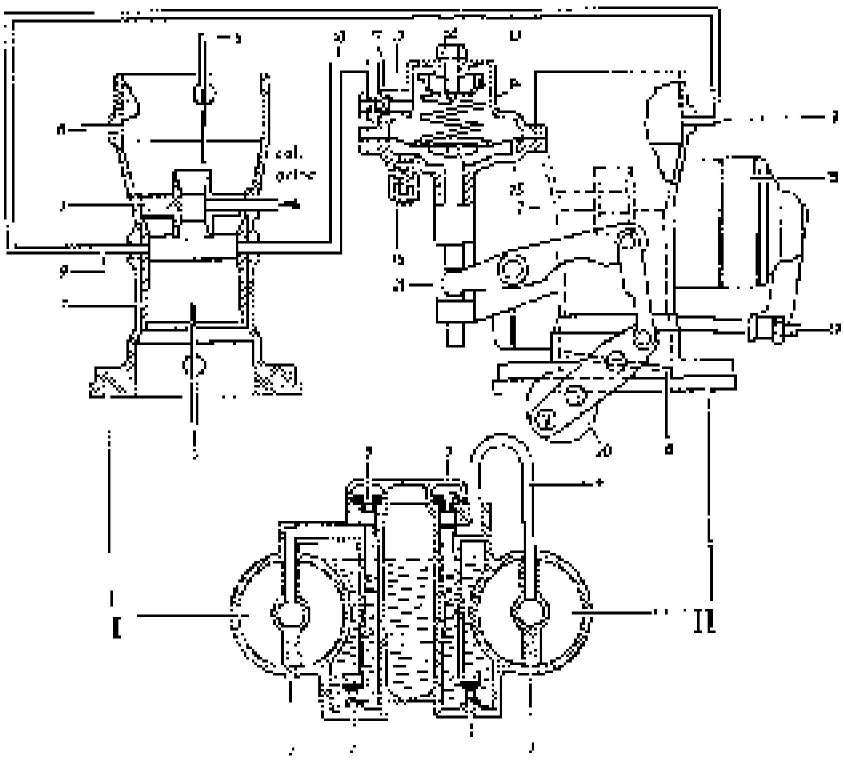


Fig. 07–0/31

Solex Carburetor Type 44 PHH

(Sand-cast carburetor)

I Stage 1 — II Stage 2

1 Main jet
2 Air correction jets with mixing tubes
3 Diffuser
4 Overflow control tube
5 Throttle valve of stage 1
6 Choke valve
7 Air horn
8 Throttle valve of stage 2
9 Fuel suction [illegible]
10 Vacuum line to vacuum box
11 Fuel return line
12 Vacuum box
13 Adjusting screw
14 Diaphragm spring
15 Diaphragm with diaphragm rod
16 Ball valve (delay valve) on atmospheric side
17 Ball valve (delay valve) on vacuum side
18 Accelerating pump
19 Connecting rod with pressure spring and adjustment nut
20 Throttle valve lever of stage 2 with counterweight
21 Relay lever

B. Arrangement and Function of the Throttle Valves

The compound cross-draft carburetor has two suction canals with one throttle valve each. Each suction canal forms one "stage" and there is no connection between the throttle valve (27) of stage 1 and the throttle valve (26) of stage 2 (see Fig. 07–0/30). Whereas the throttle valve shaft of stage 1 is actuated as usual via the throttle valve lever (38), the throttle valve of stage 2 is opened automatically via the vacuum box (17). The diaphragm (20) in the vacuum box is connected to the throttle valve lever (25) of stage 2 by means of the diaphragm rod (34), the relay lever (35) and the relay arm (36). In the "at rest" position the diaphragm (20) is pushed to the right by the diaphragm spring (19) and thus closes the throttle valve of stage 2.

The counterweight on the throttle valve lever (25) prevents the throttle valve of stage 2 from fluttering when it is closed. The space to the left (spring side) of the diaphragm in the vacuum box is connected via the vacuum line (22) to the suction canal of stage 1 at the narrowest point of the air horn (32).
The space to the right of the diaphragm (atmosphere side) is under atmospheric pressure. The vacuum obtaining in the air horn of stage 1 when the throttle valve is fully open causes the throttle valve (26) of stage 2 to open at an engine speed of approx. 3500 rpm. The two ball valves (delay valves) (21) on the vacuum side and (18) on the atmosphere side of the vacuum box prevent a sudden opening of the throttle valve of stage 2 (Figs. 07–0/32 and 07–0/33).

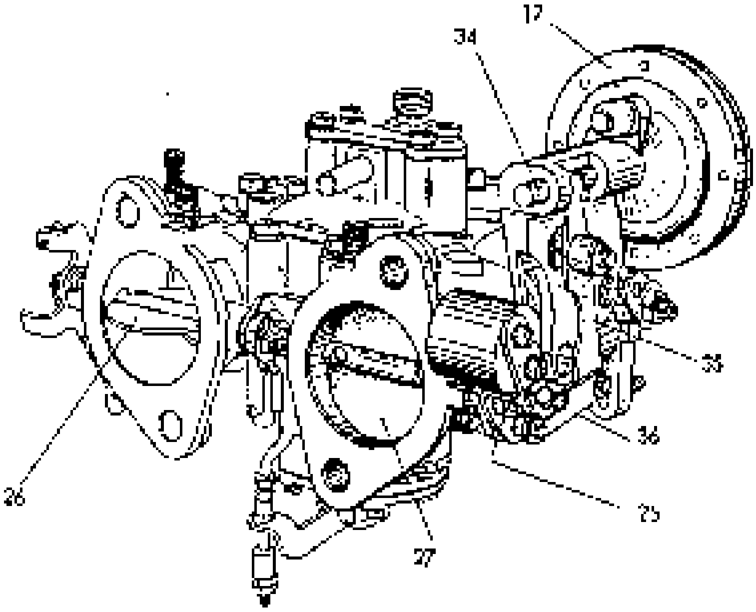


Fig. 07–0/32

Throttle valve of stage 2 not yet operative
(Stage 1 in full-load position)

17 Vacuum box
25 Throttle valve lever of stage 2 with counterweight
26 Throttle valve of stage 2
27 Throttle valve of stage 1
34 Diaphragm rod
35 Relay lever
36 Relay arm

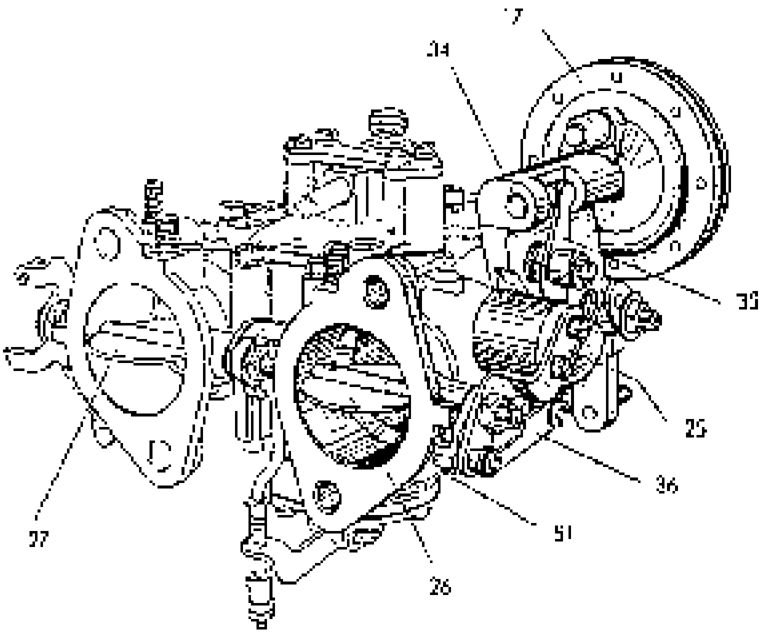


Fig. 07–0/33

Throttle valve of stage 2 operative
(Stages 1 and 2 in full-load position)

17 Vacuum box
25 Throttle valve lever of stage 2
with counterweight
26 Throttle valve of stage 2
27 Throttle valve of stage 1
34 Diaphragm rod
35 Relay lever
36 Relay arm
51 Aperture limiting screw for
throttle valve of stage 2

When the accelerator pedal is released, the so-called automatic return mechanism of stage 2 causes the throttle valve of stage 2 to be closed by the throttle valve shaft of stage 1. The automatic return mechanism consists of the relay lever (59) on the throttle valve shaft (53) of stage 1, the set screw (69), the clamping strap (67) of the clamping screw (68) and the abutment screw (70) screwed into the throttle valve shaft (61) of stage 2 (Fig. 07–0/34).

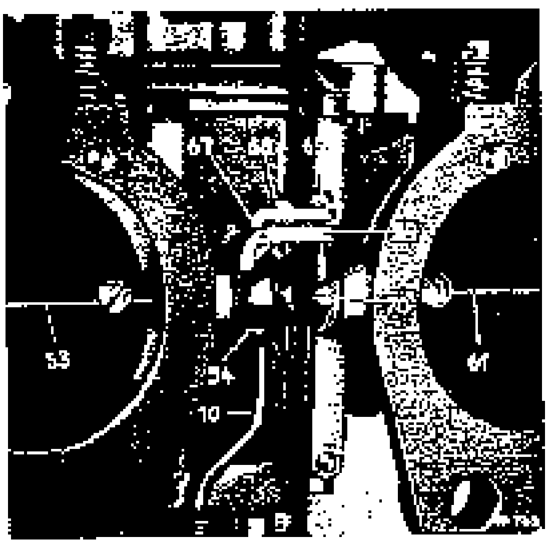


Fig. 07–0/34

10 Connecting rod with pressure spring
53 Throttle valve shaft of stage 1
54 Transmission lever for connecting rod
of accelerating pump
59 Relay lever
61 Throttle valve shaft of stage 2
67 Clamping strap
68 Button head screw (clamping screw)
69 Button head screw (set screw)
70 Abutment screw

In the idle position of the carburetor linkage the set screw (69) must rest against the abutment screw (70) without any clearance.

When the two throttle valves of stages 1 and 2 are fully opened, the set screw also rests against the abutment screw, so that the throttle valve shaft of stage 1 makes stage 2 automatically inoperative when the accelerator pedal is released.

The automatic return mechanism of stage 2 should be adjusted after the idle adjustment has been made (see Job No. 07–3, Section K).

C. Starter Mechanism

The starter mechanism of the carburetor works on the choke valve system, a stepless and progressive system in which there is a fixed relationship between choke valve position and start mixture enrichment. The starter mechanism is actuated by a pull knob on the instrument board and a bowden cable. The starter mechanism consists of a choke valve in the suction canal of stage 1; the choke valve shaft (71) is offset from the center of the suction canal.

In the sand-cast carburetors the starter mechanism is located in a special choke valve section screwed to the carburetor housing. The die-cast carburetors have no special choke valve section and the choke valve shaft is located in the carburetor housing itself.

When the starter mechanism is not in operation under normal running conditions, the choke valve (33) is open (Fig. 07–0/35).

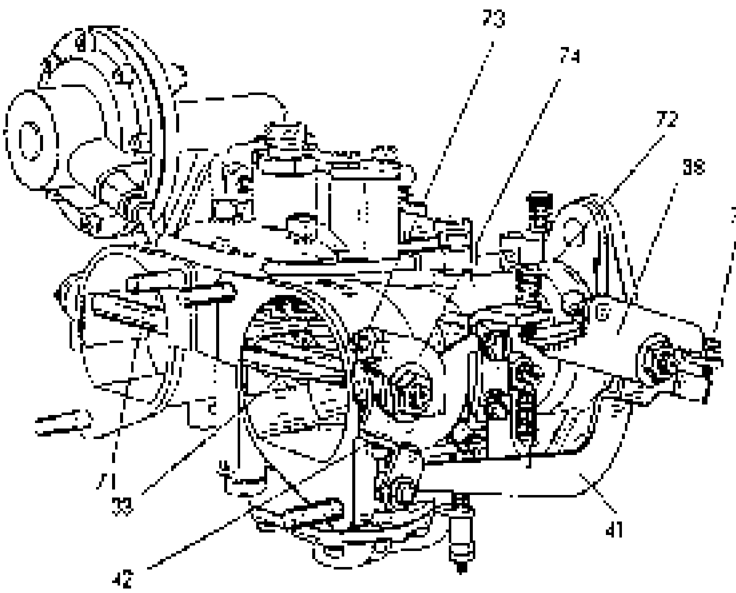


Fig. 07–0/35

Normal running position — Starter mechanism inoperative
(Choke valve open)

33 Choke valve
38 Throttle valve lever of stage 1
39 Adjusting screw
41 Relay lever
42 Choke valve lever with cam plate
71 Choke valve shaft
72 Idle adjustment screw
73 Adjusting screw
74 Abutment

When the knob is pulled out, the starter mechanism is in operation and the choke valve (33) is closed (Fig. 07-0/36).

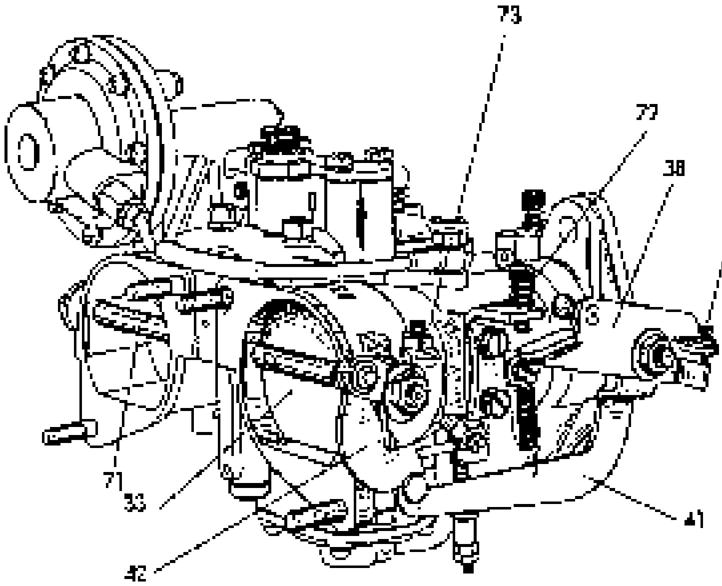


Fig. 07–0/36

Starter mechanism operative
(Choke valve closed)

33 Choke valve
38 Throttle valve lever of stage 1
39 Adjusting screw
41 Relay lever
42 Choke valve lever with cam plate
71 Choke valve shaft
72 Idle adjustment screw
73 Adjusting screw

The choke valve is closed by a coil spring; it is opened by a relay lever when the engine has started.

When the choke valve closes, the throttle valve (27) of stage 1 is automatically opened approx. 5° by the choke valve lever (42) with cam plate and the relay lever (41) (Fig. 07-0/37).

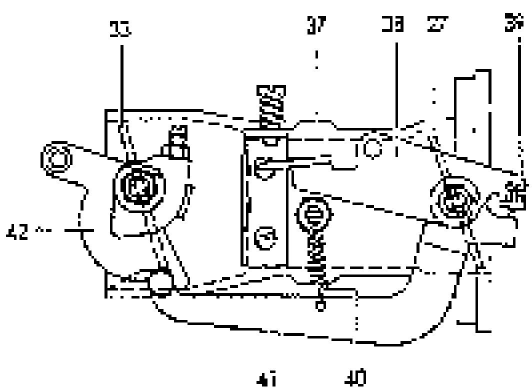


Fig. 07-0/37

Starter mechanism

27 Throttle valve of stage 1
33 Choke valve
37 Carburetor housing
38 Throttle valve lever of stage 1
39 Adjusting screw
40 Torsion spring
41 Relay lever
42 Choke valve lever with cam plate

The throttle valve must open in order to ensure that the vacuum building up in the suction tube can become effective in the mixing chamber of the carburetor and in order to ensure proper starting and running of the engine.

Note: a) The cam plate on the choke valve lever (42) and the relay lever (41) are fitted to the rear carburetor only. The throttle valve on the front carburetor is automatically opened by the control shaft of the carburetor linkage (see Fig. 07-0/35).

b) When the choke valve is closed there must be a clearance of 1.0 mm between the adjusting screw (73) on the abutment (74) and the choke valve lever (42) (see Fig. 07-0/35).

c) When the starter mechanism is inoperative, the choke valve must be fully open. The stop lever on the choke valve shaft must rest against the carburetor housing. This point needs particular attention when the choke cable is being connected (see also Job No. 30-6).

d) When the starter mechanism is inoperative, there must be a clearance of approx. 0.4 mm between the adjusting screw (29) on the throttle valve lever and the relay lever (41) when the carburetor linkage is in the idle position. The tension spring must press the relay lever against the cam plate of the choke valve lever (see Fig. 07-0/35).

Cold Start

When the engine is being started, the closed choke valve (33) produces an effective vacuum in the diffuser (13) of stage 1, so that sufficient fuel is drawn from the main supply system to provide a mixture rich enough to start the engine cold. When the engine has started, the pressure flow regulates the opening of the choke valve (33) against the pressure of the coil spring, with the result that the combustion air necessary for the start mixture can enter (Fig. 07-0/38).

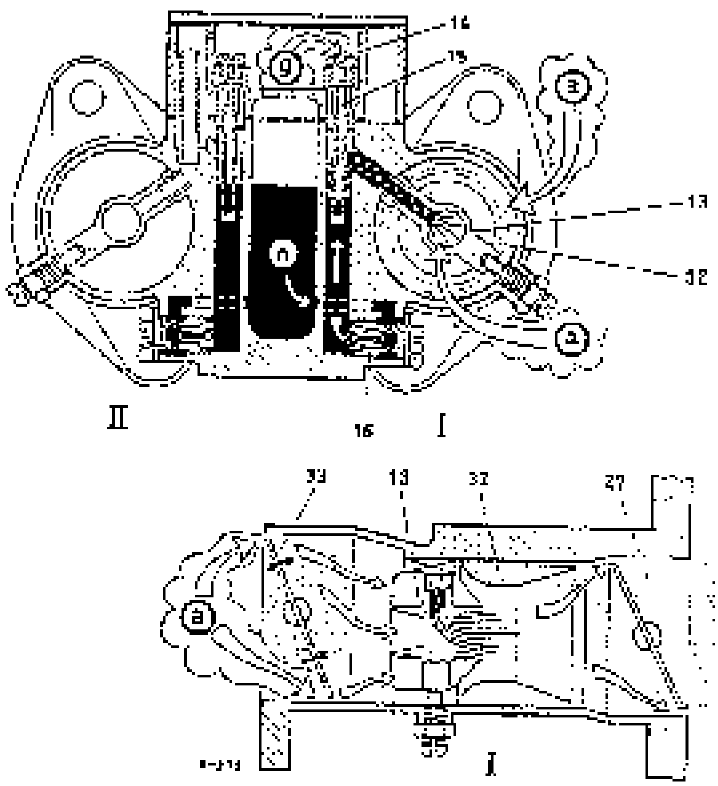


Fig. 07-0/38

Cold start
(After engine has started)

I Stage 1 II Stage 2

a Starter air entry
b Entry of compensating air for main carburetion system
g Fuel feed
13 Diffuser
14 Air correction jet
15 Mixing tube
16 Main jet plug with main jet
31 Throttle valve of stage I
32 Air horn
33 Choke valve

By slowly pushing in the pull knob the engine speed can be adapted to the driving situation.

There is no objection to warming up the engine with the starter mechanism in operation. However, the starter mechanism should be switched off by pushing the knob right in as soon as the engine has reached normal working temperature. When the engine is warm, the knob must not be pulled to start the engine.

D. Idle System

The carburetor has two idle systems, one for stage 1 and one for stage 2. The idle system of stage 1 serves the normal purpose of supplying the engine with the idle mixture required and of ensuring a satisfactory change-over to the main carburetion system.

The idle system of stage 2 only serves to improve speed build-up when stage 2 is brought into operation.

Idle System of Stage 1

The difference between the idle systems in die-cast and sand-cast carburetors is that in the die-cast carburetor the idle air supply is drawn from the mixing chamber in the suction of the carburetor and passes via the recess in the air horn (32) through the idle air bore (43) (replacing the idle air jet) into the idle canal (45), whereas in the sand-cast carburetor the idle air passes into the idle canal through the idle air jet (44) from outside (Figs. 07-0/39 and 07-0/40).

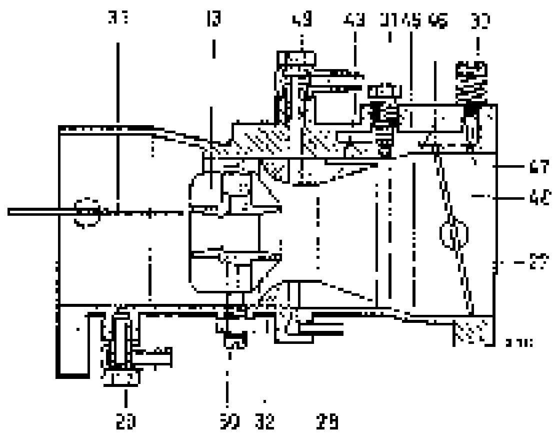


Fig. 07-0/39

Idle system of stage 1
(Die-cast carburetor)

13 Diffuser
27 Throttle valve of stage 1
28 Fuel suction line
29 Union for fuel outlet line
30 Idle mixture adjustment screw of stage 1
31 Idle fuel jet of stage 1
32 Air horn
33 Choke valve
43 Idle air bore of stage 1
45 Idle canal of stage 1
46 By-pass bores of stage 1
47 Idle mixture bore of stage 1
48 Suction canal of stage 1
50 Retaining screw for diffuser

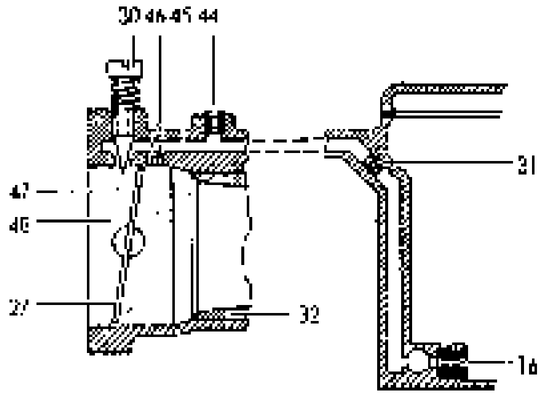


Fig. 07-0/40

Idle system of stage 1
(Sand-cast carburetor)

16 Main jet
27 Throttle valve of stage 1
30 Idle mixture adjustment screw of stage 1
31 Idle fuel jet of stage 1
37 Air horn
44 Idle air jet
45 Idle canal of stage 1
46 By-pass bores of stage 1
47 Idle mixture bore of stage 1
48 Suction canal of stage 1

a) Idle Phase 1

The fuel which is drawn in via the idle fuel jet (31) mixes with the air entering through the idle air bore (43) forming a mixture which then passes into the idle canal (45). When the throttle valve (27) is in the idle position, a further supply of air enters through the rear by-pass bore (46); the idle mixture enters the suction canal through the idle mixture bore (47) and through the front by-pass bore (46) and combines with the air flowing past the throttle valve to form the final idle mixture (Figs. 07-0/39 and 07-0/41).

The section of the idle mixture bore can be varied by the idle mixture adjustment screw (30) (Fig. 07-0/41). The final idle mixture can be leaned out by tightening the idle mixture adjustment screw and enriched by slackening it. The idle speed is adjusted with the idle adjustment screw (72) on the throttle valve lever (38) (see Job No. 01-3, Section K, and Fig. 07-0/36).

b) Idle Phase 2

When the throttle valve is opened slightly, idle mixture emerges both through the idle mixture bore (47) and the rear by-pass bore (46). The two by-pass bores now ensure a smooth change-over from the idle to the main carburetion system (see Figs. 07-0/39 and 07-0/41).

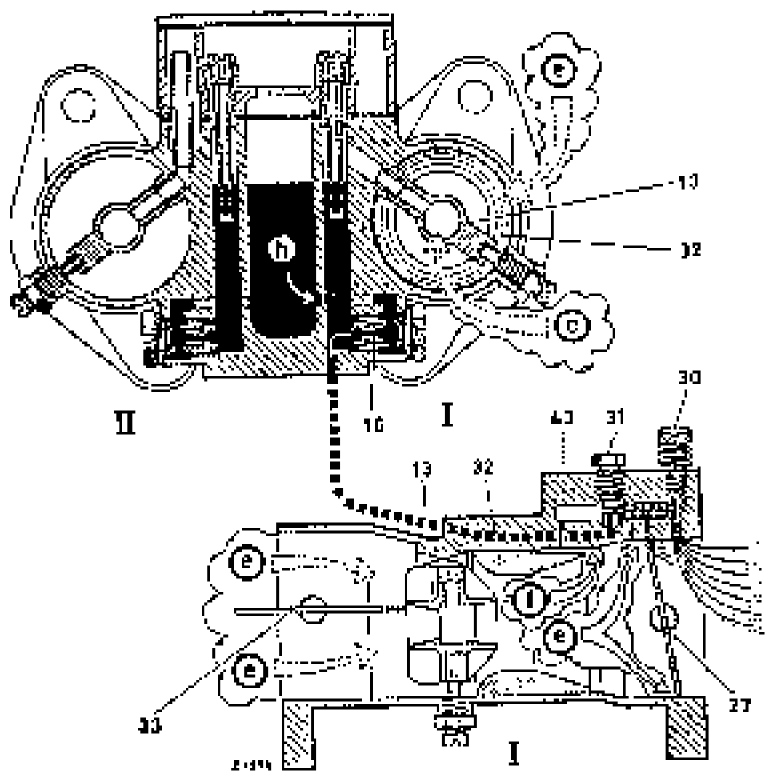


Fig. 07-0/41

Idle — Phase 1

I Stage 1 II Stage 2

e) Entry of main air
c) Entry of idle air
h) Fuel feed

13 Diffuser
32 Main jet plug with main jet
27 Throttle valve of stage 1
33 Idle mixture adjustment screw of stage 1

31 Idle fuel jet of stage 1
10 Air horn
30 Choke valve
43 Idle air bore of stage 1

Idle System of Stage 2

The 2nd stage of the carburetor also has an idle system which is used only to improve the speed build-up when the 2nd stage is brought into operation. When the engine is idling, is in the partial-load range and in the full-load range up to approx. 3500 rpm, the idle system of stage 2 is not in operation, since both the mixture adjustment screw (24) and the throttle valve (26) of stage 2 are closed.

The idle air supply for the idle system of stage 2 of both die-cast and sand-cast carburetors is drawn in from the mixing chamber in the suction canal through the idle air bore (63) (Figs. 07-0/42 and 07-0/43).

Note: As from Engine End No. 65 01 133 the die-cast carburetors have only one by-pass bore in stage 2.

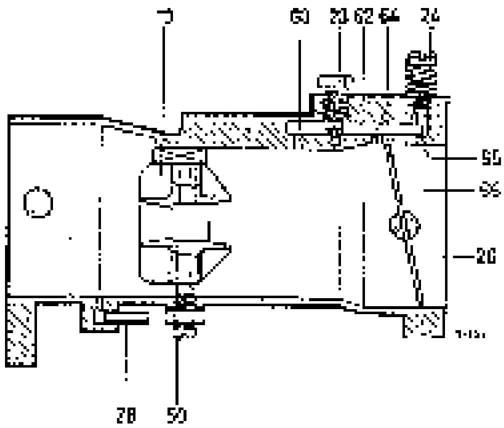


Fig. 07-0/42

Idle system of stage 2
(Die-cast carburetor)

13 Diffuser
23 Idle fuel jet of stage 2
24 Idle mixture adjustment screw of stage 2
26 Throttle valve of stage 2
28 Fuel suction line
30 Retaining screw for diffuser
62 Idle canal of stage 2
63 Idle air bore of stage 2
64 By-pass bores of stage 2
65 Idle mixture bore of stage 2
66 Suction canal of stage 2

When the engine reaches a speed of approx. 3500 rpm under full load, the throttle valve (26) of stage 2 begins to open. The fuel drawn in through the idle fuel jet (23) combines with the air entering through the idle air bore (63) to form a mixture in the idle canal (62). This mixture emerges of the by-pass bores (64) as soon as the throttle valve (26) of stage 2 opens. This additional enrichment of the fuel-air mixture prevents a change-over shock when stage 2 is brought into operation (see Figs. 07-0/42 and 07-0/43).

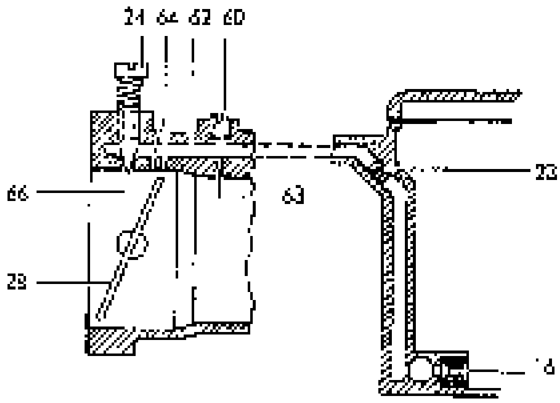


Fig. 07-0/43

Idle system of stage 2
(Sand-cast carburetor)

15 Main jet
23 Idle fuel jet of stage 2
24 Idle mixture adjustment screw of stage 2
26 Throttle valve of stage 2
60 Grub screw
62 Idle canal of stage 2
63 Idle air bore of stage 2
64 By-pass bores of stage 2
66 Suction canal of stage 2

Note: The idle mixture adjustment screw of stage 2 remains closed.

E. Main Carburetion System

The float chamber (9) of the carburetor is located in the center between the two suction canals. The connection (7) connects the float chamber with the outside air via the fuel overflow line. The float chamber is closed at the top by the carburetor cover (11). The cover carries the float valve (T) and the threaded union for the fuel line.

The suction canal of stage 1 has an air horn (32) with a diffuser (13) installed in front of it. The outlet tube for the fuel and the fuel mixture opens into the diffuser. By a canal the outlet tube is connected with a cylindrical cavity which is supplied with fuel from the float chamber via the main jet (16) screwed into the main jet plug. The mixing tube (15), which is held in the carburetor by the air correction jet (14), projects from above into the cylindrical cavity.

The suction canal of stage 2 has the same type of diffuser as stage 1, but it has no air horn because stage 2 is only brought into operation at relatively high engine speeds. Main jet plug with main jet, mixing tube and air correction jet are arranged symmetrically to stage 1.

Particular importance attaches to the overflow control tube (12) in stage 2 through which the fuel mixture must pass on its way to the outlet tube of the diffuser (13) of stage 2. This device is necessary in order to counteract the effect of the partial vacuum which is formed in the air suction tube between carburetor and air filter. When the throttle valve of stage 2 is closed, this partial vacuum acts also on the main carburetion system of this stage and would flood it, i. e. without the overflow control tube, fuel would be drawn from the diffuser and – mixed with inlet air – would pass to stage 1 through the air suction tube (Fig. 07-0/44)

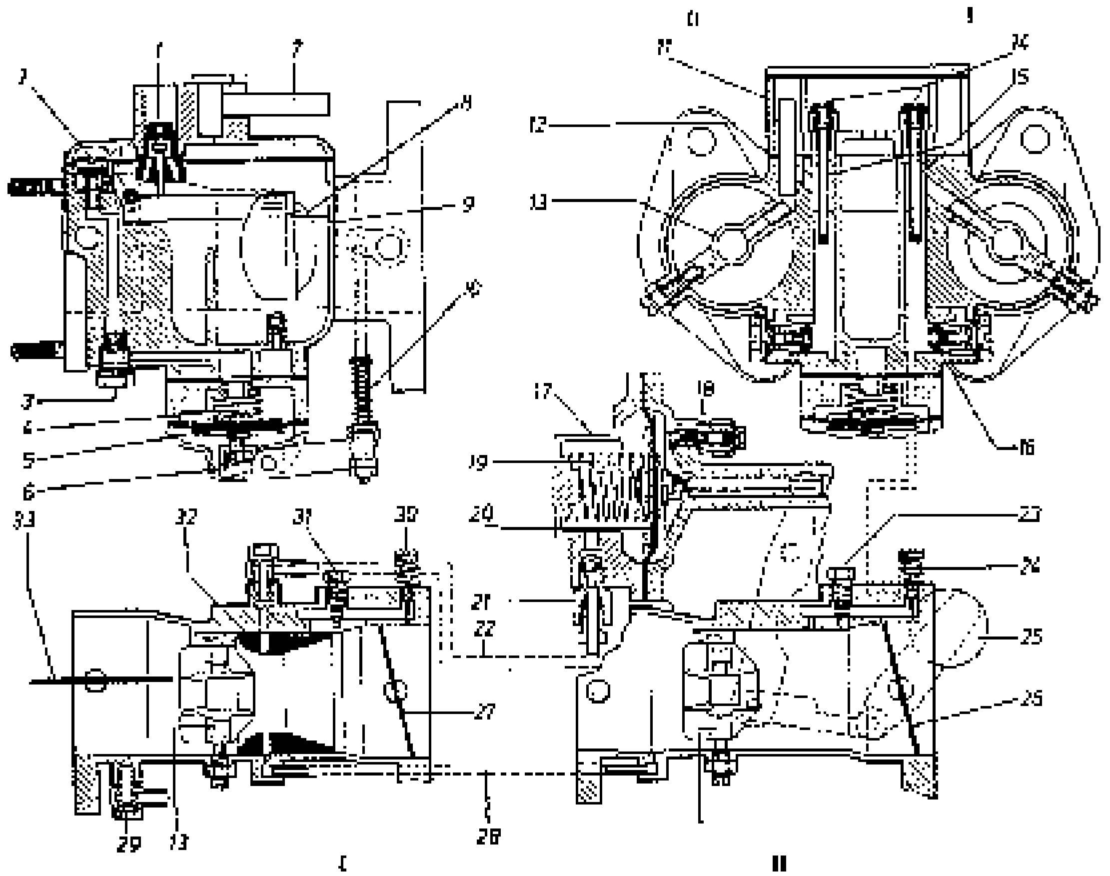


Fig. 07-0/44

I Stage 1 II Stage 2

1 Float needle valve
2 Pump jet
3 Ball valve for accelerating pump
4 Diaphragm spring
5 Pump diaphragm
6 Pump arm
7 Connection for fuel overflow line and float chamber ventilation
8 Float
9 Float chamber
10 Connecting rod with pressure spring and adjusting nuts
11 Carburetor cover
12 Overflow control tube
13 Diffuser
14 Air correction jets
15 Mixing tubes
16 Main jet plug with main jets
17 Vacuum line
18 Ball valve (delay valve on atmosphere side)
19 Diaphragm spring
20 Diaphragm
21 Ball valve (delay valve on vacuum side)
22 Vacuum line
23 Idle fuel jet of stage 2
24 Idle mixture adjustment screw of stage 2
25 Throttle valve lever of stage 2 with counterweight
26 Throttle valve of stage 2
27 Throttle valve of stage 1
28 Fuel suction line
29 Union for fuel outlet line
30 Idle mixture adjustment screw of stage 1
31 Idle fuel jet of stage 1
32 Air horn
33 Choke valve

Note: a) Fig 07-0/44 shows the die-cast carburetor. As far as the main carburation system is concerned, the sand-cast carburetor works the same way, the only difference is in the arrangement of the canals and jets (see 07-0/31)

b) In the die-cast carburetor the compensating air passes to the correction jet through the fuel overflow line and in the sand-cast carburetor through two openings which are located at the side of the carburetor cover and are covered by strainers.

c) In both types of carburetors the float chamber is ventilated through the fuel overflow line whose connection has a 6 mm internal diameter in the die-cast carburetor and a 4 mm internal diameter in the sand-cast carburetor.

d) Arrangement and mounting of the float in the carburetor cover are the same for both types. The floats themselves have the same weight, but differ in their shape and must not be mixed up.

e) In the sand-cast carburetor the overflow control tube is screwed to the carburetor housing, whereas in the die-cast carburetor it is located inside the carburetor (see Figs. 07-0/31 and 07-0/44).

a) Partial-Load and Full-Load Range at Low Engine Speed

(Only stage 1 in operation)

Normally the fuel level is the same in the float chamber and in the two cylindrical cavities into which the fuel flows through the main jets (16).

When the throttle valve (27) of stage 1 is opened, the partial vacuum begins to have an effect on the outlet tube of the diffuser. As a result, fuel is drawn from the cylindrical cavity via the outlet tube of the diffuser and is mixed with the air entering through the air inlet branch. Compensating air enters through the air correction jet (14) in progressively larger amounts, passes through the bores of the mixing tube (35) and combines with the fuel flowing through the main jet to form a mixture. Air enrichment increases with increasing engine speed, thus preventing overenrichment of the mixture (Fig. 07-0/45).

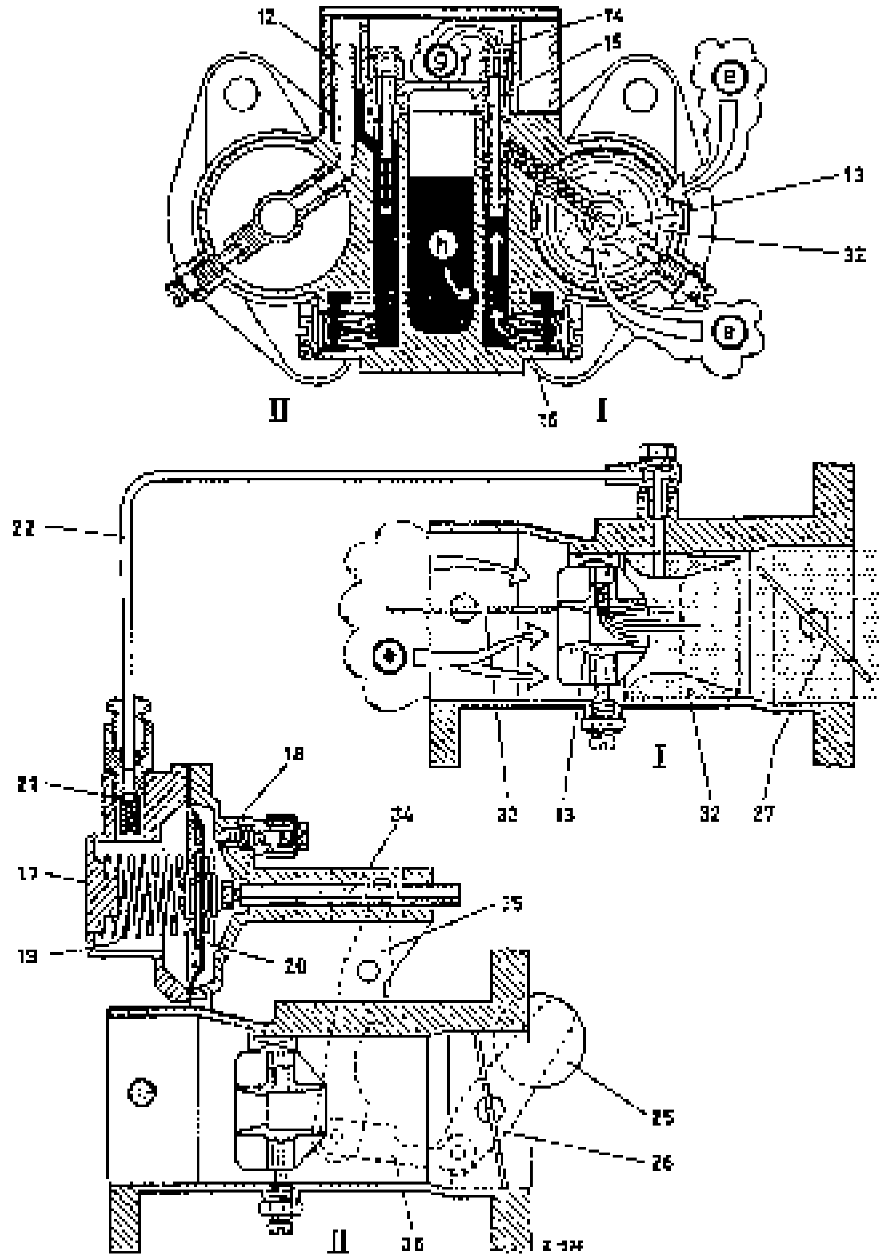


Fig. 07-0/45

Function in partial-load range and
in full-load range at low engine speed
(Only stage I in operation)

I Stage I   II Stage 2

e) Entry of main air
g) Entry of compensating air for main carburetion system
h) Fuel feed

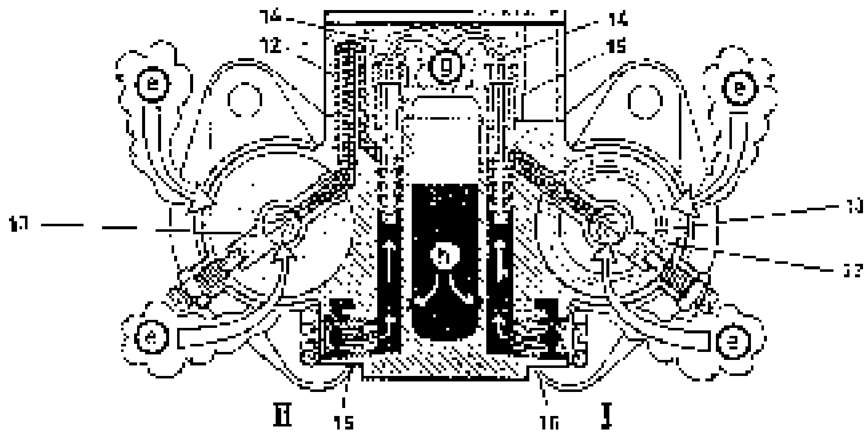
12 Overflow control tube
13 Diffuser
14 Air correction jets
15 Mixing tubes
16 Main jet plug with main jets
17 Vacuum box
18 Ball valve (delay valve on atmosphere side)
19 Diaphragm spring
20 Diaphragm
21 Ball valve (delay valve on vacuum side)

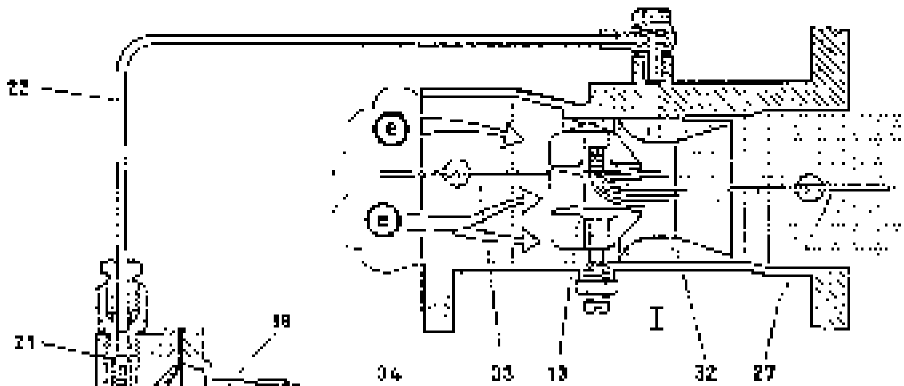
22 Vacuum line
25 Throttle valve lever of stage 2 with counterweight
26 Throttle valve of stage 2
27 Throttle valve of stage 1
32 Air horn
33 Choke valve
34 Diaphragm rod
35 Relay lever
36 Relay arm

b) Full-Load Range at High Engine Speed

(Stage 2 brought into operation)

When the engine has reached approx. 3500 rpm with the throttle valve of stage I completely open, the partial vacuum in the air horn has increased to such an extent that through the vacuum line (22) it begins to operate the vacuum box (17) by overcoming the weight and the spring pressure. As a result, the throttle valve (26) of stage 2 begins to open; the change-over is made easier by the fuel mixture which emerges through the by-pass bores (64) of the idle system of stage 2. With increasing throttle valve opening the supply of mixture is taken over by the main jet system of stage 2, so that the engine can reach its full output.





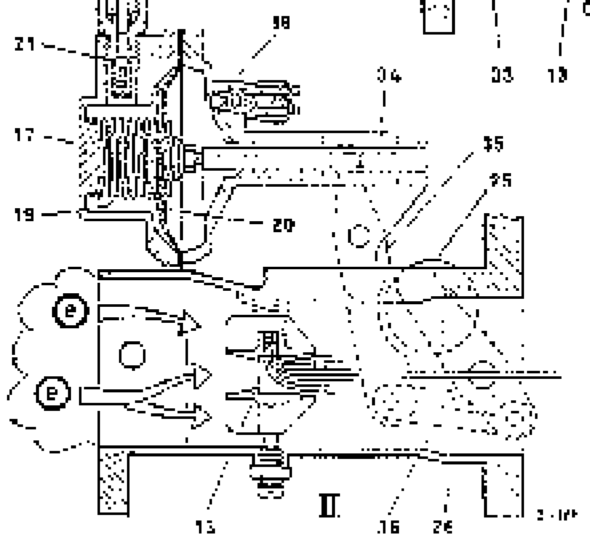


Fig. 07-0/46

Function in full-load range at high engine speed (stage 2 brought into operation)

I Stage 1 II Stage 2

e) Entry of main air
a) Entry of compensating air for main carburetion system
h) Fuel level

12 Overflow control tube
13 Diffuser
14 Air correction jets
15 Mixing tubes
16 Main jet plug with main jets
17 Vacuum box
18 Ball valve (Relay valve on atmosphere side)
19 Diaphragm spring
20 Diaphragm
21 Ball valve (Relay valve on vacuum side)
22 Vacuum line
25 Throttle valve lever of stage 2 with counterweight
26 Throttle valve of stage 2
27 Throttle valve of stage 1
32 Air horn
33 Choke valve
34 Diaphragm rod
35 Relay lever
36 Relay arm

Note: The amount of vacuum required to bring the 2nd stage into operation can only be achieved under full load. Over the whole partial-load range only stage 1 is in operation.

F. Accelerating Pump

The "neutral" pump No. 82 is used as an accelerating pump for both the sand-cast and the die-cast carburetor. With this type of pump the engine draws in fuel from the pump system via the injection tube according to the degree of vacuum obtaining in the intake pipe.

However, the main task of the accelerating pump is to spray additional fuel into the mixing chamber of the suction canal of stage 1 when the accelerator pedal is depressed; as a result, speed build-up and acceleration are improved.

The accelerating pump is located at the bottom of the carburetor housing between the two suction canals (Fig. 07-0/47).

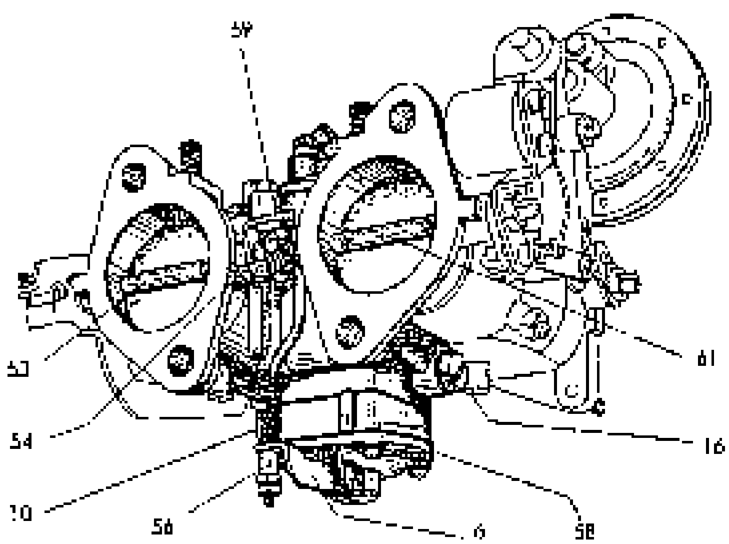


Fig. 07-0/47

6 Pump arm
16 Connecting rod with pressure spring
10 Main jet plug with main jet
53 Throttle valve shaft of stage 1
54 Transmission lever
55 Adjusting nuts
58 Accelerating pump
59 Relay lever for automatic return mechanism of stage 2
61 Throttle valve shaft of stage 2

The pump arm (6) of the accelerating pump is connected to the throttle valve shaft (53) of stage 1 by the adjustable connecting rod (10) and the transmission lever (54). When the throttle valve is closed, the diaphragm spring (4) presses the pump diaphragm (5) outward. Since the pump chamber is connected with the float chamber via the ball valve (55) the pump chamber is filled with fuel.

When the accelerator pedal is depressed, the pump arm (6) is moved via the connecting rod (10). The pump arm in turn presses the diaphragm (5) inward so that the fuel which is in front of the diaphragm is injected through the ball valve (3), the pump jet (2) and the graded injection tube (52).

During the injection period the ball valve (55) now operating as a check valve is closed. When the accelerator pedal is released, the diaphragm spring (4) presses the diaphragm (5) back. The ball valve (55) now operates as a through-way valve, whereas the ball valve (3) works as a check valve and prevents air from entering the pump system from the suction canal (Fig. 07-0/48).

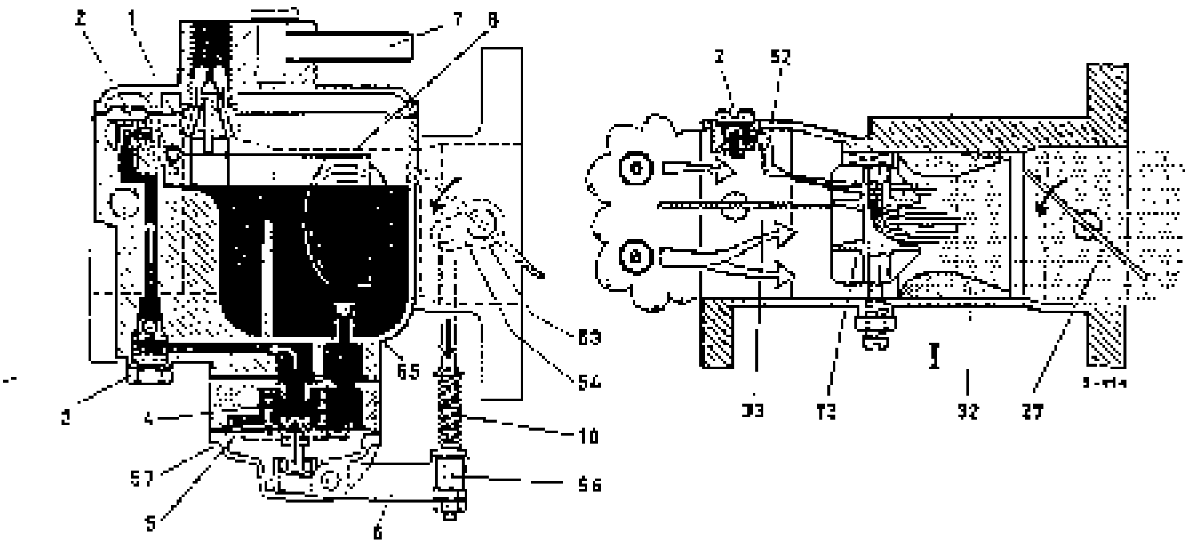


Fig. 07-0/48

Acceleration

I Stage 1

Entry of main air

1 Float needle valve
2 Pump jet
3 Ball valve of accelerating pump
4 Diaphragm spring
5 Pump diaphragm
6 Pump arm
7 Connection for fuel overflow line and float chamber ventilation
8 Float
10 Connecting rod with pressure spring
13 Diffuser
27 Throttle valve of stage 1
32 Air horn
33 Choke valve
52 Injector tube
53 Throttle valve shaft of stage 1
54 Transmission lever
55 Ball valve for accelerating pump
56 Adjusting nuts
57 Cover

Depending on the degree of vacuum obtaining in the suction canal, extra fuel can be drawn in from the pump system without operating the pump arm of the accelerating pump.

The injection amount of the accelerating pump can be varied by adjusting the adjusting nuts (56) on the connecting rod (10). When the nuts are tightened, the pump stroke and in consequence the injection amount is increased and vice versa.

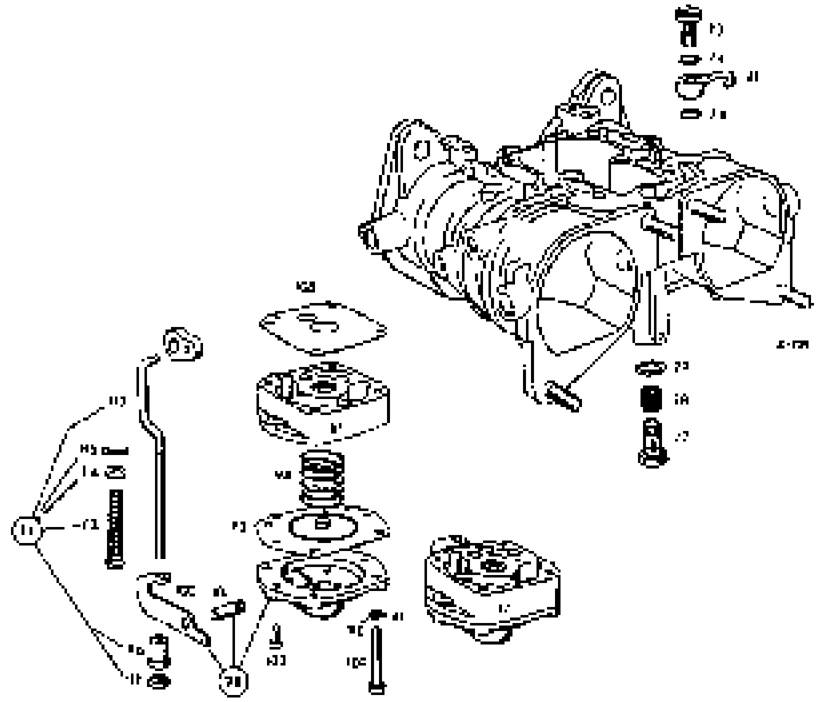


Fig. 07–0/49

Accelerating pump
(Die-cast carburetor)

13 Transmission lever on throttle valve shaft page 1
73 Pump jet
74 Fiber sealing ring
77 Ball valve
78 Strainer for ball valve
79 Fiber sealing ring
81 Injection tube
91 Accelerating pump
96 Pump diaphragm
98 Diaphragm spring
99 Cover (complete)
100 Pump arm
101 Pump arm shaft
102 Oval head countersunk screw
103 Rubberized-fabric gasket
105 Cheese head screw
110 Lock washer
111 Connecting rod (complete)
112 Connecting rod
113 Pressure spring
114 Washer
115 Cotter pin
116 Shoulder nut (adjusting nut)
117 Hexagon nut (lock nut)

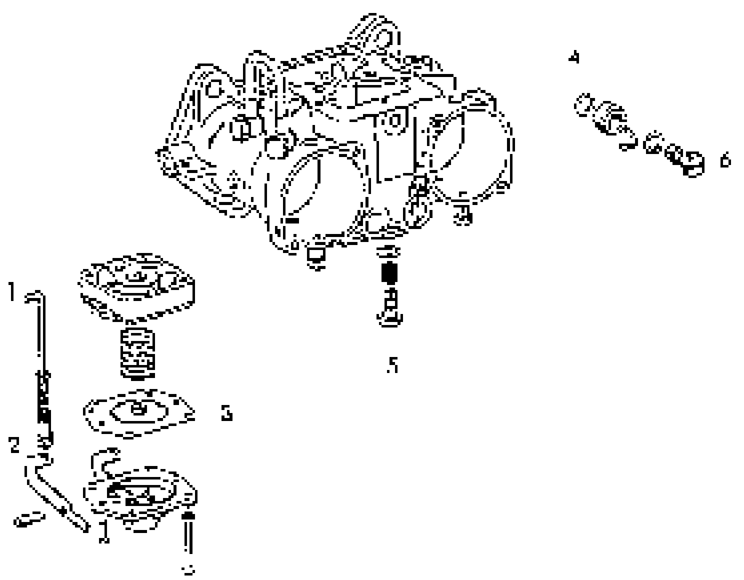


Fig. 07–0/50

Accelerating pump
(Sand-cast carburetor)

1 Connecting rod (complete)
2 Pump arm
3 Pump diaphragm
4 Injection tube
5 Ball valve
6 Pump jet

The adjusting nuts (56) must not be tightened until the pump arm (6) moves away from the diaphragm since in that case injection would not take place immediately the throttle valve is opened. The injection amount of the accelerating pump should be 0.4–0.6 cc/stroke. Adjustment of the injection amount is described in Job No. 01-3, Section H.

Note: a) This version of the neutral accelerating pump has no plate valve as a stop for the diaphragm.

b) In the case of the die-cast carburetor the fuel line to the accelerating pump is calibrated by the ball valve (55) with a diameter of 0.5 mm (installed as a standard part as from Engine End No. 55 01523). In all engines with Engine End Nos between 55 00709 (in which the first die-cast carburetors were installed) and 55 01822 the fuel line to the accelerating pump can be calibrated subsequently by installing the calibrated sleeve Part No. 000 071 03 40 on the ball valve (see also Job No. 01-3, Section I).

c) Sand-cast and die-cast carburetors differ in the arrangement of the canals in the carburetor housing and in the arrangement and design of the injection tube and the pump jet (Figs. 07-0/49 and 07-0/50).

G. Fuel Exhaust Device

When the throttle valves of stages 1 and 2 are suddenly closed at high engine speeds, some fuel may remain in the suction canals of the carburetors.

This would enrich the mixture in stage 2 and would have an undesirable effect both at idling speed and when the throttle valves are opened. For this reason the fuel left in stage 2 is drawn off via the fuel suction line (4) and passes into the suction canals of stage 1 and from there into the mixing chambers of the suction canals.

When the engine is not running, the fuel accumulating in stage 1 of both carburetors runs off through the fuel outlet line (16) and ensures that the engine will start properly when hot. The arrangement of the fuel suction line and the fuel outlet line for the die-cast carburetors is shown in Fig. 07–0/51.

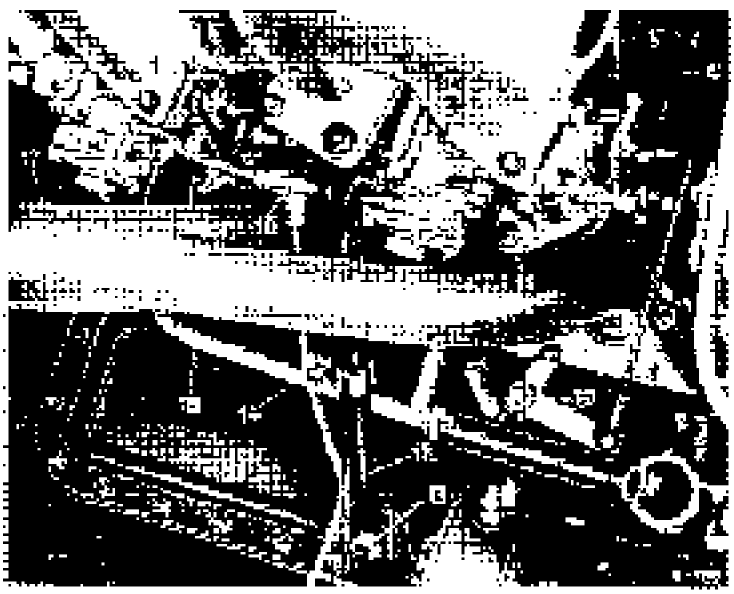


Fig. 07–0/51

1 Choke valve lever of rear carburetor
2 Choke valve lever of front carburetor
3 Hexagon nut
4 Fuel suction line
5 Return spring for carburetor linkage
6 Push rod from control shaft to throttle valve lever of front carburetor
7 Throttle valve lever
8 Push rod from angle lever on crankcase to control shaft
9 Fuel overflow line
10 Angle lever
11 Hexagon screw
12 Strut for supporting air suction tube
13 Hexagon screw
14 Pipe clip
15 Cooling water return line for pre-heating of intake pipe
16 Fuel outlet line
17 Exhaust manifold

In the die-cast carburetors the fuel suction line is firmly connected to the carburetor housing, whereas in the sandcast carburetors the line is connected from the outside (Fig. 07–0/52).

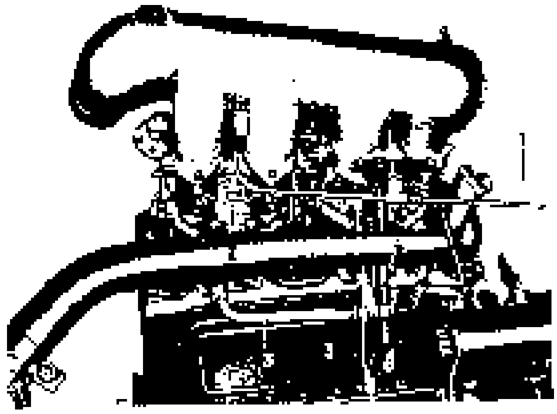


Fig. 07–0/52

1 Fuel overflow line
2 Fuel suction line
3 Fuel outlet line
4 Strut for supporting air suction tube
5 Cooling water return line for preheating of intake pipe

H. Hot-Start Mechanism

In order to ensure that the engine also starts at high outside temperatures a hot-start mechanism is incorporated in the carburetor system; it is operated by a pull knob and bowden cable from the instrument panel. When the hot-start control is pulled, the throttle valves of stage 2 are forced open by the angle levers. This enables the evaporated fuel to be drawn off quickly. As soon as the engine has started, the pull knob should be released quickly. The accelerator pedal must be depressed fully before the hot-start control is pulled since otherwise the throttle valves of stage 1 would be opened via the automatic return mechanism levers of stage 2 and this might result in a distortion of the levers (Figs. 07–0/53 and 07–0/54).

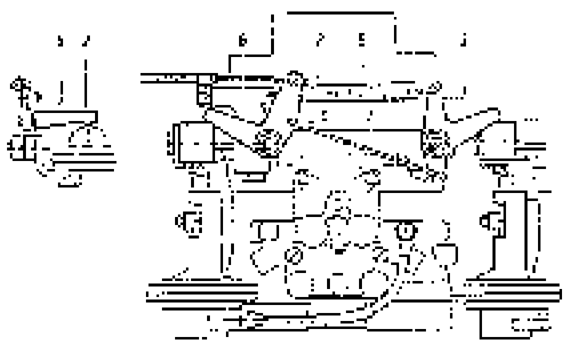


Fig. 07–0/53

1 Bearing bracket
2 Angle lever for rear carburetor
3 Angle lever for front carburetor
4 Connecting strap
5 Return spring
6 Bracket for return spring on bearing bracket

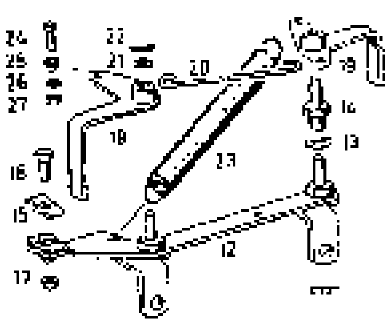


Fig. 07–0/54

12 Bearing bracket for hot-start control
13 Spring washer
14 Pivot pin
15 Fixing clip for hot-start control
16 Hexagon screw
17 Hexagon nut
18 Rear angle lever for hot-start control
19 Right angle lever for hot-start control
20 Connecting strap for angle lever
21 Washer
22 Limiter arm
23 Return spring
24 Fixing screw for bowden cable on angle lever
25 Bushing
26 Washer
27 Hexagon nut

Under normal conditions the hot-start mechanism is not required for starting the engine at normal running temperature; fully depress the accelerator pedal as usual.

I. Installation of Electrical Idle Cut-Out Valves

Engines with high compression ratios have a tendency to self-ignition when fuels of low anti-knock value are used and when outside temperatures are high; as a result, there is after-firing when the engine is switched off.

Fuels should have a minimum anti-knock rating of 92 according to the research method (ROZ); when fuels of a lower anti-knock rating are used and heavy after-firing occurs when the engine is switched off, electrical idle cut-out valves manufactured by the firm of Solex can be subsequently installed in the die-cast carburetors (Fig. 07-0/56).

Note: Because of the different arrangement of the idle fuel jets these electrical idle cut-out valves cannot be subsequently installed in sand-cast carburetors.

The idle cut-out valves (Part No. 000 071 02 92), together with the special idle fuel jets size 55 (Part No. 000 071 28 35) are screwed in in place of the standard idle fuel jets. When the ignition is switched on, the electro-magnet (8) in the valve moves the magnet core (2), the valve needle (9) opens up the idle fuel jet (1) and the idle system of the carburetor can fulfil its normal function.

When the ignition is switched off, the current to the electro-magnet (8) is interrupted and the valve needle (9) is forced on to the sealing cone (10) by a pressure spring (3). Now the idle system is cut off from its fuel supply and after-firing of the engine is therefore no longer possible.

If anything should happen to interrupt the electrical operation of the valve (blown fuse, burnt-out electro-magnet, etc.), it is possible to put the cut-out valve out of operation in the open position by unscrewing the threaded sleeve (4) (Fig. 07–0/55) after having removed the valve cap (5).

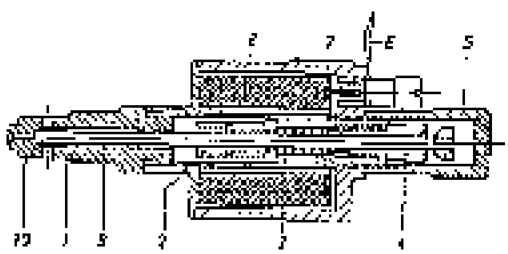


Fig. 07–0/55

1 Idle fuel jet
2 Magnet core
3 Pressure spring
4 Threaded sleeve
5 Valve cap
6 Electric lead
7 Contact ring
8 Electro-magnet
9 Valve needle
10 Sealing cone

In engines from Engine End No. 55 00709 (in which the die-cast carburetors were first installed) to Engine End No. 55 01822 these cut-out valves can be installed subsequently only when the mixing tube No. 43 has been installed in stage I and if the fuel flow to the accelerating pump is regulated by a calibrated sleeve.

As from Engine End No. 55 08123 mixing tube No. 43 has been installed in stage I as a standard part and the fuel line to the accelerating pump has been calibrated (see also Job No. 07–3, Section I)

Work Involved

1 Unscrew the idle fuel jets of stage I on both carburetors and screw in the complete idle cut-out valves (1), together with the special jets (see Fig. 07–0/56).

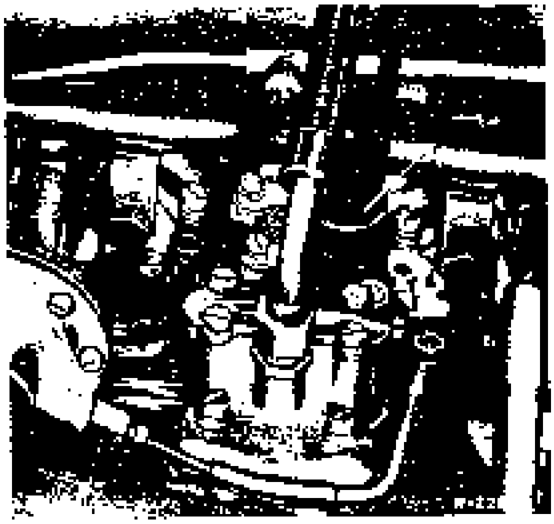


Fig. 07–0/56

1 Spec. electrical idle cut-out valve, (Part No. 000 071 02 43) with special jet size 55 (Part No. 000 071 70 36).

Note: The standard idle fuel jets cannot be used when the idle cut-out valves are installed.

2. Connect the two idle cut-out valves by a cable 400 mm long and fasten the cable to the fuel line with a cable holder. Lay a cable 1100 mm long from the idle cut-out valve of the rear carburetor along the hot-start control cable to the cowl and then lay the cable, together with the lead of the flash signal mechanism through the rubber grommet into the interior of the car and to the fuse box. Then fix the cable to the hot-start control cable and the fuel line by four cable holders (Fig. 07–0/57).

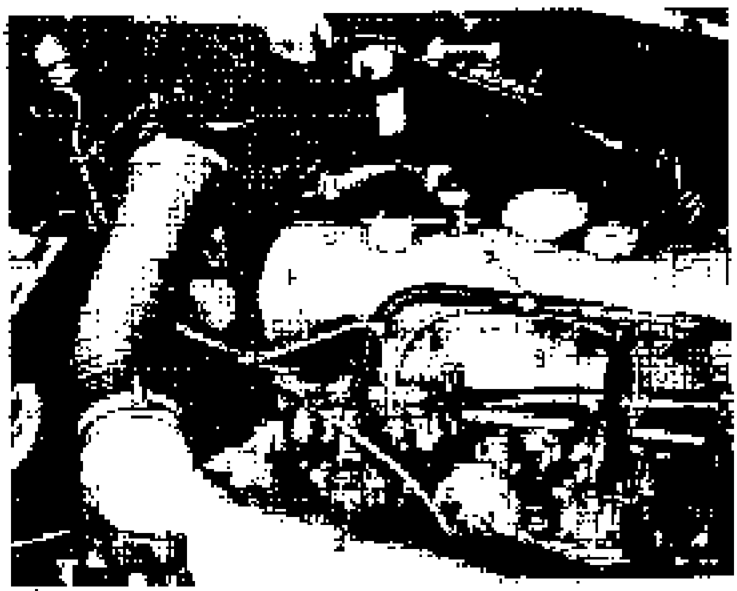


Fig. 07–0/57

1 Idle cut-out valve on front carburetor
2 Idle cut-out valve on rear carburetor
3 Cable 400 mm long
4 Cable 1100 mm long
5 Cable holder with pad
6 Rubber [illegible]

3. Connect the cable leading from the idle cut-out valves to the fuse box to the consumer side of the 8-ampere fuse (No. 3 or No. 4), together with the horn or reversing light switch cables.

Note: c) The cable must have a section of at least 1 sq. mm. Cover the cable sockets on the idle cut-out valves with an oil and fuel-resistant rubber hose so that no parts are exposed. Use suitable small cable sockets (e. g. the 3.5×0.5 mm sockets produced by the firm of Noris) for connecting the cable to the idle cut out valves in order to exclude the danger of short-circuits. To prevent possible damage use a pad between the cable holder (5) and the cable (see Fig. 07-0/57).

b) When adjusting the idle make quite sure that the idle mixture adjustment screw of stage 2 and the throttle valve of stage 2 are completely closed on both carburetors (see Job No. 01-3, Section K).

K. Technical Specifications of Solex Compound Crossdraft Carburetor Type 44 PHH

Details of the Carburetor	Model 190 SL			
	Sand-Cast Carburetor (Installed up to Engine End No. 55 007081)		Die-Cast Carburetor (Installed as from Engine End No. 55 00709)	
	Stage 1	Stage 2	Stage 1	Stage 2
Suction canal diameter	40		40	
Air horn "K"	26	—	26	—
Main jet "G"	125	180	130	160
Air correction jet "a"	170	120	180	160
Mixing tube "s"	1	19	43	42
Mixing tube holder (reserve) (cast into carburetor housing)	7	7	7	7
Idle fuel jet "g"	50	50	55	55
Idle air jet "u"	1.7	—	—	—
Idle air bore	—	1.7	1.7	1.7
Accelerating pump	No. 82 (neutral)		No. 82 (neutral)	
Injection amount cc/stroke	0.4–0.6		0.4–0.6	
Pump jet "Gp"	40		50	
Injection tube	Special version (0.4 graded)		Special version (0.8 graded)	
Float needle valve	2.0		2.0	
Float weight (brass float) g	10		10	
Float adjustment mm	35–40		37–38	
Angle of inclination of throttle valves	13°	13°	13°	17°
Angle of inclination of choke valve	13	—	13°	
By-pass bores mm Ø	1.3/1.7	1.3/1.7	1.3/1.7	1.7

Note: a) Mixing tube "s" has been installed as a standard part, together with the calibrated fuel line to the accelerating pump as from Engine End No. 55 01823. From Engine End No. 55 00709 (when the die-cast carburetors were first installed) to Engine End No 55 01822, mixing tube "s" 42 was installed and the fuel line to the accelerating pump was not calibrated.

b) Idle fuel jets "g" 55 have been installed as standard parts as from Engine End No 65 01365. Up to Engine End No. 65 01364 idle fuel jets "g" 50 were used.

c) The dimension given for the float adjustment refers to the distance from the separating surface of the carburetor cover (with gasket) to the upper edge of the vertical float wall.

d) On the die-cast carburetors the throttle valve of stage 2 has been installed at an angle of 17° as from Engine End No. 65 01133. Up to Engine End No. 65 01132 the throttle valve angle of inclination was 13°

e) The by-pass bore in the suction canal of stage 2 in the die-cast carburetor has a diameter of 1.7 mm as from Engine End No. 65 01133. Up to Engine End No. 65 01132 the suction canal of stage 2 had two by-pass bores with a 1.3 and 1.7 mm diameter.

V. Carburetor Altitude Adjustment

A. General

At high altitudes the carburetor, with a standard set of jets delivers too rich a mixture, a result of the decrease in atmospheric pressure. Engine performance will drop and fuel consumption will become unnecessarily high, to prevent this it is generally sufficient to provide the carburetor with a smaller main jet to re-establish the correct fuel-to-air mixture in order to attain the highest possible performance at the prevailing atmospheric pressure. On the compound carburetors of models 190, 190 b, 220 S and 190 SL only the main jets of the 1st stage need be replaced by smaller ones. Basically, the main jet for altitude adjustment should be selected as small as possible, though the drop in performance should not be too high. If the main jets installed for altitude driving is too small, or if a main jet, selected for altitude operations is run at full load in normal altitudes, there is the danger that the engine will overheat because the mixture supplied by the carburetor is too lean.

B. Selection of Main Jets

For proper selection of main jets for altitude adjustment with regard to the individual models refer to the table below which provides data on size of main jets.

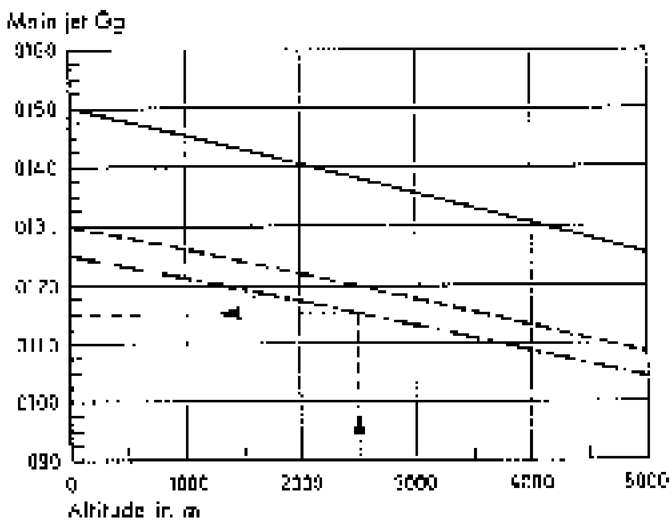


Fig. 07–0/58

———— With standard main jet "Gg" 0150: Models 180 a, 180 b

- - - - - - With standard main jet "Gg" 0130: Models 220c, 219 (up to engine end No. 10-9501618 and 11-9500363)
Model 190 SL (with die-cast carburetors)

— - — With standard main jet "Gg" 0125: Models 180, 190, 190 b, 220 S
Model 219 (as from engine end No. 10-9501619 and 11-9500364)
Model 190 SL (with sand-cast carburetors)

Example: Model 180

Standard main jet:	"Gg" 0125
Main jet at 2500 m altitude:	"Gg" 0115

C. Solex Altitude Corrector

Instead of changing to smaller main jets, models 180 a, 180 b, 180 c, 190, 190 b and 220 S may use Solex altitude correctors, together with the standard main jets. By means of the altitude corrector the engine will receive the correct fuel/air mixture for any altitude or any atmospheric pressure. The altitude corrector is particularly recommended for vehicles which drive frequently both at normal and at high altitudes.

The aneroid compensator built into the altitude corrector controls the fuel supplied to the main jet automatically in dependence of the prevailing atmospheric pressure (Fig. 07–0/59).

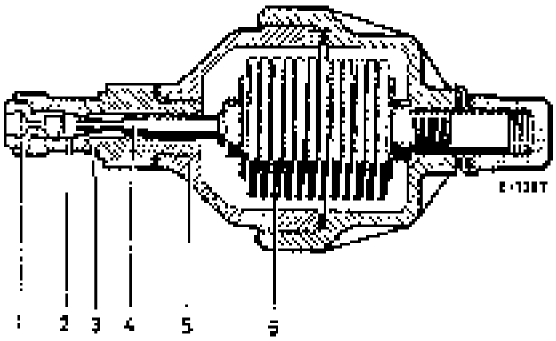


Fig. 07–0/59

1 Main jet
2 By-pass bore
3 Fuel intake bore
4 Needle
5 Housing
6 Capsule box

There are different altitude correctors for the various models (refer to table).

Model	Altitude Corrector Part No.	By-pass bore mm diameter	Main jet "Gg"
180, 180 a, 180 b	000 072 02 05	1.3	0150
180 c	000 072 04 05		0145
190, 190 b, 220 S	000 072 01 05	1.0	0125

Note: a) For compound downdraft carburetors of models 190, 190 b and 220 S the altitude corrector is used only for the main jet of the 1st stage.

b) On the double downdraft carburetor of models 219, 220 a, and on the compound cross-draft carburetor of model 190 SL the altitude corrector can not be installed for lack of space.

Disassembly and Reassembly of Carburetor

Job No.
07-3

With a few exceptions the procedures for disassembling and reassembling the carburetors are the same as for the compound downdraft carburetor in Model 190. The same is true of the cleaning and checking procedures for the various carburetor parts (see Workshop Manual Model 190). For this reason only the deviations from the standard procedure for the compound downdraft carburetor are described in the following pages.

I. Downdraft Carburetor for Models 180, 180 a, and 180 b

The Solex downdraft carburetor Type 32 PICB for Models 180 and 180 a as well as Type 34 PICB for Model 180 b have the same basic design as the compound downdraft carburetor, but the carburetor housing is cast integral. The carburetor cover is fastened to the carburetor housing by three screws (see also Job No. 07-0, 1.). Figs. 07-3/1, 07-3/2, and 07-3/3 show the carburetor from both sides and with the carburetor cover removed.

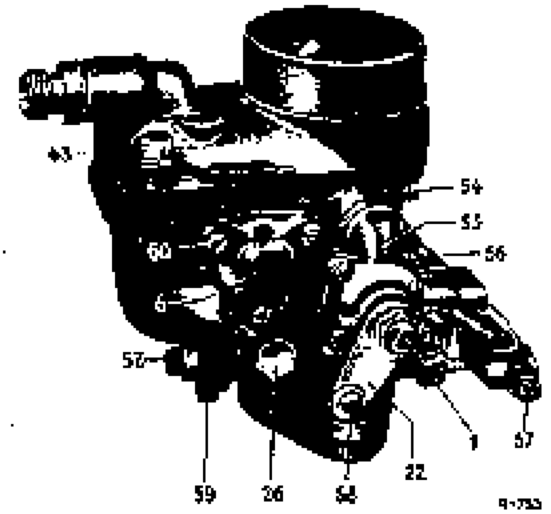


Fig. 07-3/1

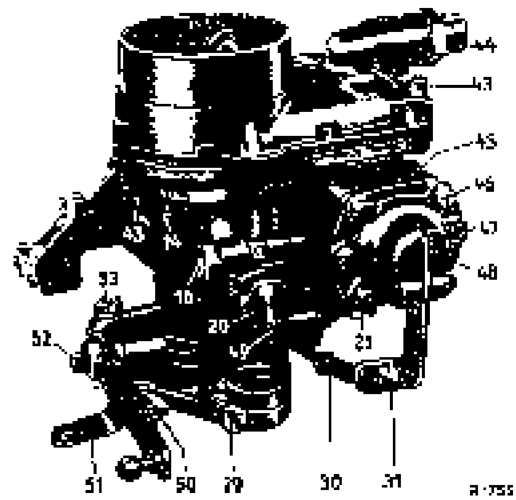


Fig. 07-3/2

1 Starter rotary slide valve
6 Starter air valve
14 Idle fuel jet
16 Pump jet
20 Main jet plug with main jet
21 Ball valve
23 Starter lever
26 Starter fuel jet
29 Idle mixture adjustment screw
30 Connecting rod with pressure spring
31 Pump arm
43 Square screws for fastening of carburetor cover
44 Threaded union for connection of fuel line
45 Accelerating pump
46 Cheese head screws for accelerating pump
47 Oval head countersunk screws for pump cover
48 Pump cover
49 Threaded bore for threaded union of vacuum line to distributor
50 Idle adjustment screw
51 Throttle valve lever
52 Throttle valve shaft
53 Aperture limiting screw
54 Retaining screw for air horn
55 Starter housing
56 Oval head countersunk screws for starter mechanism
57 Clamping screw for choke control sleeve
58 Clamping screw for choke control
59 Transmission lever
60 Oval head countersunk screws for starter air valve

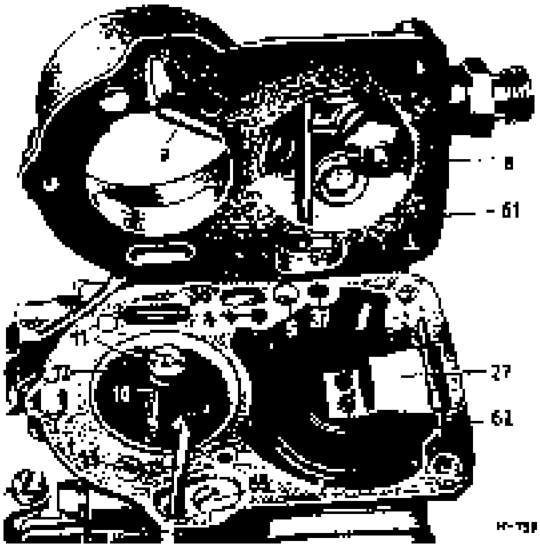


Fig. 07-3/3

4 Fuel canal to starter system	27 Float
5 Air canal from starter air valve to fuel canal (4) (is closed by plug)	37 Air canal from float chamber to starter air valve
8 Float needle valve	38 Starter air canal
9 Float chamber vent tube	61 Carburetor cover gasket
10 Mixing tube holder with mixing tube	62 Float shaft
11 Air correction jet	63 Oval head countersunk screw for injection tube
12 Air horn	64 Notch in carburetor cover
13 Idle air jet	
15 Injection tube	

Note: a) When reassembling the carburetor, make sure that the correct pump diaphragm is used (see Job No. 07-0, I., Section F). After installation check not only the injection amount of the accelerating pump on carburetor Type 32 PICB, but also the enrichment delivery point for the pump system (see Job No. 01-3, Section H).

b) The position of the cotter pins in the connecting rod for the accelerating pump is shown in Job No. 07-0, I., Section F.

c) When installing the starter mechanism make sure that the starter air bore in the rotary slide valve is in the center above the starter mixture canal of the starter flange when the starter lever rests against the stop in the cold-start position (see Job No. 07-0, I., Section B).

List of Component Parts of Solex Downdraft Carburetors Types 32 PICB and 34 PICB

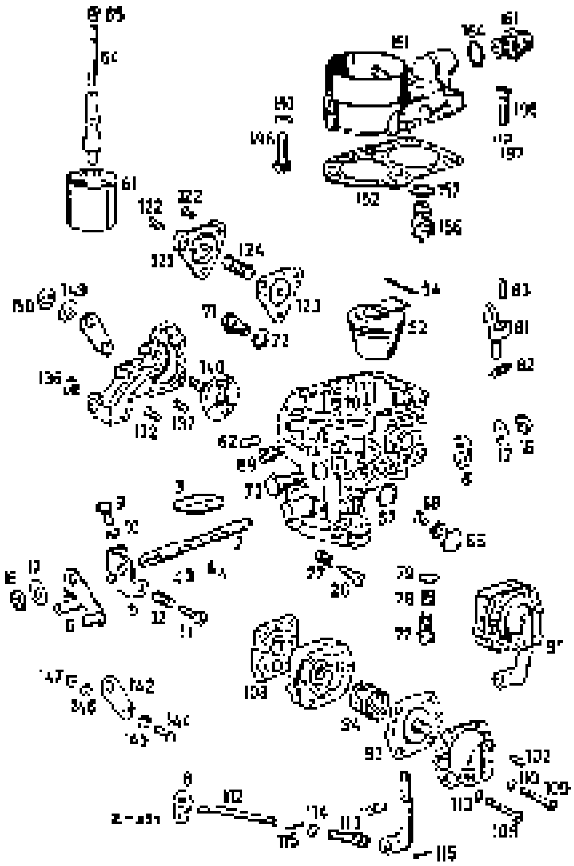


Fig 07-3/4

2 Throttle valve shaft
3 Throttle valve
4 Oval head countersunk screw
5 Abutment
6 Throttle valve lever
8 Transmission lever for accelerating pump
9 Aperture limiting screw (button-head screw)
10 Lock washer
11 Idle adjustment screw (cheese head screw)
12 Pressure spring
16 Hexagon nut
17 Retaining washer
26 Idle mixture adjustment screw
27 Pressure spring
52 Float
54 Shaft for float
61 Air horn
62 Retaining screw for air horn
64 Mixing tube
65 Air correction jet
66 Main jet plug
67 Fiber sealing ring
68 Main jet
69 Idle fuel jet
70 Idle air jet
71 Starter fuel jet
72 Fiber sealing ring
73 Pump jet
74 Fiber sealing ring
77 Ball valve
78 Strainer
79 Fiber sealing ring
81 Injection tube
82 Injection tube gasket
83 Oval head countersunk screw
91 Accelerating pump (complete)
93 Diaphragm
94 Diaphragm spring
102 Oval head countersunk screw
108 Rubberized fabric gasket
109 Cheese head screw
110 Lock washer
112 Connecting rod
113 Pressure spring
114 Washer
115 Cotter pin
121 Cover for starter disc valve
122 Oval head countersunk screw
123 Diaphragm
124 Valve spring
132 Oval head countersunk screw
136 Clamping screw for choke control cable
140 Starter rotary slide valve
142 Starter lever
144 Clamping screw for choke control
145 Bushing
146 Washer
147 Hexagon nut
149 Washer
150 Hexagon nut
151 Carburetor cover
152 Carburetor cover gasket
154 Float needle valve
157 Copper sealing ring
161 Threaded union
164 Fiber sealing ring
196 Square screw
197 Lock washer

II. Double Downdraft Carburetor for Models 220 a and 219

The Solex double downdraft carburetor Type 32 PAATi, which to all intents and purposes consists of two separate carburetors in a single housing, is designed on the same principle as the single downdraft carburetor. Each suction canal of the carburetor has a main carburetion and an idle system. The float chamber, the accelerating pump and the starter mechanism supply both suction canals of the carburetor together. Like the compound downdraft carburetor the double downdraft carburetor has a special choke valve section with a screwed-on grey cast iron flange (see also Job No. 07-0, II.). Figs. 07-3/5, 07-3/6, and 07-3/7 show the carburetor from both sides and also with the carburetor cover removed.

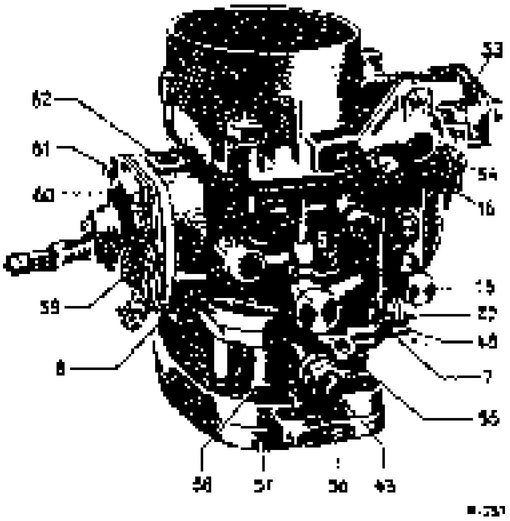


Fig. 07-3/5

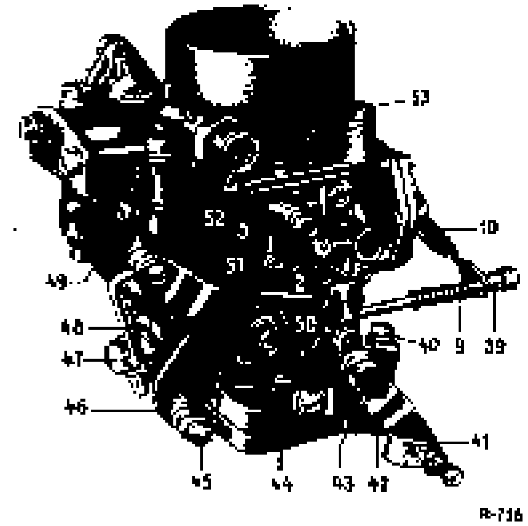


Fig. 07-3/6

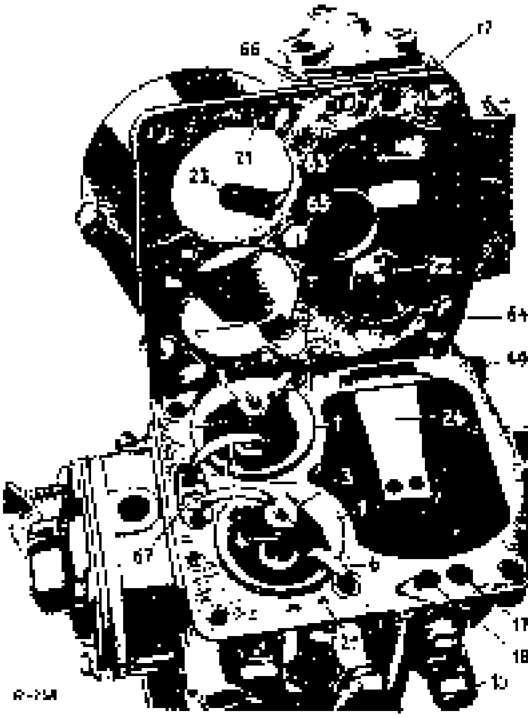


Fig. 07-3/7

1 Air horn
2 Main jet plug with main jet
3 Air correction jet
4 Mixing tube holder with mixing tube
5 Idle fuel jet
6 Idle intake pipe
7 Idle mixture adjustment screw
8 Ball valve
9 Connecting rod with pressure spring
10 Pump arm
11 Injection tube
15 Starter fuel jet
16 Starter air valve
17 Air canal from starter air valve to fuel canal (18)
18 Fuel canal to starter system
21 Vacuum canal for starter air valve
22 Float needle valve
23 Float chamber vent tube
24 Float
39 Adjusting nuts
40 Accelerator limiting screw
41 Throttle valve lever
42 Clamping screw for choke control sleeve
43 Throttle valve shaft
44 Idle adjustment screw
45 Clamping screw for choke control
46 Angle lever
47 Starter lever
48 Starter housing
49 Float shaft
50 Transmission lever
51 Retaining screw for air horn
52 Threaded union for connection of fuel line
53 Fastening screws for fastening carburetor cover
54 Oval head countersunk screws for starter air valve
55 Threaded hole for threaded union of vacuum line to distributor
56 Grub screw for connection of vacuum lever
57 Grey cast iron flange
58 Throttle valve part
59 Oval head countersunk screws for pump cover
60 Pump lever
61 Cheese head screws for accelerating pump
62 Accelerating pump
63 Air canal from float chamber to starter air valve
64 Carburetor cover gasket
65 Button-head screw for fastening gasket
66 Notch in carburetor cover
67 Oval head countersunk screw for injection tubes

Note: a) Use Special Screw-Driver 187 589 12 61 for tightening and loosening the idle intake pipes. If this tool is not available, a standard screw-driver can be ground to the correct angle.

b) When the throttle valve part and the grey cast iron flange have been removed from the carburetor housing, the various surfaces should be coated with sealing compound before the parts are screwed on again. The sealing compound coating should be very thin, so that the fine bores cannot be closed by the compound when the parts are fastened together. Tighten the four screws evenly.

c) When installing the starter mechanism make sure that the opening (34) in the starter rotary slide valve is opposite the starter mixture canal (30) of the starter flange when the starter lever rests against the stop in the cold-start position (see Job No. 07-0, II., Section B).

List of Component Parts of Solex Double Downdraft Carburetor Type 32 PAATI

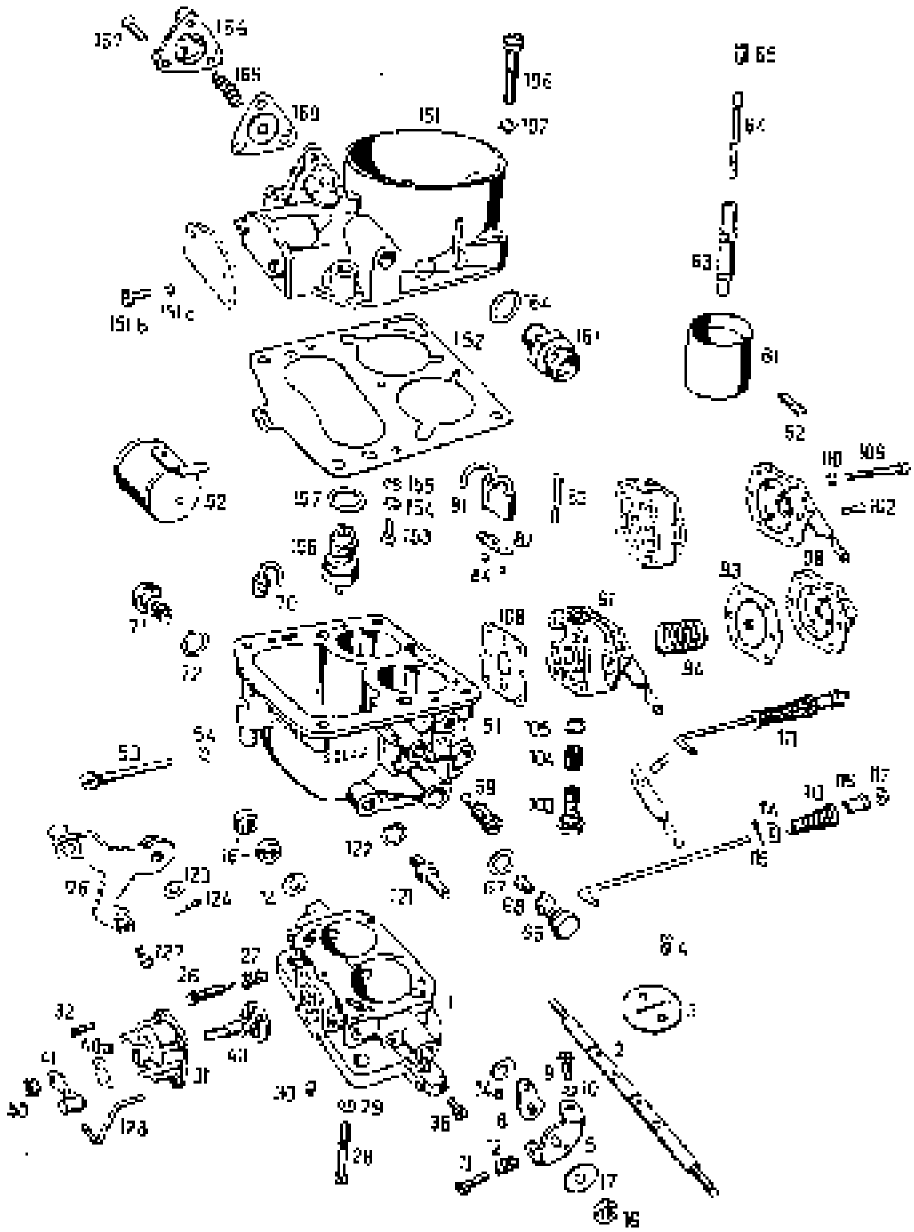


Fig. 07-3/8

1 Throttle valve part
2 Throttle valve shaft
3 Throttle valve
4 Oval head countersunk screw
5 Abutment
8 Transmission lever for accelerating pump
9 Aperture limiting screw
10 Lock washer
11 Idle adjustment screw
12 Pressure spring
14 Washer
14a Washer
16 Hexagon nut
17 Retaining washer
26 Idle mixture adjustment screw
27 Pressure spring
28 Cheese head screw
35 Lock washer
30 Drain screw
31 Starter housing
32 Oval head countersunk screw
33 Clamping screw for choke control sleeve
40 Starter rotary slide valve
40a Stop plate
41 Starter lever
50 Hexagon nut
51 Carburetor housing
52 Float
53 Float shaft
54 Fiber sealing ring
61 Air horn
62 Retaining screw for air horn
63 Mixing tube holder
64 Mixing tube
65 Air correction jet
66 Main jet plug
67 Fiber sealing ring
68 Main jet
69 Idle fuel jet
70 Idle intake plug
71 Starter fuel jet
72 Fiber sealing ring
81 Injection tube
82 Gasket for injection tubes
83 Oval head countersunk screw
84 Balls
91 Accelerating pump (complete)
93 Diaphragm
94 Diaphragm spring
98 Cover with pump arm
102 Oval head countersunk screw
103 Ball valve
104 Strainer
105 Fiber sealing ring
108 Rubberized fabric gasket
109 Cheese head screw
110 Lock washer
111 Connecting rod (complete)
113 Pressure spring
114 Washer
115 Cotter pin
116 Shoulder nut (adjusting nut)
117 Hexagon nut (lock nut)
121 Pivot pin
122 Toothed washer
123 Washer
124 Cotter pin
126 Angle lever
127 Clamping screw for choke control
128 Connecting rod
151 Carburetor cover (complete)
151b Hexagon screw
151c Lock washer
152 Carburetor cover gasket
153 Fillister-head screw
154 Toothed washer
155 Washer
156 Float needle valve
157 Copper sealing ring
161 Threaded union
164 Fiber sealing ring
165 Starter air valve cover
167 Oval head countersunk screw
160 Diaphragm
163 Valve spring
159 Hexagon screw
158 Lock washer

III. Compound Downdraft Carburetor for Model 220 S

The two Solex carburetors Type 32 PAITA used in Model 220 S are the same as the carburetor in Model 190 (see Workshop Manual Model 190), with the following differences:

1. Details of the carburetor jets etc. (see Job No. 07-0, III, Section E)

2. As compared with the carburetor for Model 190 the vent tube for the float chamber which is cast into the carburetor cover is not calibrated by a plug.

3. The bracket for the choke control (137) and the angle lever (142a) for the starter mechanism of the front carburetor differ from those of the rear carburetor and those of the carburetor for Model 190. The starter mechanism of the front carburetor is operated by the angle lever of the rear carburetor via the connecting rod (209) (Fig. 07-3/9).

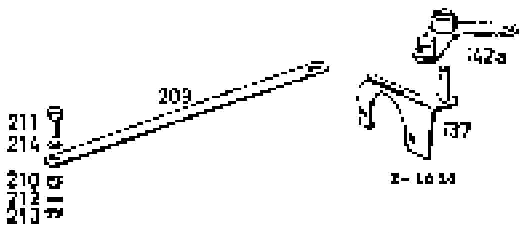


Fig. 07-3/9

137 Bracket for choke control on front carburetor
142a Angle lever for choke control on front carburetor
210 Bushing
211 Hexagon screw
212 Lock washer
213 Hexagon nut
214 Washer

4. The height of the carburetor cover measured from the separating surface to the upper edge of the air inlet branch is 33 mm on the carburetor for Model 220 S and 43 mm on the carburetor for Model 190.

5. On cars with a scavenging device for the fuel system the front carburetor is equipped with a fuel return valve and a longer pump arm (see also Job No. 07-0, III, Section D).

IV. Compound Cross-Draft Carburetor for Model 190 SL

The design of the Solex compound cross-draft carburetor Type 44 PHH differs considerably from that of the compound downdraft carburetor. The arrangement of the jets is shown in Figs 07-3/10, 07-3/11, and 07-3/12 for the die-cast carburetor and in Fig. 07-3/13 for the sand-cast carburetor.

Die-cast carburetor

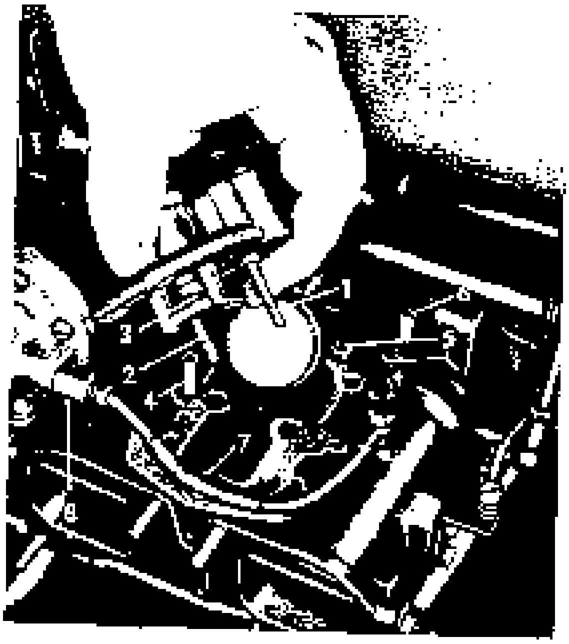


Fig. 07-3/10

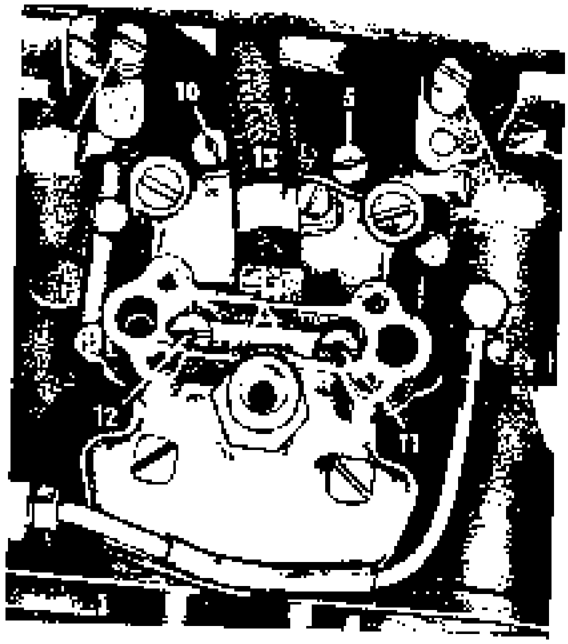


Fig. 07-3/11

1 Mixing tube of stage 1
2 Mixing tube of stage 2
3 Float needle valve
4 Overflow control tube
5 Idle fuel jet of stage 1
6 Idle mixture adjustment screw of stage 1
7 Pump jet with injection tube
8 Ball valve (delay valve on vacuum side)
9 Idle mixture adjustment screw of stage 2

10 Idle fuel jet of stage 2
11 Air correction jet of stage 1
12 Air correction jet of stage 2
13 Fuel overflow line
14 Float chamber vent screw
15 Main jet plug with main jet of stage 2
16 Main jet plug with main jet of stage 1
18 Fuel outlet line of stage 1

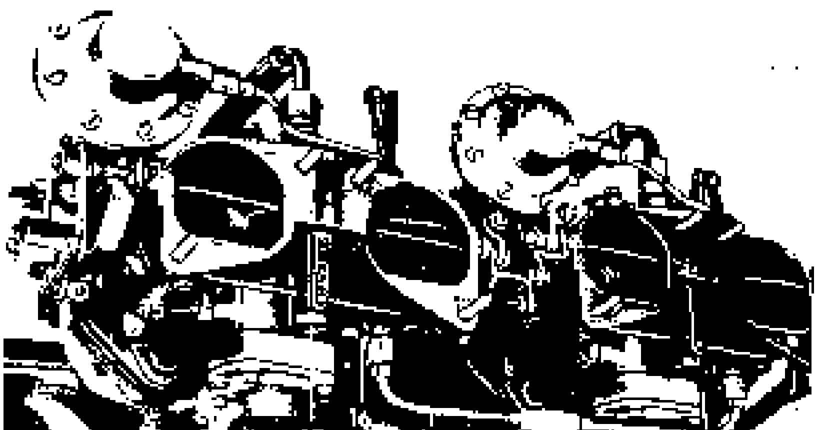


Fig. 07-3/12

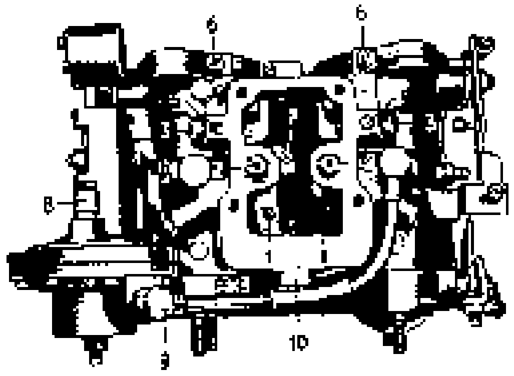


Fig. 07-3/13

Sand-cast carburetor

1 Main jet plug with main jet
2 Air correction jet with mixing tube
3 Idle fuel jet
4 Idle air jet of stage 1
5 Grub screw
6 Idle mixture adjustment screw
7 Ball valve for accelerating pump
8 Ball valve (delay valve on atmosphere side)
9 Ball valve (delay valve on vacuum side)
10 Pump jet with injection tube

Figs. 07-3/14, 07-3/15, 07-3/16, and 07-3/17 show the arrangement of the levers for operating stage 2, the starter mechanism, the carburetor cover and the accelerating pump for the die-cast carburetor.

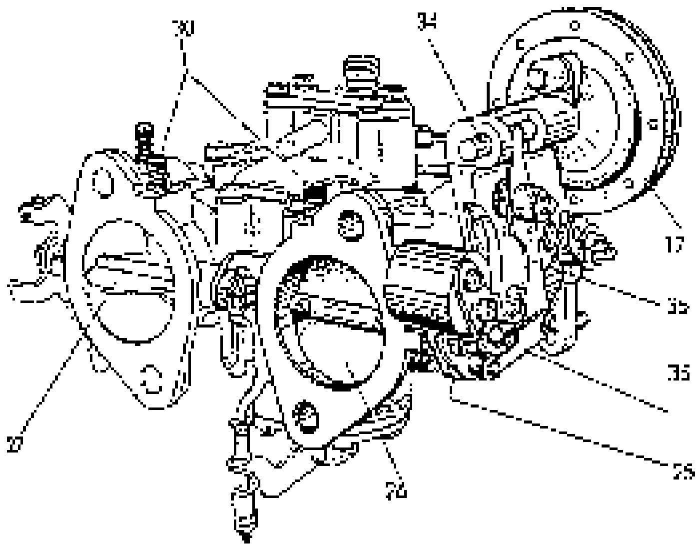


Fig. 07-3/14

Lever arrangement for operating stage 2

17 Vacuum box
25 Throttle valve lever with counterweight
26 Throttle valve of stage 2
27 Throttle valve of stage 1
30 Idle mixture adjustment screw
33 Diaphragm rod
35 Relay lever
36 Transmission lever

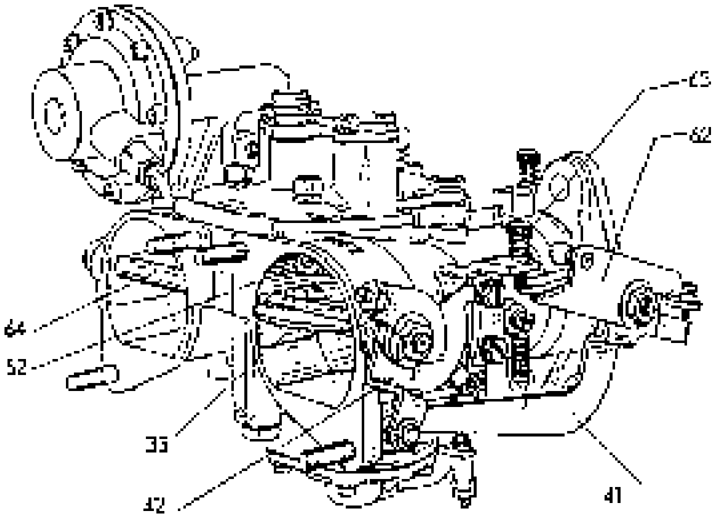


Fig. 07-3/15

Lever arrangement for operating starter mechanism

[illegible] Choke valve
41 Relay lever
42 Choke valve lever with cam plate
52 Injection tube
62 Throttle valve lever
63 Idle adjustment screw
64 Choke valve shaft

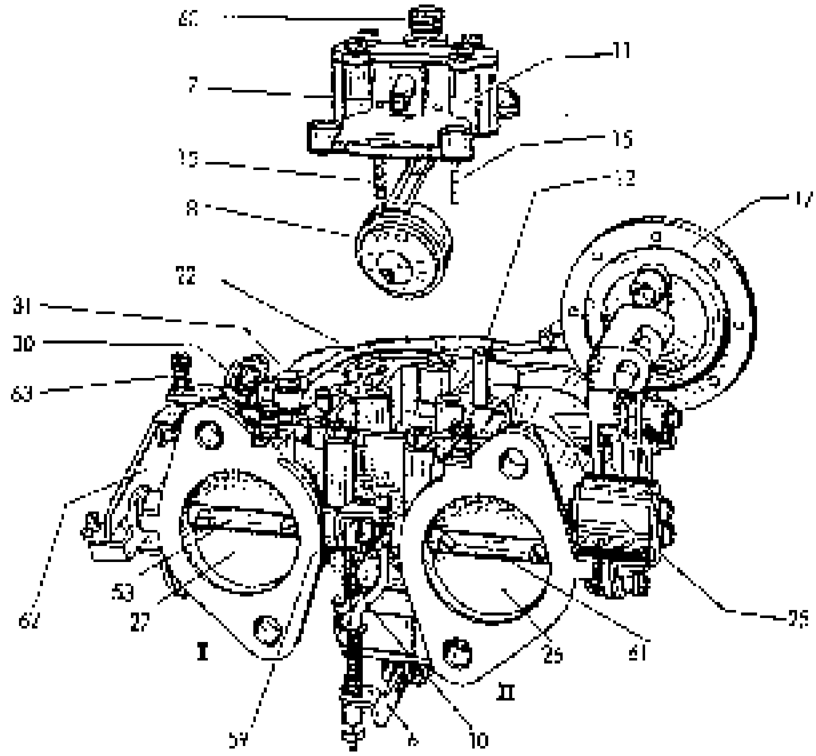


Fig. 07-3/16

Carburetor cover arrangement

6 Pump arm
7 Connection for fuel overflow line and float chamber ventilation
8 Float
10 Connecting rod with pressure spring and adjusting nuts
11 Carburetor cover
12 Overflow control tube
15 Mixing tube
17 Vacuum box
22 Vacuum line
25 Throttle valve lever with counterweight
26 Throttle valve of stage 2
27 Throttle valve of stage 1
30 Idle mixture adjustment screw
31 Idle fuel jet of stage 1
53 Throttle valve shaft of stage 1
59 Relay lever for automatic return mechanism of stage 2
60 Threaded union for connection of fuel line
61 Throttle valve shaft of stage 2
62 Throttle valve lever with counterweight
63 Idle adjustment screw

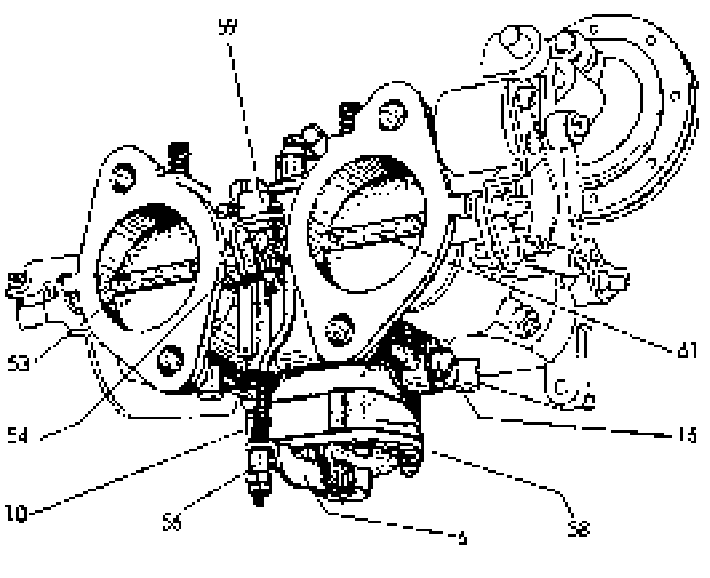


Fig. 07-3/17

Accelerating pump arrangement

6 Pump arm
10 Connecting rod with pressure spring
16 Main jet
53 Throttle valve shaft of stage 1
54 Relay lever
56 Adjusting nuts
58 Accelerating pump
59 Relay lever for automatic return mechanism of stage 2
61 Throttle valve shaft of stage 2

Note: a) When disassembling the carburetor remember that the gasket for the carburetor cover can only be removed after the float shaft has been pushed out. The float shaft must be pushed out very carefully, so that the float mounting in the carburetor cover is not damaged.

b) Replace the gaskets for the carburetor cover and the cover plate as well as the gaskets for the needle valve (in the sand-cast carburetor).

c) Check whether the diaphragm of the vacuum box is still serviceable and replace if necessary. Check whether the ball valve (delay valve on the atmosphere side) in the vacuum box is properly seated. Carefully clean and check the threaded union and ball valve (delay valve on the vacuum side in the die-cast carburetor) and the hollow screw and ball-valve (in the sand-cast carburetor). If necessary, replace the ball valves and the connecting hose for the vacuum line.

d) The strainers for the compensating air (in the sand-cast carburetor) must be cleaned.

When reassembling the carburetor watch the following points carefully: The diffusers for stages 1 and 2 must be parallel to the axis of the suction canals. The retaining screws of the diffusers and the air horn of stage 1 should be well tightened and locked.

e) When reassembling the vacuum box, coat the two separating surfaces and the push rod with grease. When attaching the vacuum box, coat the thread of the fixing screws with sealing compound. Use only hexagon socket screws M 6×15 DIN 912–8G instead of the cheese head screws used previously.

Grease the lever linkage for stage 2 at the diaphragm rod of the vacuum box, at the relay arm (see Fig. 07–3/14).

f) It is advisable to use grease to retain the gaskets in place when screwing on the choke valve section of the sand-cast carburetor.

After reassembling the carburetor, check the starter mechanism and all levers for correct position and ease of movement (see Figs. 07–3/14 and 07–3/15).

g) In the die-cast carburetor as from Engine End No. 015676 (Solex Carburetor No. 39 465) the throttle valve shaft of stage 2 is carried in bronze bushings and is sealed on the outside by elastic rings.

Component Parts of Solex Compound Cross-Draft Carburetor Type 44 PHH (Die-Cast Carburetor)

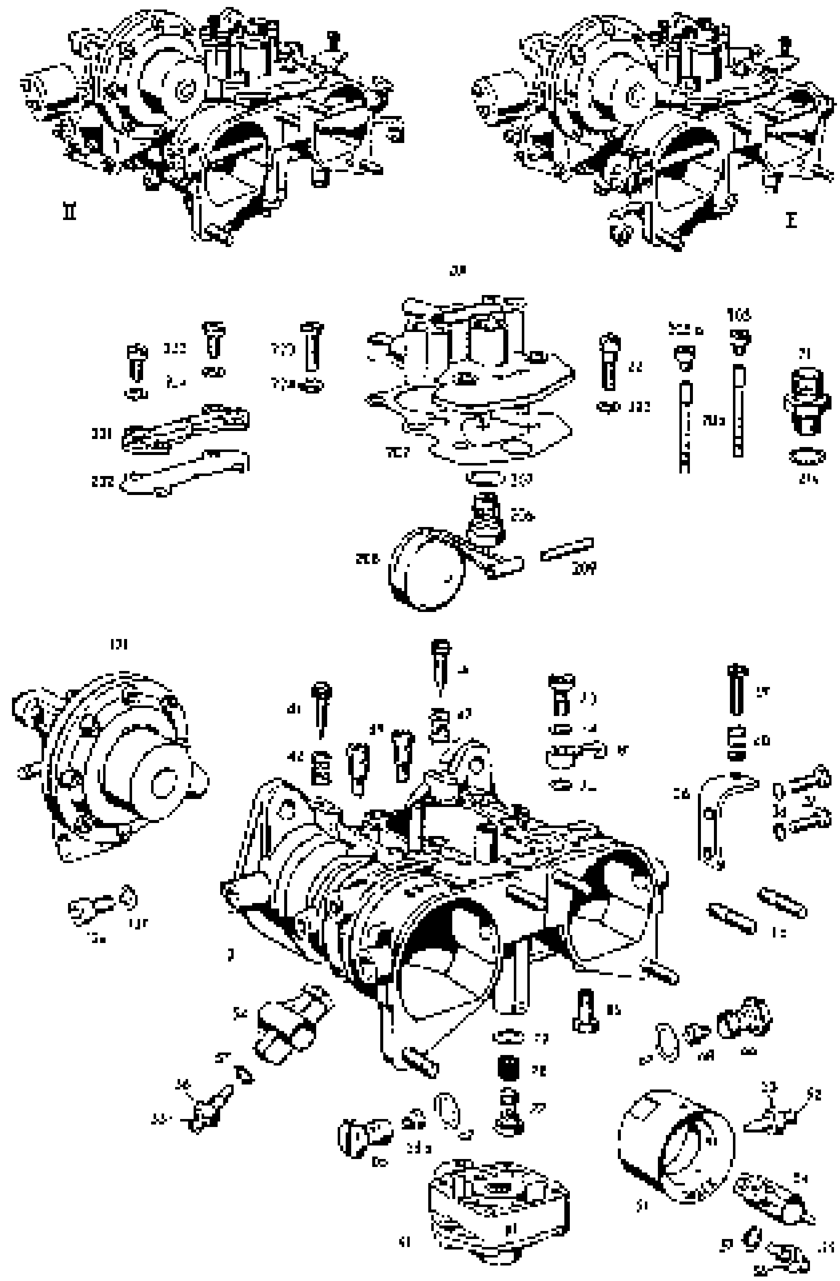


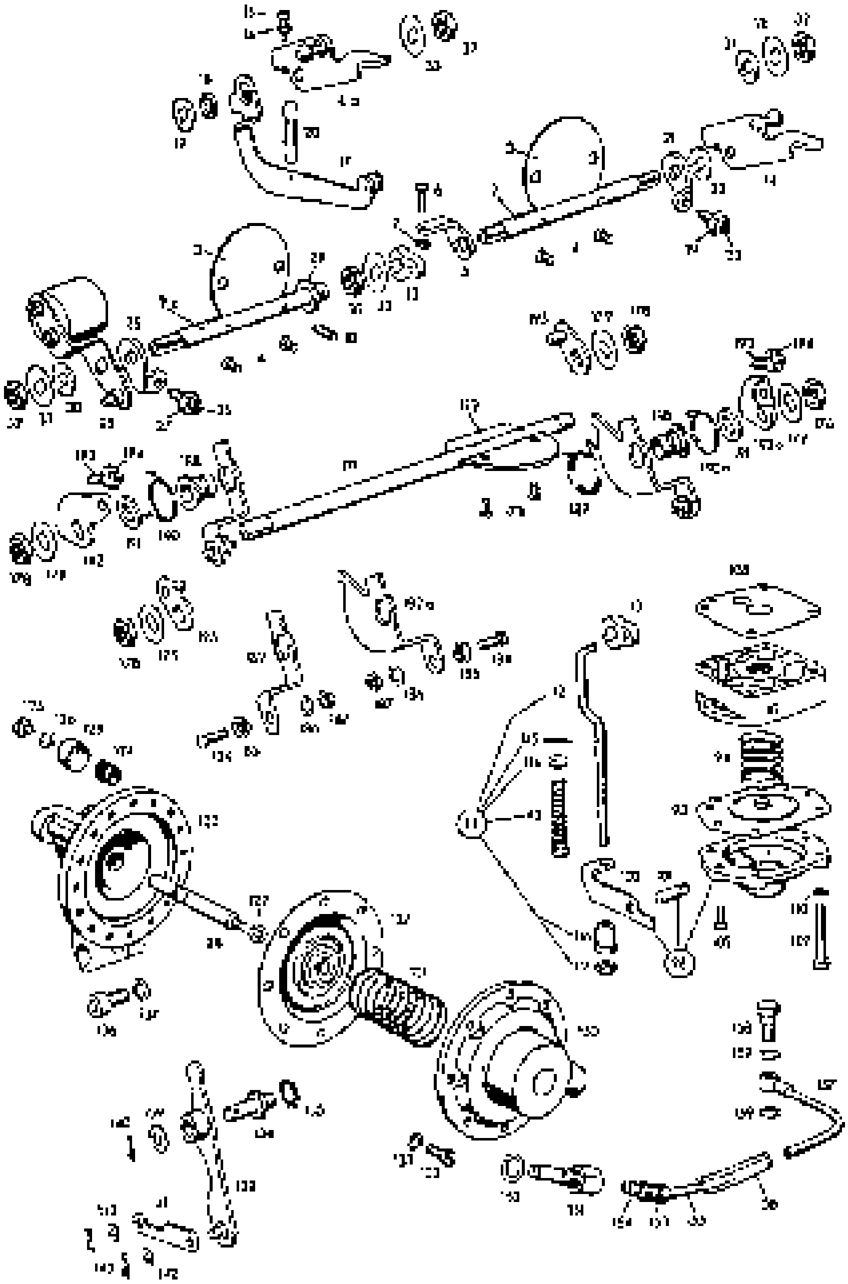
Fig. 07-3/18

I Front carburetor
II Rear carburetor

1 Carburetor housing
1a Stud bolt
36 Bracket
37 Hexagon screw
38 Lock washer
39 Idle adjustment screw
40 Pressure spring
41 Idle mixture adjustment screw
42 Pressure spring
51 Air horn
52 Retaining screw for air horn
53 Hexagon nut
54 Diffuser
55 Retaining screw for diffuser
56 Hexagon nut
57 Lock washer
66 Main jet plug
67 Fiber sealing ring
68 Main jet
68a Main jet
69 Idle fuel jet
73 Pump jet
74 Fiber sealing ring
77 Ball valve
76 Strainer for ball valve
78 Fiber sealing ring
81 Injection tube
86 Hollow screw
91 Accelerating pump
171 Vacuum line (complete)
201 Carburetor cover
202 Carburetor cover gasket
204 Mixing tube
205 Air correction jet of stage 1
205a Air correction jet of stage 2
206 Float needle valve
207 Copper sealing ring
208 Float
209 Float shaft
211 Threaded union
214 Fiber sealing ring
221 Square screw
222 Lock washer
223 Countersunk screw
224 Toothed washer
231 Cover plate
232 Cover plate gasket
233 Hexagon screw
234 Lock washer

Component Parts of Solex Compound Cross-Draft Carburetor Type 44 PHH (Die-Cast Carburetor)

Fig. 07-3/17



- 2 Throttle valve shaft of stage 1
- 2a Throttle valve shaft of stage 2
- 3 Throttle valve
- 4 Oval head countersunk screw
- 5 Relay lever for throttle valve shaft of stage 1 (1st Version)
- 5a Relay lever for throttle valve shaft of stage 2 (2nd Version)
- 6 Button-head screw
- 7 Hexagon nut
- 8 Button-head screw (clamping screw)
- 9 Clamping piece
- 10 Abutment screw for throttle valve shaft of stage 2
- 13 Transmission lever
- 14 Throttle valve lever for front carburetor
- 14a Throttle valve lever for rear carburetor
- 15 Cheese head screw
- 16 Hexagon nut
- 17 Relay lever for rear carburetor
- 18 Spacer sleeve for rear carburetor
- 19 Spacer washer
- 20 Tension spring for rear carburetor
- 21 Stop lever for rear carburetor
- 22 Spacer washer
- 23 Aperture limiting screw for throttle valve of stage 2
- 24 Hexagon nut
- 25 Stop lever
- 26 Aperture limiting screw for throttle valve of stage 1
- 27 Hexagon nut
- 28 Lever with counterweight
- 29 Washer
- 30 Washer
- 31 Washer
- 32 Hexagon nut
- 33 Retaining Washer
- 92 Pump Diaphragm
- 94 Diaphragm spring
- 98 Cover and pump arm
- 99 Cover
- 100 Pump arm
- 101 Shaft
- 102 Oval head countersunk screw
- 108 Rubberised fabric gasket
- 109 Cheese head screw
- 110 Lock washer
- 111 Connecting rod (complete)
- 112 Connecting rod
- 113 Pressure spring
- 114 Washer
- 115 Cotter pin
- 116 Shoulder nut (adjusting nut)
- 117 Hexagon nut (lock nut)
- 122 Lower section with ball valve (delay valve on atmospheric side)
- 123 Cap
- 124 Strainer
- 125 Hexagon screw
- 126 Lock washer
- 127 Diaphragm
- 128 Diaphragm rod
- 129 Hexagon nut
- 130 Upper section
- 131 Diaphragm spring
- 132 Hexagon socket cheese head screw
- 133 Lock washer
- 134 Pivot pin
- 135 Toothed washer
- 136 Hexagon socket screw
- 137 Lock washer
- 138 Relay lever
- 139 Washer
- 140 Cotter pin
- 141 Relay arm
- 143 Washer
- 144 Cotter pin
- 151 Threaded union with ball valve (delay valve on vacuum side)
- 152 Fiber sealing ring
- 153 Union nut
- 154 Sealing cone
- 155 Vacuum line
- 156 Connecting tube
- 157 Vacuum line
- 158 Hollow screw
- 159 Fiber sealing ring
- 171 Choke valve shaft for front carburetor
- 171a Choke valve shaft for rear carburetor
- 173 Oval head countersunk screw
- 176 Hexagon nut
- 177 Retaining washer
- 180 Choke valve lever for front carburetor
- 184 Clamping screw
- 185 Bushing
- 186 Washer
- 187 Hexagon nut
- 188 Spacer sleeve
- 190 Torsion return spring for front carburetor
- 191 Washer
- 192 Abutment for front carburetor

Component Parts of Solex Compound Cross-Draft Carburetor Type 44 PHH (Sand-Cast Carburetor)

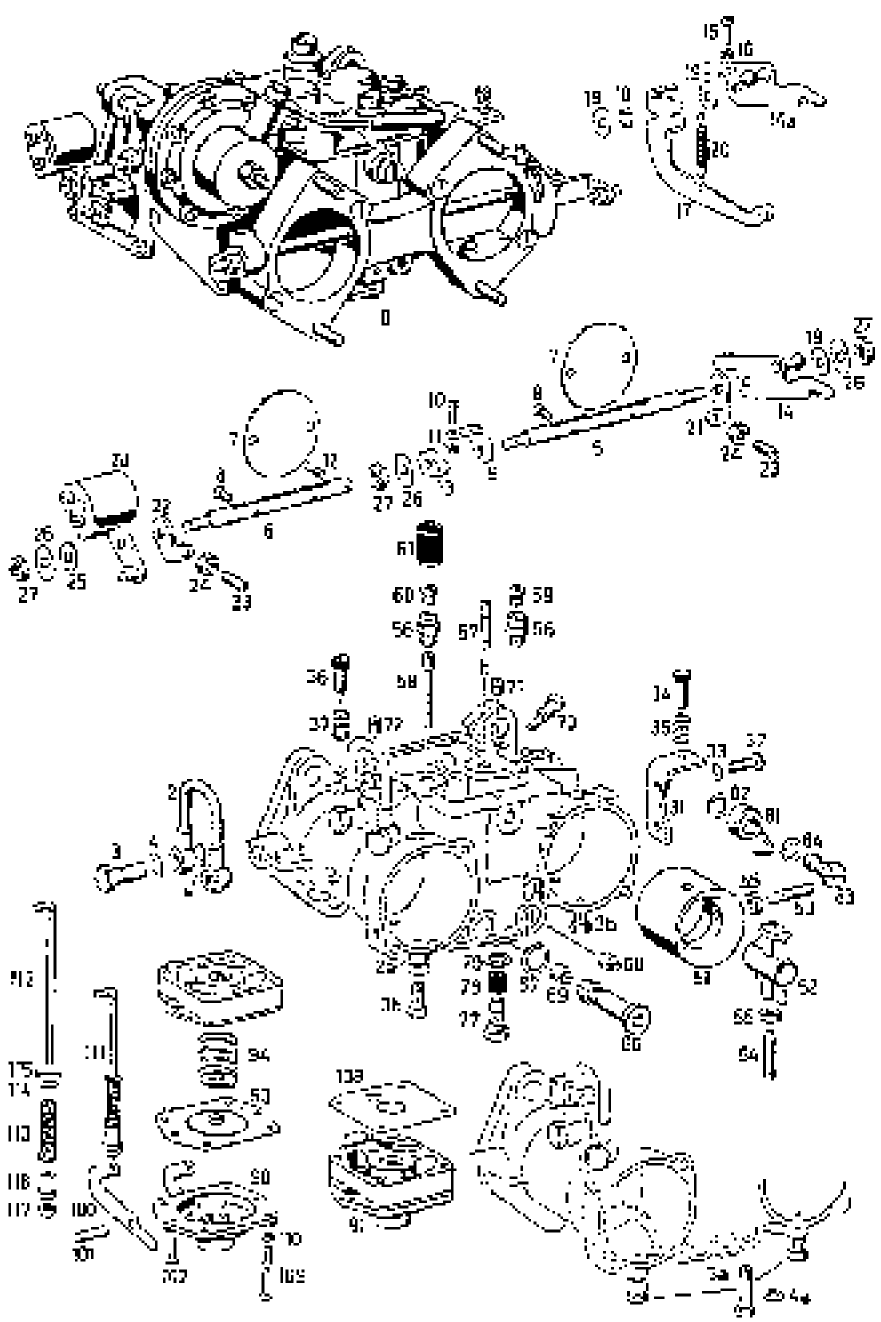


Fig. 07–3/20

I Front carburetor   II Rear carburetor

2 Overflow return line
2a Fuel suction line
3 Hollow screw
3a Hollow screw (for 1st outside suction line)
3b Hollow screw
4 Fiber sealing ring
4a Fiber sealing ring
5 Throttle valve shaft of stage 1
6 Throttle valve shaft of stage 2
7 Throttle valve
8 Oval head countersunk screw
9 Relay lever for throttle valve shaft of stage 1
10 Button-head screw
11 Hexagon nut
12 Abutment screw
13 Intermediate lever
14 Throttle valve lever for front carburetor
14a Throttle valve lever for rear carburetor
15 Adjusting screw
16 Hexagon nut
17 Relay lever
18 Spacer sleeve
19 Washer
20 Tension spring
21 Stop lever
22 Stop lever
23 Abutment limiting screw
24 Hexagon nut
25 Washer
26 Retaining washer
27 Hexagon nut
29 Lever with counterweight
31 Bracket
32 Hexagon screw
33 Lock washer
34 Idle adjustment screw
35 Pressure spring
36 Idle mixture adjustment screw
37 Pressure spring
51 Air horn
52 Diffuser
53 Retaining screw for air horn
54 Retaining screw for diffuser
55 Hexagon nut
56 Mixing tube holder
57 Mixing tube of stage 1
58 Mixing tube of stage 2
59 Air correction jet of stage 1
60 Air correction jet of stage 2
61 Strainer for compensating air
64 Main jet plug
67 Fiber sealing ring
68 Main jet of stage 1
69 Main jet of stage 2
71 Idle fuel jet
72 Idle air jet of stage 1
73 Grub screw
77 Ball valve for accelerating pump
78 Strainer
79 Fiber sealing ring
81 Injection tube
82 Fiber sealing ring
83 Pump jet
84 Fiber sealing ring
91 Accelerating pump
93 Pump diaphragm
94 Diaphragm spring
98 Cover with pump arm
100 Pump arm
101 Shaft for pump arm
102 Oval head countersunk screw
108 Rubberized fabric gasket
109 Cheese head screw
110 Lock washer
111 Connecting rod (complete)
112 Connecting rod
113 Pressure spring
114 Washer
115 Cotter pin
116 Shoulder nut (adjusting nut)
117 Hexagon nut (lock nut)

Component Parts of Solex Compound Cross-Draft Carburetor Type 44 PHH (Sand-Cast Carburetor)

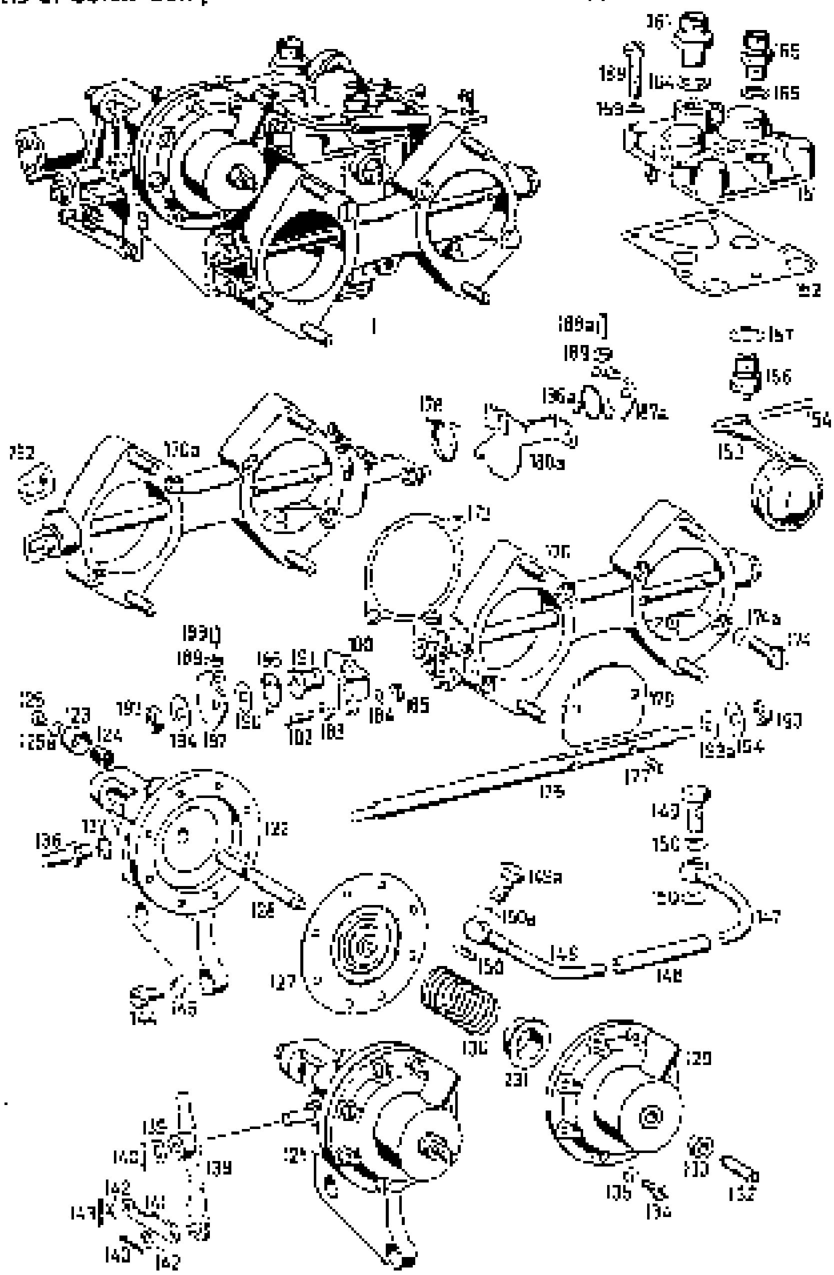


Fig. 07-3/21

121 Vacuum box (complete)
122 Lower section with ball valve (relay valve on atmospheric side)
123 Cup for ball valve
124 Strainer
125 Hexagon screw
125a Lock washer
127 Diaphragm
128 Diaphragm rod
129 Upper section
130 Diaphragm spring
131 Retainer cup
132 Set screw
133 Hexagon nut
134 Cheese head screw
135 Lock washer
136 Pivot pin
137 Toothed washer
138 Relay lever
139 Washer
140 Cotter pin
141 Transmission lever
142 Washer
143 Cotter pin
144 Cheese head screw
1st version with slot,
2nd version with hexagon socket

145 Lock Washer
146 Vacuum line
147 Vacuum line
148 Connecting hose
149 Hollow screw
149a Ball valve (relay valve on vacuum side)
150 Fiber sealing ring
150a Fiber sealing ring
151 Carburetor cover
152 Carburetor cover gasket
153 Float
154 Float shaft
156 Float needle valve
157 Copper sealing ring
161 Threaded union
164 Fiber sealing ring
165 Threaded union
166 Copper sealing ring
168 Cheese head screw
169 Lock washer
170 Choke valve section for front carburetor
170a Choke valve section for rear carburetor

172 Gasket
174a Lock washer
175 Choke valve shaft
176 Choke valve
177 Oval head countersunk screw
179 Torsion return spring
180 Choke valve lever for front carburetor
180a Choke valve lever for rear carburetor
182 Clamping screw
183 Bushing
184 Washer
185 Hexagon nut
186 Torsion return spring
186a Torsion return spring
187 Abutment for front carburetor
187a Abutment for rear carburetor
189 Adjusting screw for front carburetor
189a Adjusting screw for rear carburetor
190 Hexagon nut
191 Washer
192 Spacer sleeve
193 Stop lever
193a Washer
195 Hexagon nut
196 Retaining washer

Air Intake Silencer and Fuel Feed Pump

Job No.
09-5

A. Air Intake Silencer

The air intake silencer cleans the inlet air for the engine and muffles the intake noises. We distinguish between the following types of air intake silencers.

I. Dry air filters with replaceable paper element (micronic or pico element).

II. Wet air filters with oil-wetted cartridge elements (steel mesh or rubberized coir in the filter top).

III. Oilbath air filters with oil-wetted cartridge elements (steel mesh or rubberized coir in the filter top) and a certain amount of oil in the filter base (design for tropical countries).

Careful servicing of the air intake silencer is of particular importance for engine performance and engine service life. Clogged air-intake silencers reduce engine performance, increase fuel consumption, and increase the wear and tear of pistons and cylinders.

When reassembling the filters make sure that the seals are properly seated. Swollen or deformed seals should always be replaced.

I. Dry Air Filters

Models 180 c, 180 b, 220 S, and 220 SE have a dry air filter with paper insert like Model 190 (Fig. 09-5/1).

This paper element (micronic or pico element) must be cleaned after every 5000 km by lightly tapping it on an even surface and by blowing it out at an angle from the outside and from the inside with compressed air at a minimum pressure of 5 atm. (Fig. 09-5/2). The filter housing top and base must also be cleaned to remove the dust that has accumulated.

After a mileage of 48 000 km the paper element must be replaced.

If the car is driven mainly or regularly in dusty country the element must be cleaned at more frequent intervals and must be replaced after a shorter mileage.

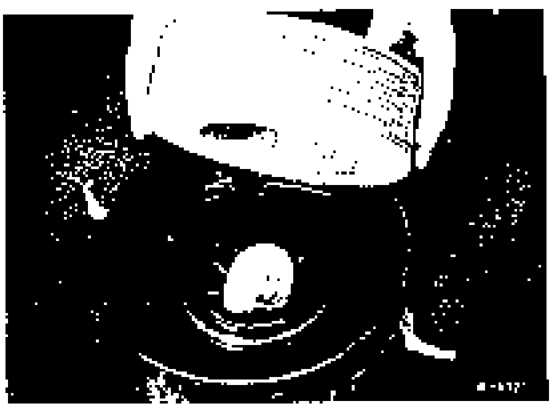


Fig. 09-5/1

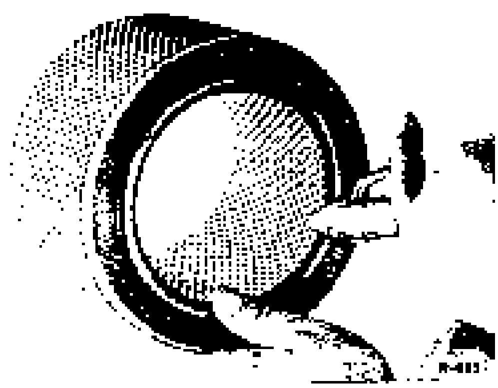


Fig. 09-5/2

When installing the filter housing top, check whether the seal is properly seated in the filter housing top and base. Swollen or deformed seals should always be replaced.

If on Models 180 a and 180 b the air-intake silencer was removed for cleaning purposes, make sure when placing it in position on the carburetor – as described for Model 190 – that the rubber sleeve is not jammed between carburetor and filter housing. On Model 220 S the filter housing is fastened to the carburetor by means of snap catches. Make sure that the air-intake silencer is properly seated and that the snap catches fit tightly.

On Models 180 a and 180 b the filter top can be installed in two positions, i. e. in the summer position (Fig. 09-5/3) and in the winter position (Fig. 09-5/4). These two positions are marked on the filter top by direction arrows and inscriptions. In the summer position the engine draws in clean air from in front of the engine and in the winter position it draws in hot air from the engine compartment. This prevents icing up of the carburetor nozzle system at very low temperatures.

Fig. 09-5/3

Summer position

Fig. 09-5/4

Winter position

Note: On Models 180 a and 190 the diameter of the connecting branch for the air vent line of the engine ventilating system has been reduced from 5.5 mm to 4.5 mm Ø. If increased oil deposits are found on the paper element in the case of older cars, this condition should be remedied by subsequently pressing a nozzle into the connecting branch. This nozzle with a diameter of 4.5 mm, an outside diameter of 13.5 mm and a length of 10 mm should be made of aluminum. It has proved advisable to give the outside diameter of the nozzle a slightly conical shape in order to obtain proper seating. The paper filter element should be replaced at the same time.

II. Wet Air Filter

Models 190 SL, 220 a, and 219 are equipped with a wet air filter. In this type of filter the filtering action is produced by the oil-wetted cartridge installed in the filter top (Fig. 09-5/5).

This filter must be cleaned after every 6000 km when the car is being serviced.

Fig. 09-5/5

The wet air filter can only be effective if the air element is cleaned at regular intervals and if it is always oiled. If these well-known servicing instructions are neglected, the intake air can pass the filter without actually being cleaned of oil and there is a danger that the abrasive effect of the dust particles will cause premature wear of the cylinder walls.

The servicing instructions are intended for **normal** conditions. It goes without saying, therefore, that both lubricating and cleaning should be carried out at more frequent intervals if the car is regularly exposed to a great deal of dust.

The element of the wet air filter should be washed in clean gasoline, Tri, P 3, kerosene or diesel fuel and should then be blown out with compressed air. In the case of Models 220 a and 219 the filter element should then be **evenly soaked** in about 120 cc and in the case of Model 190 SL in about 60 cc engine oil which can be sprayed on, poured on or applied by immersion. The filter cover should only be screwed on when the oil has fully penetrated into the filter element.

On Models 220 a and 219 make sure when installing the filter top and when tightening the snap catches that the air filter supports are positioned in the mounting ring of the filter base.

If, in the case of Models 220 a and 219, the air-intake silencer was removed from the carburetor for cleaning purposes, make sure when reinstalling it that the rubber sleeve is not jammed between the air intake silencer and the carburetor.

On Model 190 SL the air-intake silencer is screwed to the cowl; it is **not** necessary to remove the filter base for cleaning purposes.

III. Oil Bath Air Filter

The engines of Models 190 SL, 220 a and 219 can be equipped with an oilbath air filter as optional equipment.

The filtering effect of oilbath filters is produced by the cartridge in the filter top and in addition by the oil thrown up by the air stream in the filter base (Fig. 09-5/6).

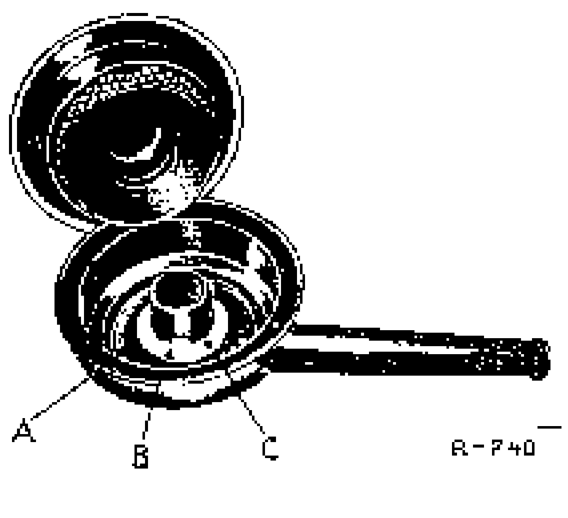


Fig. 09-5/6

Oilbath air filter
for Models 220 a and 219

A = Oil [illegible]
B = Maximum oil level
C = Standard oil level

It is impossible to give general instructions about intervals between oil replacement and filter cleaning since this depends to a large extent on local dust conditions. As a matter of principle the oil in the oil reservoir (A) of oilbath air filters should be replaced and the filter top cleaned when the oil begins to become dark and thick with the dust removed from the air. In the case of cars driven exclusively on very dusty roads or in tropical countries this may be necessary after a few weeks or even after a few days. In order to ensure that the oil is replaced whenever required, it is advisable **to check the oilbath daily when the car is driven on very dusty roads**, whereas a weekly check will be found sufficient under ordinary circumstances. In order to check the oil loosen the snap catches and remove the cover together with the filter element.

Please note: Fill up engine oil only up to the mark "Normal-Ölstand" (standard oil level) (C) and never beyond it. When the oil has been topped up, install the cover together with the filter element and clamp it down by means of the snap catches.

Caution: Under normal circumstances there is no need to top up with oil since properly proportioned and properly serviced filters do not lose oil! The oil level must not be checked with the engine hot, i. e. **not until at least one hour after switching off the engine.** The oil level can only be checked properly when the oil has run back unto the oil reservoir (A) from the filter element.

B. Disassembly and Repair of Fuel Feed Pump

On Models 180 a, 180 b, 190 SL, 220 a, 219, and 220 S the checking and repair procedures for the fuel feed pump are the same as described for Model 190. The fuel feed pump, the jointing flange with tappet, the insulating flange and the gaskets are the same on all models and are interchangeable. The pump capacity is the same as given in the Workshop Manual for Model 190.

Model 220 SE has an electric fuel feed pump (see Workshop Manual Passenger Cars as from August 1959, Job Nos 00–15 and 07–10).

Intake and Exhaust Manifold

Job No. 14-5

Carefully examine the intake and exhaust manifold for cracks before re-installing them. In addition check the contact surfaces of the attaching flanges for displacement and distortion on a surface plate and, if necessary, recondition them. Cracked exhaust manifolds must always be replaced.

A. Replacement of Heating Spiral

The removal and installation procedures for the heating spiral for Models 180 a, 180 b, 220 c, 219, and 220 S are the same as described for Model 190.

The heating spirals are identical and interchangeable.

B. Replacement of Damper Spring

The procedures for the replacement of the damper spring on Models 180 a, 180 b, 220 a, 219, and 220 S are the same as on Model 190.

C. Replacement of Heater Valve and Shaft

The removal and installation procedures for the heater valve and shaft on Models 180 a, 180 b, 220 a, 219, and 220 S are the same as described for Model 190. The diameter of the heater valve shaft, the bore in the exhaust manifold and the dimensions of the mounting bushings for the heater valve shaft are the same as on Model 190.

Drive for Oil Pump, Distributor, Revolution Counter, and Injection Pump

Job No.
18–1

I. Models 180 a, 180 b, 190 SL, 220 a, 219, and 220 S

On Models 180 a, 180 a, 190 SL, 220 a, 219, and 220 S the drive for the oil pump and the distributor is the same as on Model 190. All dimensions and tolerances necessary to check the idling gear shaft, the helical gear, and the front and rear bearing bushings are listed in the following tables.

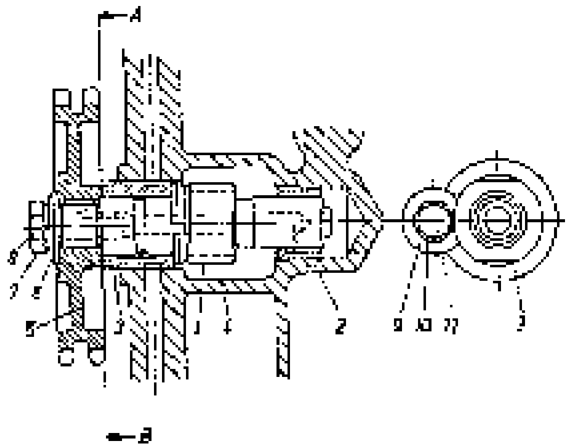


Fig. 18-1/1

1 Idling gear shaft with Woodruff key
2 Rear bearing bushing
3 Front bearing bushing
4 Crankcase
5 Idling gear
6 Washer
7 Lock washer
8 Hexagon screw
9 Retaining disc
10 Lock washer
11 Hexagon screw

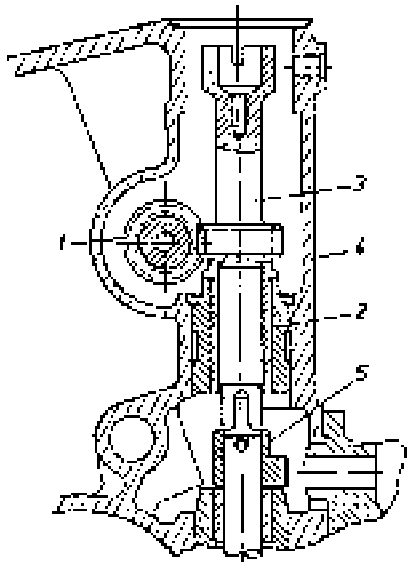


Fig. 18-1/2

1 Idling gear shaft
2 Bearing with bushing
3 Helical gear
4 Crankcase
5 Oil pump drive shaft with cam

Idling Gear Shaft with Bushings

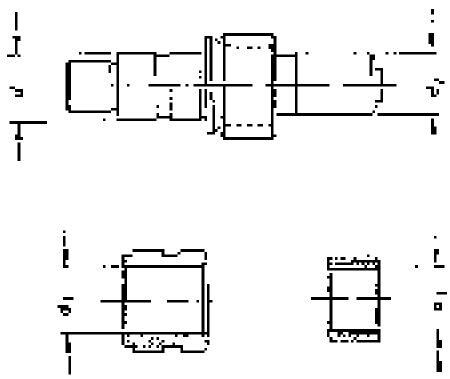


Fig. 18-1/3

d	d_1	d_2	d_3
19.980 / 19.959	20.020 / 20.033	17.960 / 17.940	18.000 / 18.018

Helical Gear with Bushing

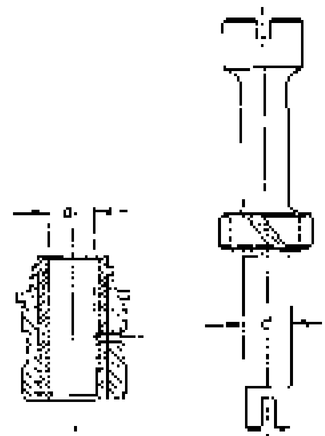


Fig. 18-1/4

d	d_1
13.566 / 13.550	14.000 / 14.018

The earlier version of Model 180 a is provided with a single roller chain and corresponding sprockets; as from Engine End No. 85 10924 the chain and the sprockets are the same as on Model 190.

II. Drive for Revolution Counter on Model 190 SL

On Model 190 SL the angle drive for the revolution counter (15) is driven by the idling gear shaft (10) via the driving screw (5). An additional centering disk (7) is located on the collar of the idling gear (8) and centers the driving screw (5) for the revolution counter (Fig. 18-1/5). When repairs are carried out, the idling gear cannot be replaced by a standard idling gear as used on Models 180 a, 180 b, 220 a, 219, and 220 S.

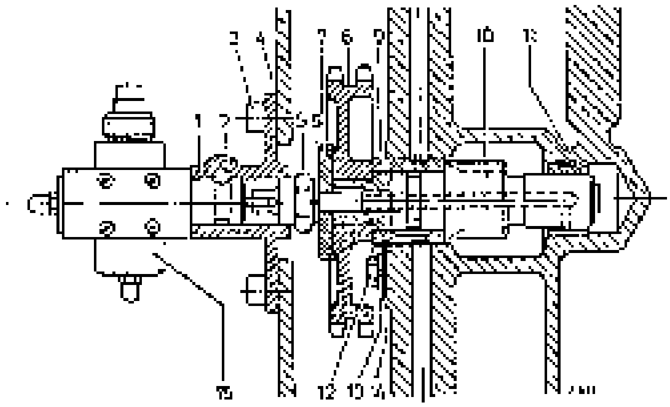


Fig. 18-1/5

1 Flanged bushing
2 Hexagon screw
3 Hexagon socket screw
4 Gasket
5 Driving screw
6 Spring washer
7 Centering disk
8 Idling gear
9 Front bearing bushing
10 Idling gear shaft
11 Rear bearing bushing
12 Hexagon screw
13 Lock washer
14 Locking plate for front bearing bushing
15 Angle drive for revolution counter

III. Drive for Injection Pump on Model 220 SE

On Model 220 SE the oil pump, the distributor, and the injection pump are driven by the idling gear shaft. The injection pump is connected with the splines at the rear end of the idling gear shaft (10) by means of a coupling sleeve (13) (Fig. 18-1/6). The helical gear (9) for driving the distributor (1) is carried in a cover screwed to the crankcase (Section A-B) and engages with the drive sleeve (18) on the idling gear shaft. As on other models the oil pump is driven by the idling gear shaft (10) via the helical gear (39) which is carried at the bottom in the bearing assembly (38) in the crankcase and at the top in the pressure piece (36). The pressure piece is sealed by means of the rubber ring (34), the cover disk (37), and the screw plug (33) and is secured by means of the hexagon screw (35) (Fig. 18-1/6).

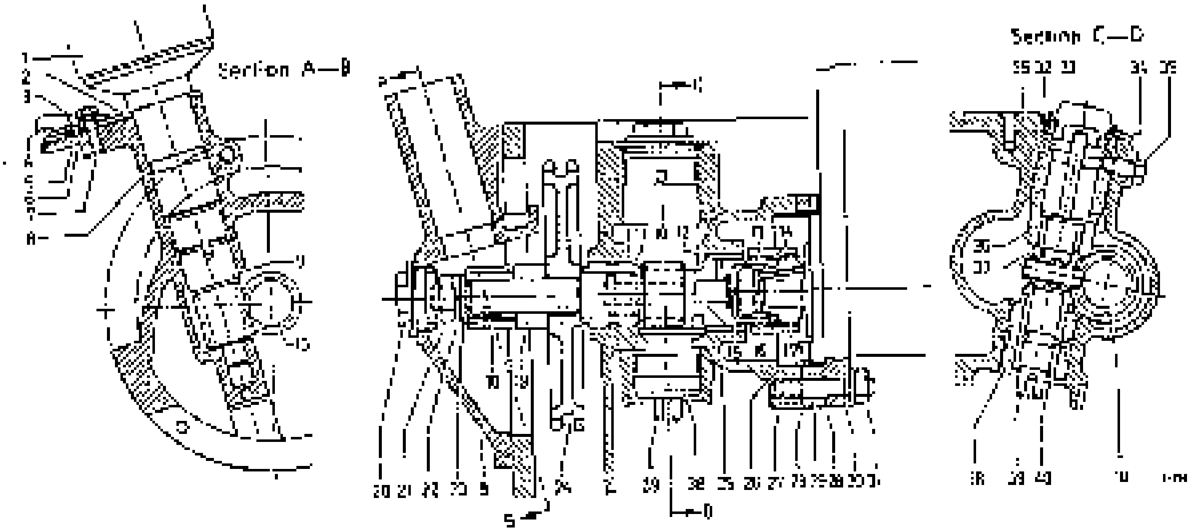


Fig. 18-1/6

1 Distributor
2 Timing lever
3 Spring washer
4 Hand lever
5 Cylindrical pin
6 Eccentric disc
7 Hexagon screw
8 Distributor bearing
9 Helical gear
10 Idling gear shaft

11 Bearing bushing, front
12 Bearing bushing, rear
13 Coupling sleeve
14 Snap ring
15 Hexagon nut
16 Lock washer
17 Follower
18 Drive sleeve
19 Spacer sleeve
20 Screw plug and seal

21 Hexagon nut
22 Lock washer
23 Washer
24 Idling gear
25 Crankcase
26 Bearing bushing
27 Stud bolt
28 Sealing flange
29 Insulating flange
30 Injection pump

31 Hexagon nut and washer
32 Cover disc
33 Screw plug
34 Rubber ring
35 Hexagon screw
36 Pressure piece
37 Bearing bushing
38 Bearing assembly
39 Helical gear
40 Bearing bushing

Bearing for Distributor Helical Gear

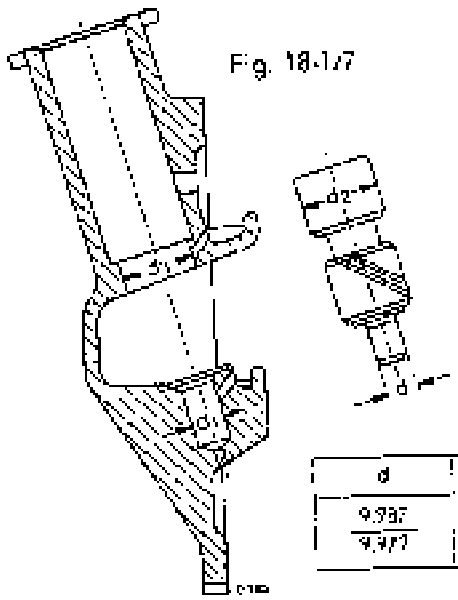


Fig. 18-1/7

d	d_1	d_2	d_3
9.987 / 9.977	10.000 / 10.015	23.980 / 23.967	24.000 / 24.021

Helical Gear with Pressure Piece and Bearing Assembly

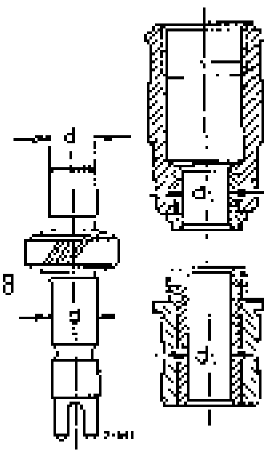


Fig. 18-1/8

d	d_1
13.968 / 13.950	14.000 / 14.018

Idling Gear Shaft with Bushings

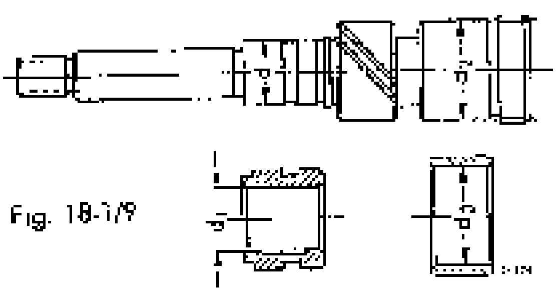


Fig. 18-1/9

d	d_1	d_2	d_3
19.980 / 19.959	20.020 / 20.033	29.960 / 29.927	30.000 / 30.021

Engine Lubrication

A. General

On Models 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE engine lubrication is of the pressure-circulating type and the oil circulation system is the same as in Model 190.

B. Repair of Oil Pump

The 1st version oil pump on Models 180 a and 190 SL is the same as on Model 190 (Fig. 18-5/1). The 2nd version pump differs only in a modified suction strainer for improved suction which today is installed in Models 180 a, 180 b, and 190 SL as a standard part (on Model 180 b it has been installed in all cars). When repairs are carried out, the new suction strainer can be subsequently installed in the 1st version oil pump.

The 1st version oil pump on Models 220 a, 219, 220 S, and 220 SE has a grey-cast iron housing base which differs from the oil pumps of the 4-cylinder engines; the oil pump shafts are carried directly in the housing base without bushings (Fig. 18-5/2). In addition the suction strainer together with the suction pipe is screwed into the housing base.

The 2nd version pump on Models 219, 220 S, and 220 SE is of the same construction as the oil pump for the 4-cylinder engines.

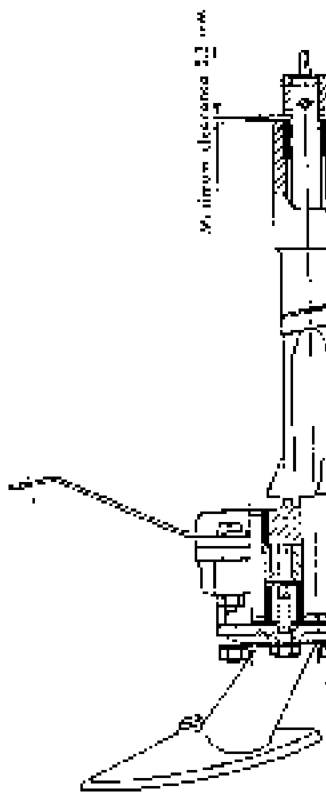


Fig. 18-5/1

Models 180 a and 190 SL 1st version
2nd version the same as 1st version,
but with suction strainer as shown in
Fig. 18—5/3
Model 180 b only with 2nd version

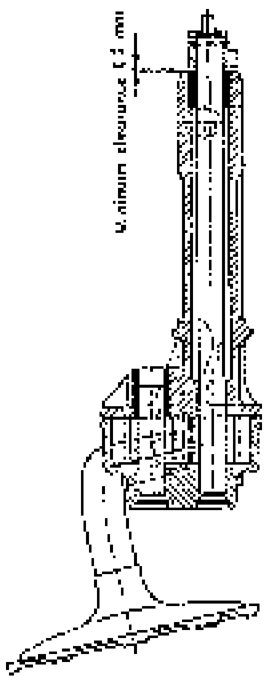


Fig. 18-5/2

Models 220 a, 219, 220 S,
and 220 SE
1st version

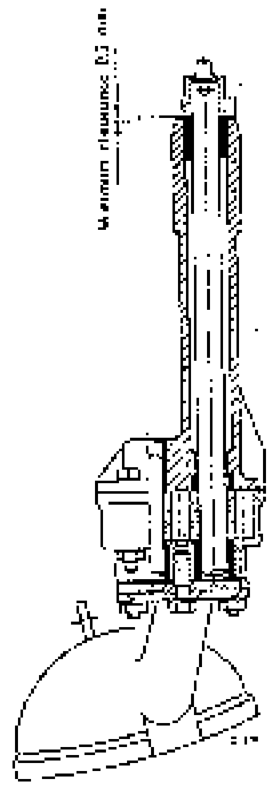


Fig. 18-5/3

Models 219, 220 S,
and 220 SE
2nd version

Note: Model 220 SE has an electrically driven fuel feed pump so that the drive cam on the oil pump shaft is not required.

The repair procedures for the oil pump are practically the same as in the case of Model 190. The diameter of the drive shaft and the oil pump shaft, the bores in the housing top and base, the radial play, end play, and backlash of the gears are identical in all types of pump.

If the bearing bushing in the housing top has to be replaced, make sure that the new bushing is pressed in with the correct oversize. To do this measure the base bore and select a bearing bushing with a suitable outside diameter. If the minimum oversize of 0.014 mm is not obtained, the housing top should be replaced.

Assembly Data for Upper Bearing Bushing

Base bore in housing	19.300 19.321
Outside diameter of bearing bushing	19.048 19.335
Oversize of bearing bushing in housing	0.014 0.048

There is a difference in the capacity of the oil pumps of the 4-cylinder and the 6-cylinder engines. The details are listed in the table below.

Delivery

Model	Engine speed r.p.m.	Delivery kg/min.	Vacuum suction side mm Hg	Pressure delivery side atm.	Oil temperature °C	Type of oil
180 a, 180 b, 190, 190 b, 190 SL	5000	24.5	400	5	100°	Engine oil SAE 10
220 b, 219, 220 S, 220 SE	5000	35	400	5	100°	Engine oil SAE 10

An oil pump is still serviceable if the minimum delivery is 80% of the specified delivery. Pumps with a lower delivery must under all circumstances be replaced or repaired.

C. Cleaning and Checking of Oil Relief Valve in Main Oil Flow

The only difference in the oil relief valves on the various models is in the shape of the housing (Figs. 18-5/4 and 18-5/5). The method of operation and the cleaning and checking procedures are the same for both versions of the oil relief valve. The piston spring, the piston and the retainer ring are identical on both valves and are interchangeable.

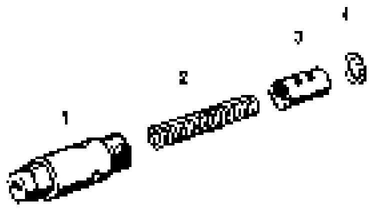


Fig. 18-5/4

Oil relief valve for Models 180 a, 180 b, 190 SL, 220 SE, and 219, 220 S (2nd version)

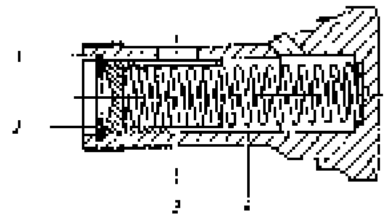


Fig 18-5/5

Oil relief valve for Models 220 a and 219, 220 S (1st version)

1 Oil relief valve
2 Retainer ring
3 Piston
4 Spring

Test Values of the Spring of the Oil Relief Valve

Length L and Pressure P					Wire gage d	External diameter D
Free length L	Valve closed		Valve open			
mm	L_1 mm	P_1 kg	L_2 mm	P_2 kg	mm	mm
43.6	39	2.4	30.5	6.8±0.35	1.4	9.1—9.4

The opening pressure is 6±0.5 kg/cm²

D. Disassembly, Cleaning, and Reassembly of Oil Filter

On Models 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE the disassembly, cleaning and reassembly procedures of the oil filter are the same as described for Model 190.

There is, however, a difference in the shape of the housing top as was mentioned in Job No. 01-4, Section I. In addition attention should be paid to the different number of elements (Figs. 18-5/6 and 7).

Various types of oil filters have been installed and cleaning procedure varies accordingly:

Oil Filter with Wire Coil Element and Paper Filter Element

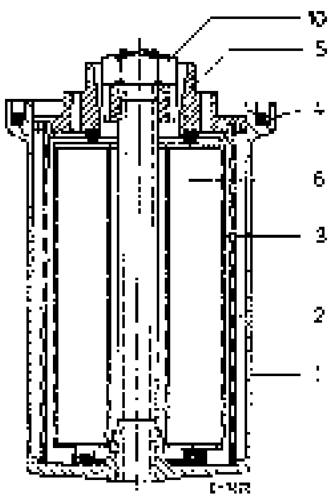


Fig. 18-5/6

1 Oil filter base
2 Wire coil
3 Paper filter element
4 Rubber sealing ring
5 Discharge plug
6 Rubber sealing ring
10 Hexagon nut

Oil Filter with Paper Filter Element

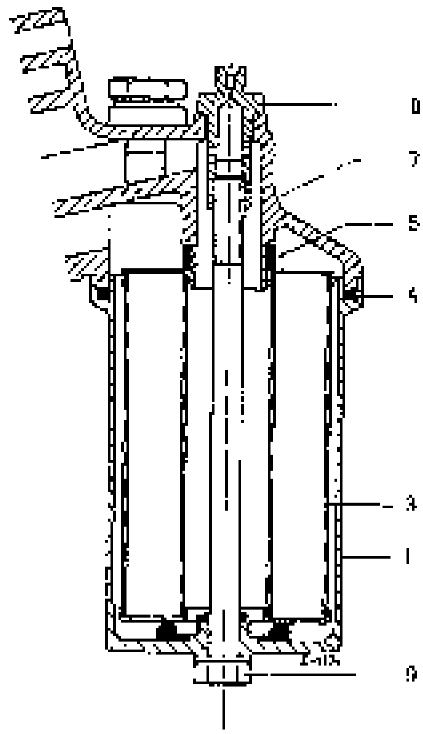


Fig. 18-5/7

1 Oil filter base
3 Paper filter element
4 Rubber sealing ring
5 Rubber sealing ring
7 Oil filter top
8 Threaded union
9 Hexagon screw with seal

The wire coil and strainer elements should be cleaned in a parts washer. If no parts washer is available, both the wire coil elements and the strainer elements must be cleaned in trichloro ethylene. To do this soak the element for some time in trichloroethylene and afterwards clean it with a brush.

Wire elements and strainer elements cannot be cleaned satisfactorily with gasoline.

The element should be cleaned very **carefully** and should be carefully inspected after cleaning. Hold the wire coils or strainer elements against the light and make sure that they are actually quite clean. Remaining traces of dirt can be removed by knocking the element against a flat surface.

Explanation of Symbols and Remarks

Symbols: O = oil change
P = replace paper element
D = clean wire coil element

Remarks: P = replace paper element.
In the case of oil filters which have **a paper element only** use paper filter element Knecht designation EH 256/1, Part No. 000 184 43 25 (paper type 200).

In the case of filters with both **paper and wire coil element** use paper filter element Part No. 000 184 22 25.

If an oil filter element shows unusual sludge formation, this is an indication that cooling water has mixed with the oil. Examine the engine and stop the leak.

The sealing ring in the oil filter base needs particular attention. **For reasons of safety always replace the sealing ring when the filter has been opened.** When inserting the sealing ring make sure that air pads do not form in the groove of the oil filter base.

The following tables indicate after what mileage the oil filter elements must be replaced or cleaned.

Oil Change under Normal Running Conditions

300 km	3000 km	6000 km	12000 km	18000 km	24000 km	etc.
Oil filter type: **Paper element and wire coil element** Models 180, 220 a, 219, 220 S, 220 S Convertible and Coupé, 220 SE and 1st version Models 180 a, 190, 190 SL, 220 SE Convertible and Coupé						
O D	O	O P D	O P D	O P D	O P D	etc.
Oil filter type: **Paper element only** Models 180 b, 190 b, and 2nd version in Models 180 a, 190, 190 SL, 220 SE Convertible and Coupé						
O P	O	O	O P	O	O P	etc.

The test values of the oil relief valve springs in the housing top are also the same as for Model 190.

Test Values of the Oil Relief Valve Springs

Length l and Pressure P					Wire Gage c	External diameter D
Free length	Valve closed		Valve open			
mm	L_1 mm	P_1 kg	L_2 mm	P_2 kg	mm	mm
49	32	2.6	24	3.30	1.25	12.25

The opening pressure of the relief valve is
for oil filter shown in fig. 18-5/6 (2 oil relief valves) — for metal filter 2 ± 0.2 kg/cm² ; for paper filter 1.2 ± 0.2 kg/cm²

for oil filter shown in fig. 18-5/7 (1 oil relief valve) — paper filter only 2.5 ± 0.3 kg/cm²

Engine Cooling System

Job No.
20 5

See also Job No. 50 0

Change: Vent hole in cap screw.

Repair of Water Pump

Repair procedures of the water pump for models 180 a, 180 b, 190 SL, 220 a, 219, 220 S and 220 SE is substantially the same as for model 190.

However, the following details for the individual models should be observed:

On model 190 SL the hub on the water pump shaft which holds the pulley and the fan has 4 threaded bores instead of 3 like the other models. If a water pump housing of models 180 a, 180 b, 220 a, 219 and 220 S is used for model 190 SL, the threaded union (10) (refer to Fig. 01—4/42) should be screwed out, while the bore is closed with a screw plug M 16 × 1.5 DIN 906—4 D. On model 190 SL the by-pass line is not connected to the water pump housing but to the distributor pipe (also refer to Job No. 01—4, Section E).

The water pumps for model 220 a were provided with an integrally cast pulley and hub up to engine end No. 5509040. If such a pulley is replaced, a pulley part No. 180 205 07 10 together with a hub part No. 180 202 00 14, may be used. To provide a tight fit of the hub on the water pump shaft, an oversize of 0.015 mm to 0.035 mm is required. The pulley and the fan are attached to the hub by means of 3 hexagon screws M 8 × 18 DIN 933-8 G and 3 spring washers B 8 DIN 137.

For models 180 a, 190, 190 SL, 219 and 220 S water pumps having a capacity of 3.25 kg/s were used exclusively up to the recent past, while for some time by now water pumps are mounted, in which the capacity has been increased to 4 kg/s by means of a larger impeller and a correspondingly larger water pump housing.

The water pump of larger capacity is available as intermediate version and a final version.

The intermediate version has no threaded union at the cooling water inlet connection, because the by-pass line of this pump type is connected to the distributor pipe. The final version, on the other hand, is again provided with a threaded union at the cooling water inlet connection to connect the by-pass line.

The following table provides data concerning the application of the new water pumps.

Model	Intermediate Version without threaded union with housing part No. 121 200 06 01 installed as from engine end No.	Final Version with threaded union with housing part No. 121 200 01 01 installed as from engine end No.
180 a	85 03385	85 14557
190	85 04452	85 14562
219	N 85 01891	N 85 06529
219	Z 85 00402	Z 85 01566
220 S	N 85 00821	N 85 13025
220 S	Z 85 01371	Z 85 05292
220 SE		as from 1st engine
190 SL	Part No. 121 200 04 01 installed as from engine end No. 85 01223	Part No. 121 200 09 01*) installed as from engine end No. 85 02544

*) The water pump with part number 121 200 09 01, is provided with a screw plug M 16 × 1.5, DIN 906–4 D instead of a threaded union, because the by-pass line of model 190 SL is connected to the distributor pipe.

Models 180 b and 190 b are provided only with water pumps of a capacity of 4 kg/s. On these models the by-pass line is connected to the distributor pipe. The part No. of these pumps without housing is 127 200 00 20, with housing 621 200 01 01.

The repair procedures of water pumps of 4 kg/s capacity is done in the same manner as that of water pumps of 2.25 kg/s capacity (refer to type 190).

Water pumps of 4 kg/s capacity can also be subsequently installed in older engines of the above models and on model 220 a. However, the intermediate version 127 200 00 01 (on model 190 SL 121 200 04 01) should be used-up during repairs for engines provided with this version as a standard part, while the previous version 180 200 10 01 may be used-up only for models 180 a, 220 a and 219.

Venting of Water Pump

The vent hole in cap screw (14) (Fig. 20-5/1) has been enlarged to prevent oil losses as a result of insufficient venting of water pump housing. The present standard-type cap screw with a larger vent hole has part No. 127 997 00 30; it can also be added subsequently. If no new cap screw is available, the axial hole of the formerly used cap screw can be drilled from 3 to 6 mm dia. and the cross bore at the hexagon from 1.5 to 2 mm dia.

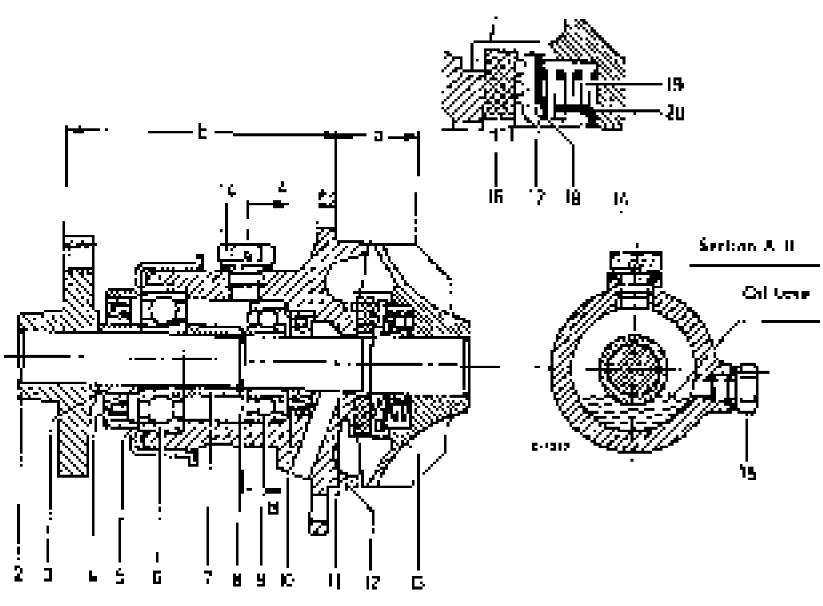


Fig 20-5/1

2 Hub
3 Intermediate ring
4 Sealing ring
5 Sealing ring holder
6 Ring groove bearing
7 Spacer sleeve
8 Lock washer
9 Ring groove bearing
10 Sealing ring
11 Water pump shaft
12 Bearing housing
13 Impeller
14 Cap screw with vent hole
15 Oil level control plug
16 Slip ring
17 Sealing ring
18 Slip ring cage
19 Pressure spring
20 Cap

Front Engine Suspension

Job No. 22-0

Front Rubber Mounting

Model	Part Nos of rubber mountings left	Part Nos of rubber mountings right	Color code	Shore hardness of rubber
180, 180 a, 180 b, 190, 190 b, 190 D, 190 Db, 190 SL, 220 S, 220 SE as well as 219 with hydraulic automatic clutch	120 223 04 12 optional 120 223 06 12	120 223 05 12 optional 120 223 07 12	red	40°
190 D, 180 Db, 220 a, 219	180 223 02 12 optional 180 223 05 12	180 223 03 12 optional 180 223 06 12	yellow	50°

In the various models the rubber mountings for the front engine suspension differ not only in the degree of hardness, but also in the types used for the left and right front engine suspension. When mountings are being replaced, make sure that the correct type is installed. The different types of mountings can be distinguished by the part number and by their color code: they are marked in red or yellow according to the degree of Shore hardness of the rubber.

Removal and Installation of Left and Right Rubber Mounting

Job No. 22-1

For Models 180 to 220 SE the removal and installation procedures are basically the same as described for Model 190. The following details require attention:

a) Protection of Rubber Mountings on Diesel Cars

On Models 180 D and 180 Db the right rubber mounting (6) is covered by a screening plate (5) in order to prevent damage to the rubber mounting if diesel oil should leak out of the fuel main filter or the injection pump (Fig. 22-1/2).

For the same reason the left rubber mounting (10) on Models 190 D and 190 Db is protected by bellows (9) and a sheet-metal cover (8) (Fig. 22-1/2).

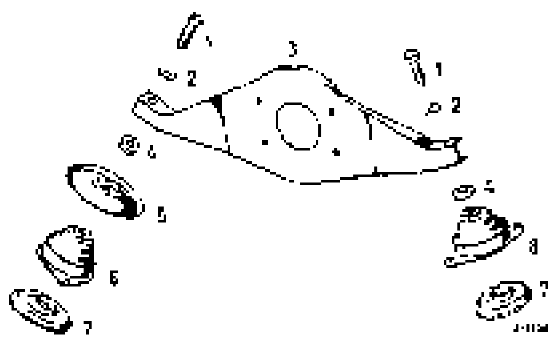


Fig. 22-1/1

1 Hexagon screw
2 Lock washer
3 Engine support
4 Washer
5 Retaining plates
6 Right rubber mounting
7 Buffer plate
8 Left rubber mounting

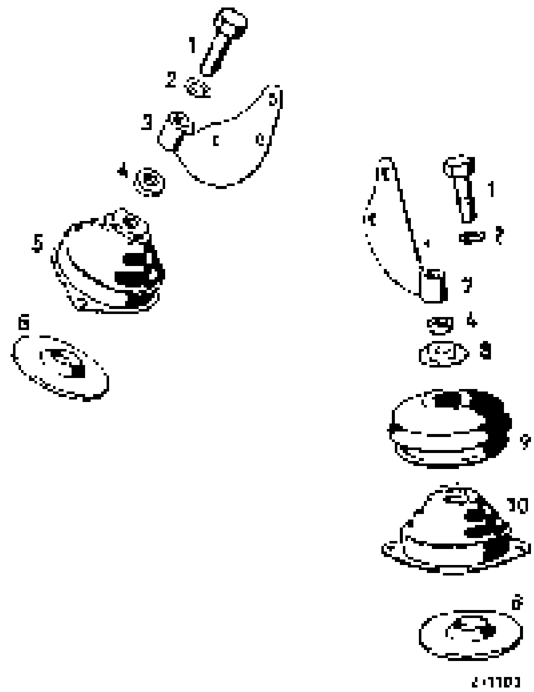


Fig. 22-1/2

1 Hexagon screw
2 Lock washer
3 Right engine support
4 Washer
5 Right rubber mounting
6 Buffer plate
7 Left engine support
8 Sheet-metal cover
9 Bellows
10 Left rubber mounting

b) Buffer Plate

In order to prevent the engine from sinking too heavily into the front rubber mountings (3), the buffer plate (4) Part No. 621 223 00 65 is added between the rubber mounting (3) and the front axle support (5) in the case of Models 180 a, 180 b, 180 D, 180 Db, 190, 190 b, 190 SL, 190 D, 190 Db, 220 S, and 220 SE and on Model 219 with hydraulic automatic clutch (Fig. 22-1/3).

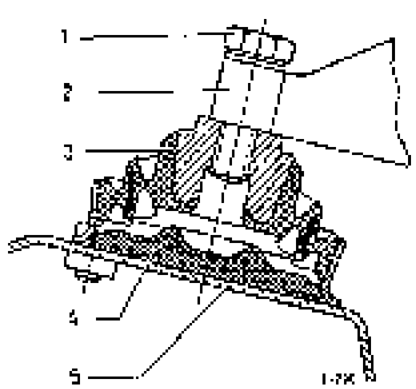


Fig. 22-1/3

1 Hexagon screw
2 Engine support
3 Rubber mounting
4 Buffer plate
5 Front axle support

On Model 180 the buffer plate can be installed subsequently without any modifications.

Note: The buffer plate, Part No. 121 223 00 65 (57° Shore, 12 mm high), has been replaced by the buffer plate, Part No. 621 223 00 65 (45° Shore, 7 mm high).

c) Washer between Rubber Mounting and Engine Support

On Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, and 190 Db an additional washer 5 mm thick (4) Part No. 186 990 16 40 has been installed between rubber mounting and engine support (Figs. 22-1/1 and 2). On these models the hexagon screw (1) is 45 mm long, whereas on the other sub-frame type models the screw without the washer is 40 mm long. Models 180 and 180 D up to Engine Support Part No. 636 220 09 16 have the short screw without the washer.

d) Jointing Rod between Engine and Front Axle Support

On Models 220 a, 219, 220 S, and 220 SE with front engine brace the jointing rod at the bracket of the front axle support must be unscrewed before the engine is lifted to enable the rubber mountings to be removed (see Job No. 22–2).

When new engine mountings have been installed, the length of the jointing rod must be correctly adjusted before it is attached to the bracket of the front axle support.

Job No.
22–2

Removal and Installation of Front Engine Brace

On Models 219, 220 S, 220 SE, and on some cars of Model 220 a a new front engine brace has been installed in order to prevent engine judder. The engine is given an additional support at the front axle support by means of the jointing rod (6) which is carried in rubber bushings. This reduces vertical movements of the engine (Fig. 22–2/1).

Removal:

1. Remove the hexagon screw (8) for fastening the engine to make it easier to push out the front axle support. If necessary, slightly lift the engine to make it easier to push out the screw.

2. Unscrew the two screws attaching the engine brace (1) to the crankcase and remove the engine brace.

Fig. 22–2/1

1 Front engine brace	6 Jointing rod
2 Rubber bushing	7 Hexagon nut
3 Hexagon nut	8 Hexagon screw
4 Lock washer	9 Washer
5 Shoulder screw	10 Rod head

Installation:

3. Before installing the engine brace, check whether the rubber bushings (2) in the engine brace (1) and in the rod head (10) are still serviceable. Worn bushings should be pressed out and replaced.

4. Before installing the jointing rod (6), attach it to the engine brace (1). This is necessary, because otherwise the shoulder screw (5) cannot be inserted.

Note: On the new version of the crankcase (without cylinder cover on the spark plug side) the left front screw for attaching the oil pan and the engine brace has been moved 35 mm toward the outside. As a result the engine brace (1) has been changed.

5. Screw the engine brace to the crankcase together with the jointing rod.

6. Screw the rod head (10) onto the jointing rod (6) until the bore of the rubber bushing (2) is aligned with the bore of the bracket on the front axle support.

Note: The jointing rod should be adjusted accurately since the engine must neither rest on the engine brace nor be pulled downward by the brace.

7. Fit the jointing rod (6) to the bracket of the front axle support by means of the hexagon screw (8).

Rear Engine Suspension

Job No.
24-0

A. Three-Point Engine Suspension on Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 190 SL, 220 a, and 219

Rear rubber mountings

Model	Part No. of rubber mounting	Shore hardness of rubber
180, 180 a, 180 b, 180 Db, 190 Db, and 190 SL (1st version[1])	120 240 04 18	40°—50°
220 a, 219	180 240 03 18 as replacement part 180 240 05 18	

[1] Cars of Model 190 SL are equipped with three-point engine suspension up to Chassis End No. 45 [illegible] and with four-point engine suspension as from Chassis End No. [illegible]

B. Four-Point Engine Suspension on Models 190 SL, 220 S, and 220 SE as well as on Model 219 with Hydraulic Automatic Clutch

Rear rubber mountings

Model	Part No. of rubber mountings left	Part No. of rubber mountings right	Color code	Shore hardness of rubber
220 S, 220 SE, and 219 with hydraulic automatic clutch	121 223 00 12 optional 121 223 02 12	121 223 01 12 optional 121 223 03 12	green	70°
190, 190 SL 2nd version	120 223 04 12 optional 120 223 06 12	120 223 05 12 optional 120 223 07 12	red	40°

On Models 220 S and 220 SE and on Model 219 with hydraulic automatic clutch the rear mountings are harder than the front mountings and are not interchangeable.

On Models 190 and 190 SL with four-point engine suspension the front and rear engine mountings are identical.

Removal and Installation of Rear Suspension

Job No.
24–1

A. Rubber Mountings with Three-Point Engine Suspension

Removal and installation procedures for the rear rubber mountings on Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 190 SL 1st version, 220 a, and 219 are as follows.

Removal:

1. Slightly lift the transmission with the car jack.

2. Unscrew the hexagon nuts fastening the engine mounting to the transmission housing rear cover.

3. Also unscrew the hexagon nuts attaching the rubber mounting to the chassis base panel, slightly lower the engine by means of the car jack and remove the rubber mounting from the transmission case cover (Fig. 24–1/1).

Installation:

4. Before reinstalling the rubber mounting carefully check the sheet-metal parts of the mountings for cracks. Cracked mountings must always be replaced.

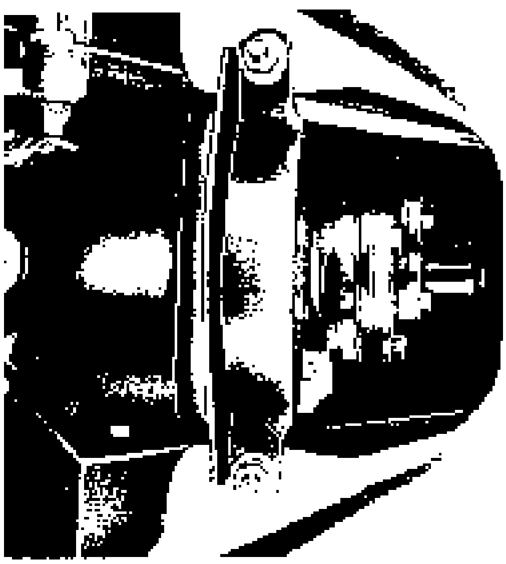


Fig 24–1/1

5. Attach the rubber mounting (2) together with the screening plate (1) to the transmission. The hexagon nuts (8) are installed together with lock washers (7) (Fig. 24–1/2).

6. Lift the transmission by means of the car jack until the engine mounting rests against the chassis base panel. Insert the two hexagon screws (3) and install the nuts (6) by hand.

When inserting the hexagon screws make sure that the correct number and type of spacer washers are installed. The middle washer (5) between chassis base panel and rubber mounting determines the installation height of the rubber mounting and the alignment of the propeller shaft with the engine (Fig. 24–1/2).

Fig 24–1/2

1 Screening plate
2 Rear rubber mounting
3 Hexagon screw M 10 × 45 for Model 190 SL
M 10 × 35 for Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 220 a, and 219
4 Washer 1 mm thick
5 Washer 10 mm thick for Model 190 SL
3 mm thick for Models 180, 180 a, 180 D, 190 D, 220 a, and 219
6 Self-locking hexagon nut
7 Lock washer
8 Hexagon nut

On Models 180, 180 D, 220 a, and 219, 3 spacer washers of equal thickness (3 mm) should be installed on each side in the following way

1 washer (4) between screw and chassis base panel

1 washer (5) between chassis base panel and rubber mounting

1 washer (4) between rubber mounting and hexagon nut.

On Model 190 SL 3 washers are used on either side, but on this model washer (5) is 10 mm thick instead of 3 mm (see Fig. 24–1/2).

Models 180 a, 180 Db, 190 D, 190 Db have a perforated insert (5) as a standard part (Fig. 24–1/3).

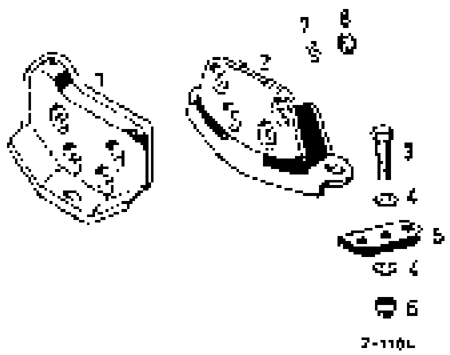


Fig. 24–1/3

1 Screening plate
2 Rear rubber mounting
3 Hexagon screw M 10 x 35
4 Washer 3 mm thick
5 Perforated insert
6 Self-locking hexagon nut
7 Lock washer
8 Hexagon nut

Model 180 D has three washers (5) on either side (see Fig. 24–1/2).

Model 180 a has only two washers with or without perforated inserts on either side, unless on export cars a reinforced rubber mounting with additional supporting plate has been installed without perforated insert. In this case a third washer, i. e. a center washer (5) must be installed between chassis base panel and rubber mounting. The washer (5) is not required if a perforated insert is installed (see Fig. 24–1/2).

It is advisable to install a perforated insert in Models 180 a and 180 D when the opportunity arises. In that case washer (5) is no longer required (see Fig. 24–1/2).

Note: Previously the nuts for the hexagon screws attaching the engine mounting to the chassis base panel on Models 180, 180 D, and 220 a were locked by lock nuts. On recent cars two self-locking hexagon nuts are used in place of the four hexagon nuts. When the transmission or a rubber mounting is installed in older cars of Models 180, 180 D or 220 a only self-locking nuts should be used.

7. Lower the transmission and allow the engine to settle in the rubber mountings until it rests easily on the mountings. Only then should the nuts be tightened on the hexagon screws.

B. Installation of Stop Piece in Rear Rubber Mounting

Model 219 has an additional stop piece (1) in the rear rubber mounting in order to limit the vertical movement of the engine (Fig. 24–1/4). This stop piece can also be installed subsequently in cars of Model 220 a if complaints are received about a rattling of the gear shift lever and in particular cases about the 3rd and 4th gear slipping out as a result of vertical and horizontal engine movements.

Other remedies for similar complaints are described in Job No. 26–3.

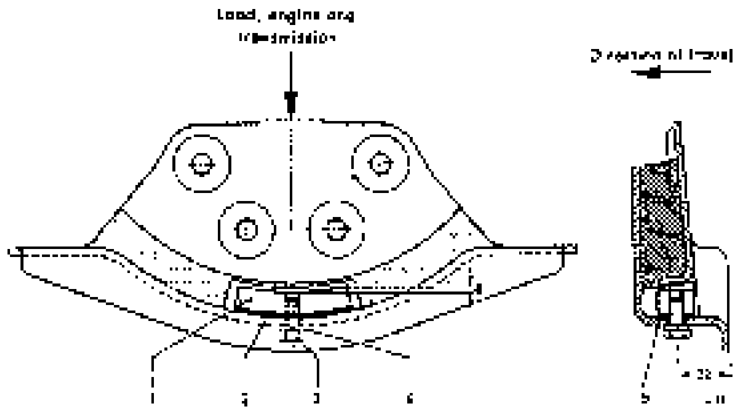


Fig. 24–1/4

a Distance = 1–2 mm
b Supporting surface for stop piece for spacer washer
1 Stop piece
2 Spacer washer
3 Hexagon screw
4 Lock washer

Subsequent installation of stop piece:

1. Mark out the bore for the **hexagon** fixing screw for the stop piece as shown in Fig. 24–1/4 and drill with a 6.4 mm ⌀ drill.

2. Remove the rubber coating of the supporting surface for the stop piece in order to obtain a better seat.

3. Screw down the stop piece (1) using as many spacer washers (2) as are necessary to produce a distance d = 1 to 2 mm between stop piece and rubber mounting **with the engine installed in the vehicle.** This distance is necessary in order to prevent an increase in the noise transmitted to the interior of the car. If the rubber mounting should settle down after a certain mileage the prescribed distance of 1 to 2 mm can be obtained by removing spacer washers.

Note: Make sure that the thin rubber coating on top of the recess is not removed, since otherwise the bare metallic part will knock against the stop piece when the engine mounting is depressed and produce a knocking noise.

C. Left or Right Rubber Mounting with Four-Point Engine Suspension

On all models with four-point engine suspension removal and installation of the rear rubber mountings are the same as described for Model 190.

Model 190 SL

The installation procedure for shorter engine supports (3rd version) and harder rubber mountings (70° Shore) is the same as described for Model 190.

Part number of the shorter engine supports for Model 190 SL:

shorter engine support left 121 223 27 04
right 121 223 28 04.

The 1st version engine supports had a lower fixing eye (6 mm high) and the rubber mountings were attached by means of hexagon socket screws M 12 × 30 DIN 912–8 G. In the case of 2nd version engine supports the height of the fixing eye was increased to 22.5 mm and hexagon screws with welded-on washers were used as fixing screws, the washer serving as a limit stop (Fig. 24–1/5). However, if longer engine supports with high eyes (22.5 mm) are installed **subsequently**, hexagon socket screws M 12 × 40 DIN 912–8 G must be used, since the sub-frames were not provided with the necessary recess for the hexagon screw (4) before the limit stop mentioned above was introduced (see Fig. 24–1/5).

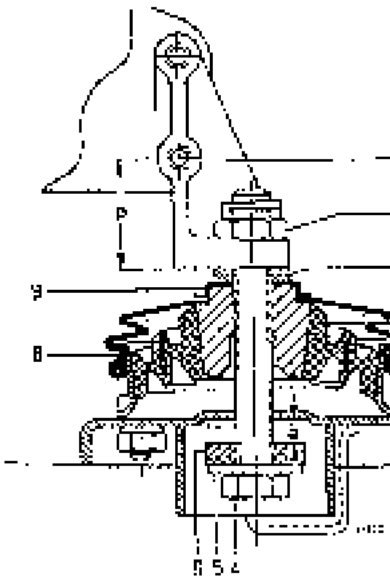


Fig. 24–1/5

1 Front axle support
2 Rubber mounting
3 Rear engine support
4 Hexagon bolt with washer (5)
5 Washer
6 Rubber spacer 3 mm thick
7 Hexagon nut (self-locking)
8 Bellows
9 Sheet-metal cover
10 Washer 5 mm thick, Part No. [illegible] 990 16 40
a = 3 mm
b = 22.5 mm (2nd version)
b = 17.5 mm (3rd version)

Clutch

Clutch Group 25

Mechanical Clutch

On Models 180 to 220 SE the clutch is essentially the same as the clutch on Model 190.

Differences exist in the method of centering the clutch pressure plate in relation to the crankshaft (see Figs. 25-0/1 and 25-0/2 and Table "Clutch Pressure Plate").

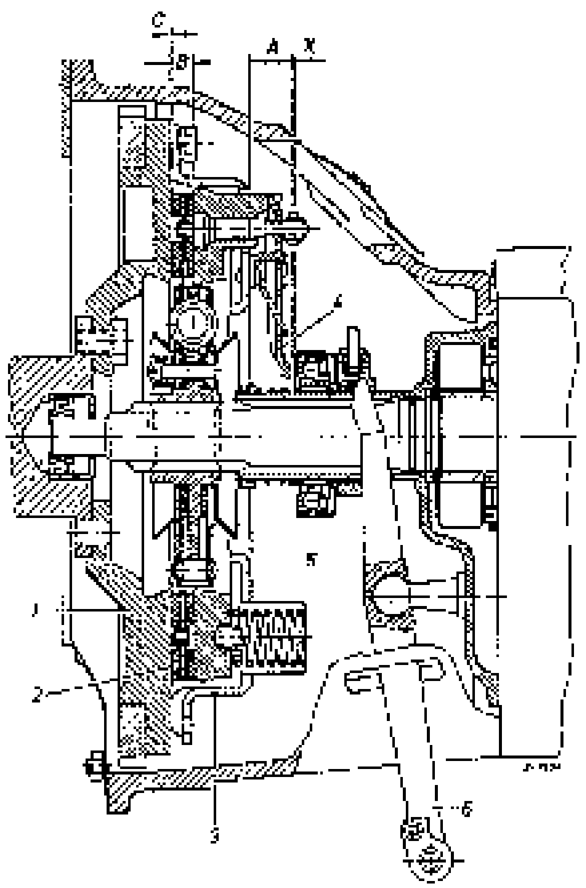


Fig. 25-0/1

Clutch arrangement with dowel pin centering

1 Flywheel
2 Driven plate
3 Clutch pressure plate
4 Release lever
5 Throw-out unit with bearing
6 Throw-out fork

A = Adjusting dimension for new driven plate
B = Thickness of a reduced concerning driven plate
C = Clearance between clutch lever and clamping face
X = Free play between release lever and throw-out bearing

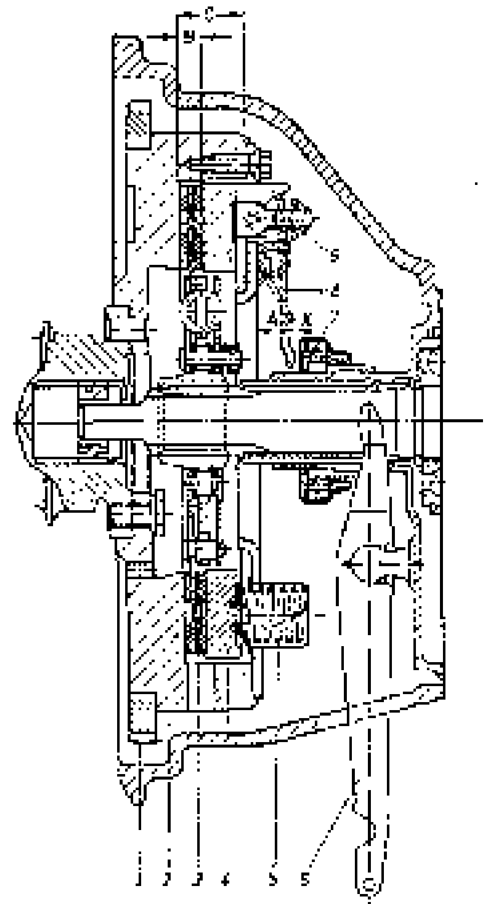


Fig. 25-0/2

Clutch arrangement with cylindrical centering

1 Starter ring gear
2 Flywheel
3 Driven plate
4 Clutch pressure plate
5 Clutch spring
6 Throw-out fork
7 Throw-out unit with bearing
8 Release lever
9 Adjusting nut

When repairs are carried out clutch KS 12 KY (180 250 07 04) can be installed subsequently on Models 180, 180 a, 180 D, 190, and 190 SL. On Models 219, 220 a, and 220 S the clutch pressure plate with cylindrical centering cannot be installed subsequently, since the 2nd version flywheel (cylindrical centering) has to be balanced dynamically together with the crankshaft.

Clutch pressure plate

Fichtel & Sachs

Model	Clutch pressure plate F. & S. Designation	D. B. Part No	Thrust pressure kg	Version	Remark
180	K 12 KV J 1 KS 12 KV	136 250 00 04 180 250 07 04	410 480	1st 2nd	cylindrical centering
180 D	K 12 KV J 1 KS 12 KV	136 250 00 04 180 250 07 04	410 480	1st 2nd	cylindrical centering
180 a	KS 12 K KS 12 KV	121 250 03 04 180 250 07 04	450 480	1st 2nd	cylindrical centering
190	KS 12 K KS 12 K KS 12 KV	121 250 02 04 121 250 03 04 180 250 07 04	410 450 480	1st 2nd 3rd	cylindrical centering
180 b, 180 Db 190 b, 190 Db	KS 12 KV	180 250 07 04	480		cylindrical centering
190 SL	KS 12 K KS 12 K KS 12 KV	121 250 02 04 121 250 03 04 180 250 07 04	410 450 480	1st 2nd 3rd	cylindrical centering
219	KFS 12 K KS 12 K KS 12 KV	180 250 05 04 180 250 03 04 180 250 07 04	480 480 480	1st 2nd 3rd	dowel pin centering cylindrical centering cylindrical centering
220 a	KFS 12 K	180 250 05 04	480		dowel pin centering
220 S	KFS 12 K KS 12 K KS 12 KV	180 250 05 04 180 250 03 04 180 250 07 04	480 480 480	1st 2nd 3rd	dowel pin centering cylindrical centering cylindrical centering
220 SE	TK 228 KV TK 228 KV	128 250 00 04 128 250 02 04	480—505 525	1st 2nd	cylindrical centering cylindrical centering

The clutch pressure plate with cylindrical centering has been installed as from the following chassis end numbers:

Model 219 85 05200
Model 220 S 85 11587

Removal and Installation of Clutch

Job No.
25-1

Removal and installation procedures for the mechanical clutch on Models 180 to 220 SE are the same as for Model 190.

Clutch Adjustment Data

Clutch pressure plate	K 12 KVJ 1	KS 12 K	KFS 12 K	KS 17 KV	TK 228 KV
Adjustment dimension "A" for new driven plate (clutch installed in vehicle) (Figs. 25-0/1 and 25-0/2)	15	17.8	17.8	17.5±0.2	9.5±0.2
Maximum adjusting dimension "A" for worn driven plate (clutch installed in vehicle) (Figs. 25-0/1 and 25-0/2)	26	23.3	28.8	28.5±0.2	30.5±0.2

Note: Press down the release levers several times before measuring. It is important that the distance from the cover plate should be identical for all three release levers (maximum difference 0.1 mm).

Disassembly, Checking and Reassembly of Clutch

Job No
25–4

On Models 180 to 220 SE this procedure is essentially the same as described for Model 190.

Pay attention to the following details.

I. Model 220 a

In the case of the 1st version clutch pressure plate the three adjusting nuts have to be sawn up and forced off before the clutch pressure plate can be disassembled. To do this place the clutch pressure plate on a suitable stand and, using a wooden bar and three equal lengths of pipe, exert pressure on the cover plate by means of a press until the pressure on the release levers is released (Fig. 25-4/1).

After adjusting the release levers the new adjusting nuts must be jammed in position as shown in Fig. 25–4/2.

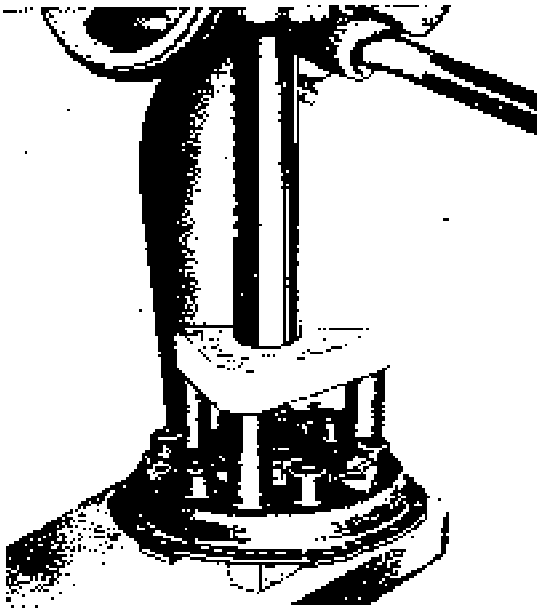


Fig. 25-4/1

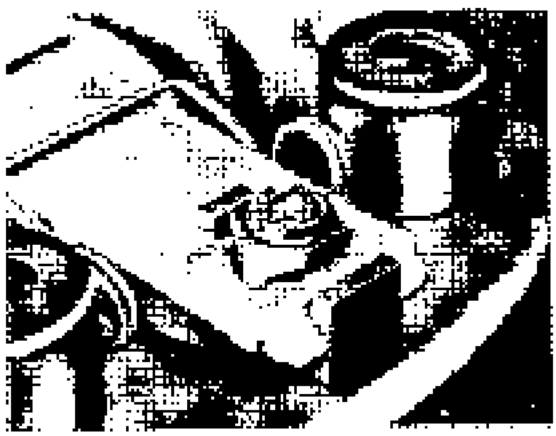


Fig. 25–4/2

II. Models 220 a, 219, 220 S, and 220 SE

The various clutch types in these models have either 9 identical clutch springs or a combination of 3 of one type and 6 of another type (see testing values for clutch springs). When reassembling clutch pressure plates with different clutch springs, pay attention to the color code and to the correct arrangement of the clutch springs (Fig. 25-4/3).

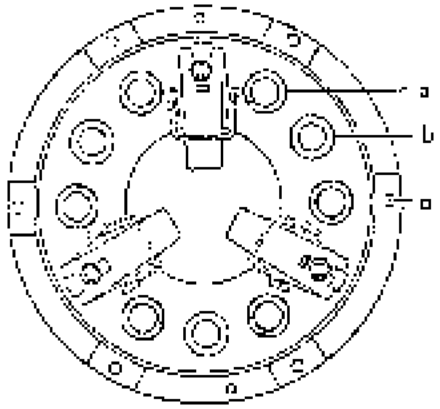


Fig. 25-4/3

Clutch pressure plate	F. A. S. Designation	KS 12 K	KFS 12 K	TK 228 KV
	D. B. Part No.	180 250 03 04	180 250 05 04	128 250 00 04
Spring	a	brown	gold	yellow
	b	white	gold	brown

Select the clutch springs in such a way that the difference between springs of the same color code in one clutch is as small as possible.

Test values for clutch springs

DB Part No. of clutch pressure plate	136 250 00 04 121 250 02 04	121 250 03 04	180 250 03 04		180 250 02 04		180 250 07 04	128 250 00 04		128 250 02 04
Thickness of pressure plate mm	15							16.5		
Reground dimension of pressure plate*) mm	5									
Total spring pressure kg	410	450	480		480		430	490—505		525
Number of springs	9									
Color code	white	plain	3 gold	6 gold	3 white	6 brown	gold	3 brown	6 yellow	gold
External diameter mm	25.6	25,6	25.6	25.75	25.6	25.6	29.0	29.0	28.8	28.6
Wire gage	3.6	3.5	3.6	3.75	3.6	3.6	4	3.8	4.3	4.1
Free length mm	44.5	49.5	44	45	44.5	51.7	50	62.8	53.3	55.5
Length under load mm	29.2	29.4	29.2	29.2	29.2	29.4	32.4	37.2	37.2	37.2
Load kg	45 ± 4	49 + 3	45 + 4	56 + 4	45 + 4	57.5 ±2.5	53 + 6	46±3	61 +2.5	63.5

*) If the reduction in thickness exceeds 0.5 mm, ground steel shims corresponding in thickness to the total amount of material removed should be placed between the clutch springs and the cups or the pressure plate (see arrow in Fig. 25-4/2) to restore the total spring pressure.

Checking and Refacing of Clutch Driven Plate

Job No.
25.5

On Models 180 to 220 SE this procedure is the same as described for Model 190.

Test Values for Driven Plate

Model	180	180 D	180 a 190	190 D	190 SL	219 220 a 220 S	220 SE
Fichtel & Sachs Designation	K 12 SSZ	K 12 ZR	K 12 SSZ	K 12 SZP	K 12 SSZ	K 12 SZ	K 16 CBL
Thickness of the driven plate not compressed mm	10.3±0.3	9.7+0.3	10.3+0.3				9.3+0.3
Thickness of the driven plate compressed "B" (figs. 25-0/1 and 25-0/2) mm	9.1+0.3						
Thickness of facing	3.5						4.2
Permissible wear of the overall facing thickness mm	1						
Permissible unbalance of the driven plate cmg	5						
Permissible run-out	0.5						
Torsion Damping							
Free motion torque, traction side mkg	11—13.5	12	12	15	16	16	21.5
Step angle	6°	2°	5° 30'	8° 30'	5° 15'	5° 15'	4° 45'
Friction torque mkg	0.4—0.6	0.5—0.7	0.3—0.5	0.5—0.7	0.4—0.6	1.5—2.0	0.9—1.3

Note: A label with the part number has been stuck on, or the part number stamped on, the driven plates.

Job No.
25-6

Replacing Throw-Out Bearing

The clutch throw-out bearing, the method of attaching the throw-out bearing to the neck of the transmission case front cover or to the throw-out fork, and the replacement procedure for throw-out bearings is the same for Models 180 to 220 SE as described for Model 190

Model 180 and 1st Version 180 D

On these models the throw-out bearing is pressed to the throw-out fork by means of a spring. Before removing the throw-out bearing, Pliers 136 589 00 37 must be used to remove the snap ring from the groove in the transmission case front cover. After removing the spring plate and the spring, the throw-out bearing can be removed from the neck of the transmission case cover. When reinstalling the throw-out bearing, make sure that it is properly seated in the throw-out fork.

Transmission

Transmission Group 26

Removal and Installation of Transmission

Job No. 26-1

On Models 180, 180 a, 180 D, 180 Db, 190 D, 190 Db, 190 SL, 220 a, and on Models 219, 220 S, and 220 SE with mechanical clutch the removal and installation procedures for the transmission are the same as described for Model 190.

The following pages contain only the description of procedures which result from the three-point engine suspension, the modified mounting of the clutch pedal shaft, the modified actuation of the reversing light switch, the modified dowel pin in the crankcase, and the floor-mounted gear shift lever on Model 190 SL.

The removal and installation procedures for the transmission in the case of cars with hydraulic automatic clutch are described in the Workshop Manual Passenger Car Models as from August 1959 under Job No. 25-15.

A. Rear Engine Suspension

On Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 190 SL, 220 a, and 219 with three-point engine suspension the rear rubber mounting must be removed at the chassis base panel before the transmission can be removed.

Removal:

1. Gently lift the engine or the transmission by means of a car jack. Unscrew the two hexagon nuts attaching the rear rubber mounting to the chassis base panel, paying attention to the shims between rubber mounting and chassis base panel (see Job No. 24-1).

2. Lower the engine with the transmission and place stands under the oil pan. The oil pan should not rest on the tie-rod or the steering shock-absorber.

Installation:

3. After installing and attaching the transmission lift the engine and attach the rear rubber mounting to the chassis base panel, but do not tighten the self-locking nuts. When inserting the hexagon screws make sure that the same shims are installed between engine mounting and chassis base panel as were removed previously (see Job No. 24-1).

   On older models where the hexagon screws for the car rubber mounting are still locked by means of lock nuts, replace these by self-locking nuts.

4. Move the engine back and forth, so that it can settle without strain on the rubber mountings. Then tighten the two hexagon nuts on the rear rubber mounting.

B. Mounting of Clutch Pedal Shaft and Clutch Actuating Linkage

1st Version

Model 180

On the 1st version without end-plate and without swivel support detach the return spring for the clutch linkage (5). Unscrew the stay rod (6) from the clutch housing and the chassis nose panel. After reinstallation adjust the stay rod in such a way that the engine can settle in its mountings without strain (see Fig. 29-1/2).

2nd Version

Models 180, 180 D, 220 a, and 190 SL

In the case of the 2nd version the clutch pedal shaft is mounted in an end-plate on the transmission on the right-hand side. The compensating spring for the clutch actuating mechanism is located on the outside of the clutch pedal (Fig. 26-1/3).

Removal:

1. Detach the return spring for the clutch throw-out fork. Remove the shackle and pull rod from the clutch throw-out fork after loosening the threaded bolt. The pull rod need not be removed from the relay lever of the clutch pedal shaft (see Fig. 26-1/3).

2. Unscrew the two lock nuts and hexagon nuts from the jointing plate for the clutch actuating mechanism. Remove the rubber cuff from the end-plate and push the clutch pedal shaft together with the flange and the jointing plate toward the outside (Fig. 26-1/3).

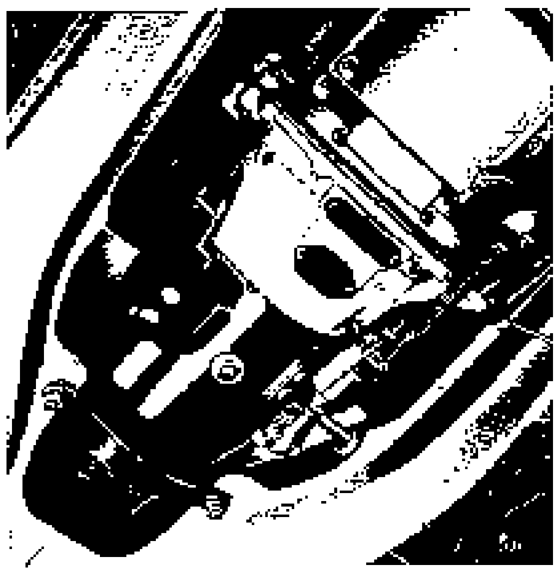


Fig. 26-1/2

Installation:

3. Fill the end-plate with grease, install the rubber cuff and insert the clutch pedal shaft in the end-plate.

4. Attach the jointing plate to the clutch pedal.

5. Check the position of the clutch pedal shaft in the mounting tube on the chassis base panel; it should be exactly in the center of the mounting tube. If the position has to be corrected, loosen the two hexagon nuts on the end-plate and change the position of the end-plate as required. Tighten the two hexagon nuts and lock them by tapping down the locking plate.

6. Attach the shackle together with the pull rod to the clutch throw-out fork and attach the return spring. Adjust the clutch pedal free play (see Job No. 29-3).

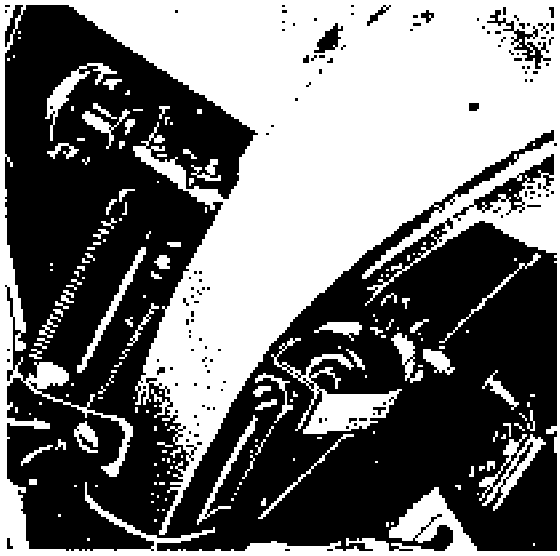
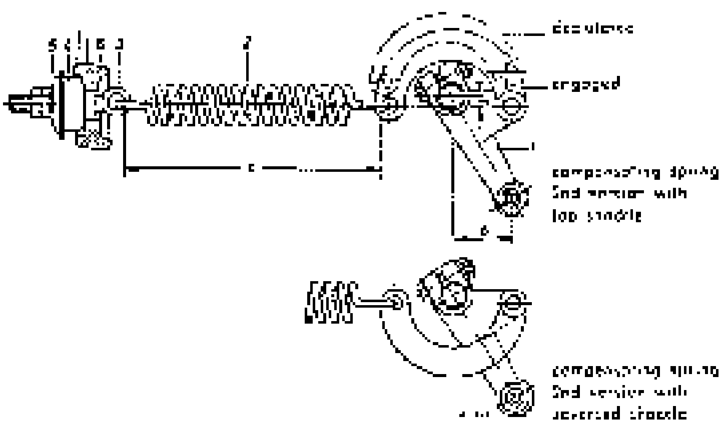


Fig 26-1/3

3rd Version

Models 180, 180 D, 190 SL, and 220 a

The clutch pedal shaft is mounted in the same way as the 2nd version shaft but the compensating spring (2) is attached to the relay lever (1) and the clutch housing (6) (Fig. 26-1/4). On later models the shackle position was reversed in order to prevent the hand brake cable from fouling the relay lever shackle. If necessary, the relay lever with top shackle can always be replaced by a lever with reversed shackle (Fig. 26-1/4).



c = Adjusting dimension for compensating spring

Models 180, 180 D, 190 SL c = 132 mm

Model 220 a c = 155 mm

Distance b see Job No. 29-3

Fig. 26-1/4

1 Relay lever with shackle
2 Compensating spring
3 Pull rod
4 Rubber buffer
5 Cup washer
6 Clutch housing

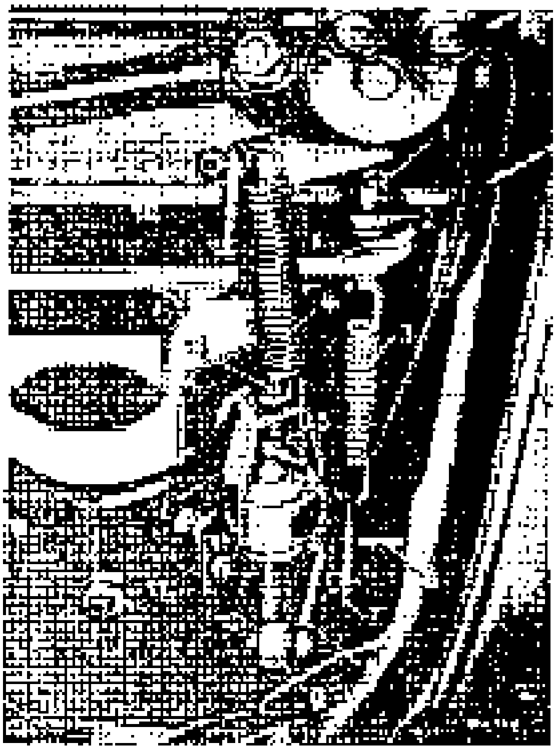


Fig. 26–1/5

1 Hexagon nut
2 Cup washer with rubber buffer
3 Compensating spring with pull rod
4 Return spring for clutch actuating mechanism
5 Clutch throwout fork
6 Clutch pedal shaft
7 Shackle for compensating spring
8 Relay lever
9 Rod head
10 Rubber buffer
11 End plate
12 Shackle
13 Threaded bolt
14 Bracket for return spring

Removal:

1. Unscrew the hexagon nuts (1) and detach the compensating spring with pull rod (3), the cup washer (2) and the rubber buffer (Fig. 26–1/5).

   The other procedures are the same as described for the 2nd version.

Installation:

2. After installing the clutch pedal shaft, attach the compensating spring, and adjust the pull rod of the compensating spring (3) by means of the two hexagon nuts in such a way that the compensating spring has a length "c" as shown in Fig. 26–1/4. Further installation procedures are identical with those described for the 2nd version.

4th Version

Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 190 SL, 219, 220 S, and 220 SE

The 4th version of the clutch pedal shaft is mounted on a swivel support which is attached to the clutch housing by means of a spring plate. This version has no compensating spring. In the case of Models 180 a, 180 b, 190 D, and 190 Db the spring bracket for the swivel support is attached to the clutch housing as on Model 190 (Fig. 26–1/6).

On all other models the bracket is screwed rigidly to the clutch housing (Fig. 26–1/7).

Removal:

1. Detach the pull rod of the clutch actuating mechanism as in the case of the 2nd and 3rd versions.

2. Detach the swivel support (9) from the spring plate (8) by removing the two hexagon screws (Fig. 26–1/7).

3. Further removal procedures correspond to those described for Model 190.

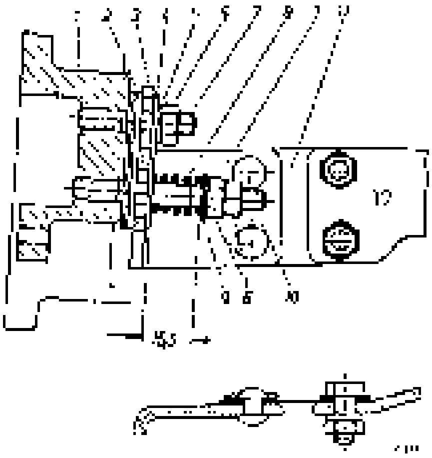


Fig. 26-1/6

1 Clutch housing
2 Shim
3 Bracket
4 Spacer
5 Lock washer
6 Hexagon nut
7 Stud screw
8 Damping spring
9 Washer
10 Stud screw
11 Spring plate
12 Swivel support

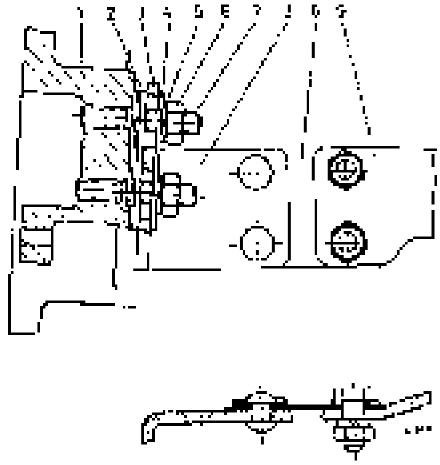


Fig. 26-1/7

1 Clutch housing
2 Shims
3 Bracket
4 Spacer
5 Lock washer
6 Hexagon nut
7 Stud screw
8 Spring plate
9 Swivel support

Installation:

4. After installing the transmission, screw the swivel support (9) to the spring plate (8) by means of the two hexagon screws (Fig. 26-1/7).

5. Center the clutch pedal shaft in the mounting tube on the chassis base panel. The shaft is centered horizontally by adding or removing shims (2) where the swivel support is fastened to the clutch housing (Figs. 26-1/6 and 26-1/7).
   The shims are available in two sizes:
   1 mm thick Part No. 120 293 01 88
   2 mm thick Part No. 120 293 02 88

   The shaft is centered vertically by shifting the bracket (3) (Fig. 26-1/6).

Note: On recent models the brackets (3) have two standard bores instead of the two slots. The spacer (4) is no longer required (Fig. 26-1/6).
In order to facilitate vertical centering of the clutch pedal shaft, the two bores in the swivel support (9) have been enlarged in diameter from 6.4 to 7.0 mm. If a new bracket (3) is installed subsequently, the two bores in the swivel support must be bored to a diameter of 7 mm (Fig. 26-1/7).

6. In the case of Models 180 a, 180 b, 190 D, and 190 Db adjust the length of the damping spring (8) to 15.5 mm by screwing in or backing out the hexagon nut (6) (spring pressure approx. 40 kg) and by locking it in position by means of the second hexagon nut (6) (Fig. 26-1/6).

7. Adjust the clutch pedal free play (see Job No. 29-3)

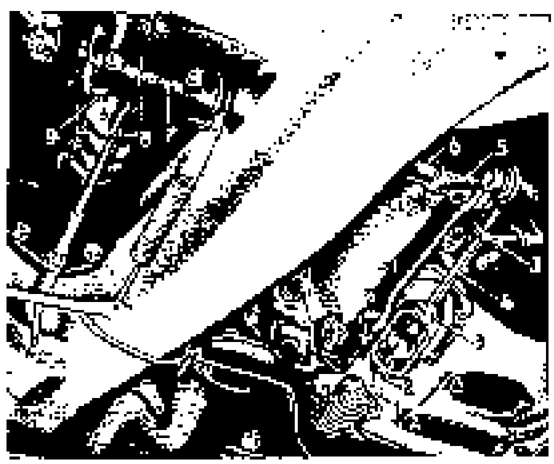


Fig. 26-1/8

4th version of clutch actuating mechanism

1 Threaded bolt for clutch pedal free play adjustment
2 Lock nut for threaded bolt
3 Lock nut for pull rod
4 Pull rod
5 Lever and bolt
6 Clutch pedal shaft
7 Brake pedal
8 Lock washer
9 Clutch pedal
10 Swivel support

C. Reversing Light Switch

1st Version

Models 180, 180 D, 220 a

In the case of the 1st version the reversing light switch is attached to the bearing assembly of the steering wheel shift system. This means that the cable need not be disconnected when the transmission is to be removed (see Fig. 26–12/1).

2nd Version

Models 180, 180 D, 190 SL, and 220 a

In the case of the 2nd version the reversing light switch is installed in the transmission case top cover. The two cables are directly connected to the main cable harness. Since the terminal clips on the switch are not accessible, the cables have to be cut and have to be re-connected by means of a cable connector after the transmission has been reinstalled.

3rd Version

Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 220 a, 219, 220 S, and 220 SE

The 3rd version of the reversing light switch is also attached to the transmission case top cover. The two cables should be disconnected from the cable connector (5) which is fastened to the bearing assembly (1) and should be re-connected after the transmission has been reinstalled (see Fig. 26–12/2).

D. Modified Dowel Pins in Crankcase

On Models 180 a, 190, 190 D, 190 SL, 219, 220 S, and 220 SE the top left dowel pin in the crankcase for centering the partition plate and the clutch housing has been increased in thickness from 8 to 12 mm. It may therefore be necessary to use a shouldered dowel pin when installing a replacement engine or a new clutch housing (see Job No. 01–4, Section Q).

E. Floor-Mounted Gear Shift Lever on Model 190 SL

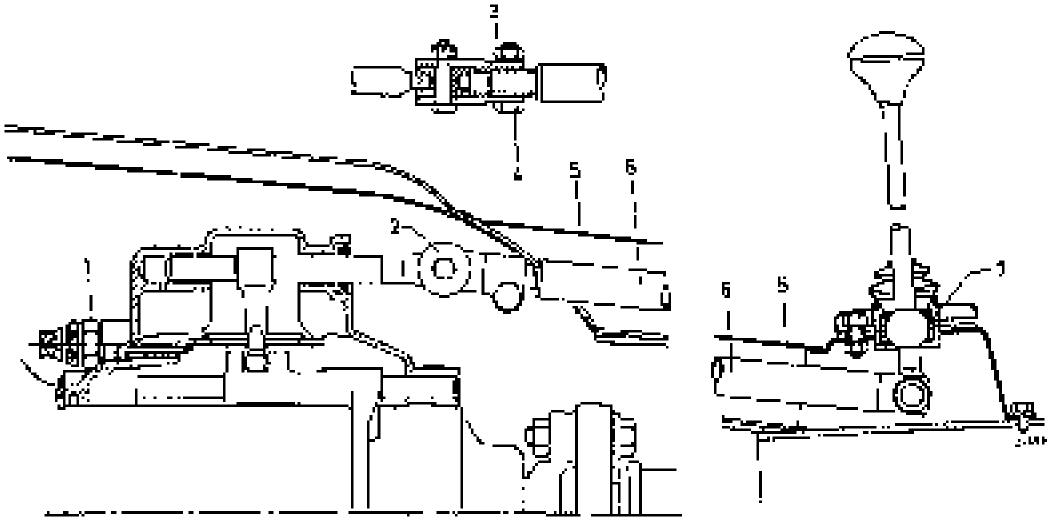


Fig. 26-1/9

1 Reversing light switch
2 Yoke end
3 Hexagon nut
4 Hexagon screw
5 Cover plate
6 Shift tube
7 Shift lever bearing

Removal:

1. Roll back the rubber mat on the transmission tunnel to the left. After unscrewing the six hexagon tapping screws from the tunnel, remove the cover plate (5) for the shift linkage (Fig. 26–1/9).

2. Loosen the hexagon nut (3) on the yoke end (2) and take out the hexagon screw (4).

3. Pull the shift tube out of the splines in the yoke end toward the rear.

Installation:

4. Fit the shifting shaft to the reverse gear stop, put the shift lever in a vertical position, and insert the shift tube in the splines on the yoke end. In this position the shift lever must be exactly vertical.

Then insert the hexagon screw (4) in the yoke end, install the lock washer and tighten the hexagon nut (3) (Fig. 26–1/9).

Note: In order to facilitate installation of the hexagon nut (3) engage 3rd gear, making sure that the position of the shift tube in the yoke end is not changed.

5. Check the gear mechanism. To do this, check the operation of all gears and check whether with the individual gears engaged there is sufficient play between the shift lever and the shift lever bearing. The shift lever must on no account foul the shift lever bearing, since this might cause the gear to slip out. Always declutch when shifting individual gears!

6. Screw on the cover plate for the shift linkage and turn the rubber mat back.

Trouble Shooting Hints for Shift Lever Noises

Job No.
26-2

In order to reduce the shift lever noises which may occur on bad and uneven roads proceed and check as follows:

I. Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 219, 220 a, 220 S, and 220 SE

1. Relay Shaft

The relay shaft (13) should have no end play in the bearing assembly. Replace the washers (15) by 0.6 mm spring washers, Part No. 121 990 00 40. It is imperative that the lever (14) should be firmly seated in the splines of the relay shaft (13). Loose levers should be electrically welded to the shaft. In order to ensure that the relay shaft has no end play whatsoever in the bearing assembly, the lever (14) and the relay lever (18) should be pressed against the bearing assembly by means of Clamping Device 180 589 05 31. Tighten the clamping screw in the relay lever (18) with the lever in this position. It is not sufficient to compress the levers by hand since this would not produce the required initial tension of the spring washers (Fig. 26–2/1).

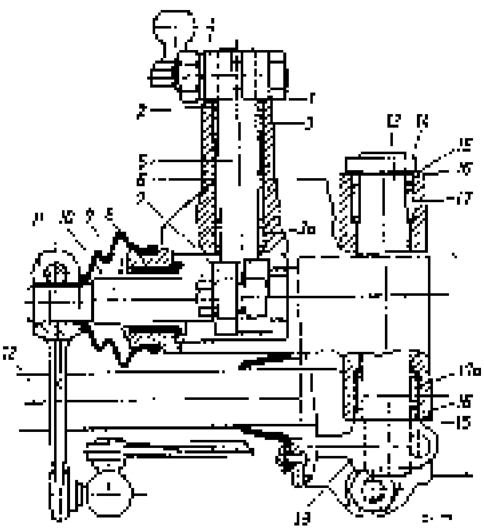


Fig. 26–2/1

1 Washer
2 Sealing ring
3 Outer needle bearing
3a Inner needle bearing
4 Selector lever
5 Selector lever shaft
6 Guide sleeve
7 Selector lever on shift tube
8 Rubber mounting
9 Snap ring
10 Shift tube
11 Lever on shift tube
12 Steering tube
13 Relay shaft
14 Relay shaft lever
15 Washer
16 Sealing ring
17 Outer needle bearing
17a Inner needle bearing
18 Relay lever

2. Selector Lever and Selector Lever Shaft

Check the end play of the selector lever claw (99) between the shift tube collar and the shift tube (65). The maximum permissible end play is 0.4 mm (see Fig. 26–2/2). When reassembling the unit please remember that a spring washer (1) 12 N 55 a must be installed between the selector lever (4) and the bearing assembly. Before tightening the clamping screw in the selector lever (4) push the lever toward the bearing assembly, so that the selector lever shaft (5) is also installed with a certain amount of initial tension (Fig. 26–2/1).

3. Rubber Mounting in Bearing Assembly

The radial play of the shift tube (65) in the rubber mounting (78) of the bearing assembly (77) should not exceed 0.06 mm. Worn rubber mountings should be replaced by 2nd version mountings (smaller tolerances). When adjusting the steering wheel shift system make sure that when the 3rd or 4th gear is engaged, the distance between the shift tube collar and the rubber mounting is approx. 1–1.5 mm (Fig. 26–2/2).

Fig. 26-2/2

55 Shift tube
77 Rocking assembly
78 Rocker mounting
79 Snap ring
99 Selector lever for shift tube
100 Lock washer
101 Hexagon nut

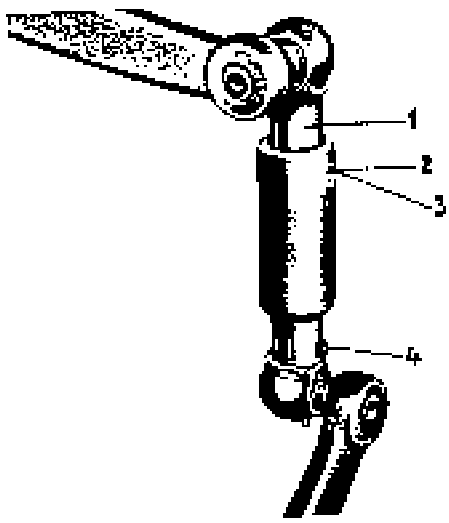


Fig. 26-2/3

1 Spring-loaded ball cup connector
2 Slot
3 Cylindrical pin
4 Spring clip

4. **Spring-Loaded Ball Cup Connector**

In previous models the cylindrical pins (3) of the spring-loaded ball cup connector (1) were insulated by means of Vulkollan bushings. On recent cars these cylindrical pins have been provided with polyamide bushings with a higher wear resistance. These bushings, which should not show any signs of wear, reduce the noise of the pins when they move against the upper and lower ends of the slot. When the gear is engaged the pin should be approximately in the center of the slot (Fig. 26-2/3).

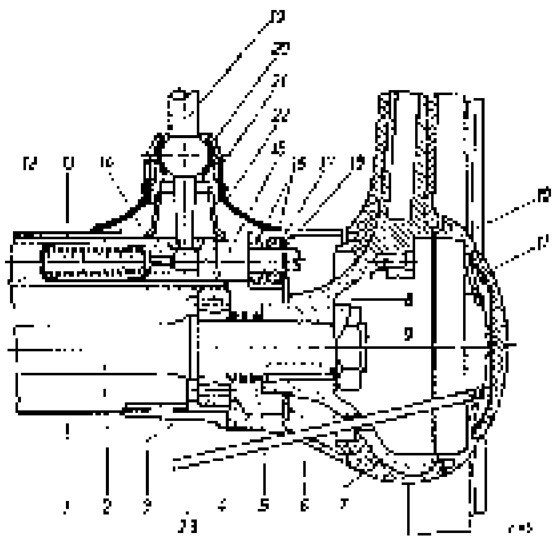


Fig. 26-2/4

1 Steering column jacket
2 Steering tube
3 Annular grooved ball bearing
4 Grub screw
5 Pressure spring for steering tube
6 Rubber washer
7 Steering wheel
8 Locking plate
9 Hexagon nut
10 Horn ring
11 Trademark plate
12 Shift tube
13 Pressure spring for shift tube
14 Spring seat pin
15 Guide pin
16 Rubber ring
17 Shim
18 Snap ring
19 Shift lever
20 Rubber cushion
21 Cover cap
22 Rubber collar
23 Welding rod (3 mm thick) to press off the trademark plate

5. **Shift Tube and Shift Lever**

The rubber rings (16) on the guide pin (15) should always be in good condition, so that the shift tube (12) and the guide pin cannot touch the steering column jacket. The radial play between guide pin and shift tube should not exceed 0.05–0.07 mm (Fig. 26-2/4).

Check the position of the shift lever. In neutral position the upward deviation of the lever from the horizontal should be approx. 80 mm. When engaging the individual gears the shift tube should not touch the recess in the steering column jacket (Fig. 26-2/5).

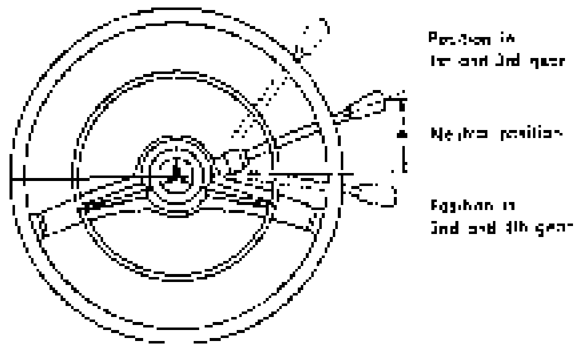


Fig. 26-2/5

a = 80 mm

6. **Rubber Cuff**

The rubber cuff must be flexible and must slide easily on the steering column jacket. Cuffs which have come into contact with grease tend to stick to the steering column jacket and should therefore be replaced. The collar of the rubber cuff (see arrow in Fig. 26-2/6) should not be too thick, so that it cannot exert any pressure on the shift lever. The flexibility of the rubber cuff can be increased by reducing the thickness of the collar.

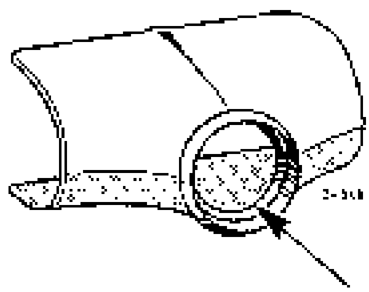


Fig. 26-2/6

7. **Engine Mountings**

On Models 190 and 190 SL harder rear engine rubber mountings can be installed in order to reduce the rattle in the shift lever.

Harder rubber mountings:
rear left: Part No. 121 223 00 12
rear right: Part No. 121 223 01 12

In order to limit the sprung movement of the engine on Models 219 and 220 a a stop piece Part No. 105 242 00 26 should be installed (Fig. 26-2/7). The stop piece should be screwed into the recess in the lower part of the engine mounting together with one or several shims Part No. 105 242 00 66 in such a way that **with the engine installed** there is a distance "a" = 1–2 mm. This distance is necessary in order to prevent an increase in the noise transmitted to the interior of the car. If the rubber mounting should settle down after a certain mileage the prescribed distance "a" = 1–2 mm can be obtained by removing shims.

Make sure that the thin rubber coating on the rubber mounting above the stop piece is not removed since otherwise the exposed movable metal part of the rubber mounting will knock against the stop piece when the engine mounting is depressed and will produce a knocking noise.

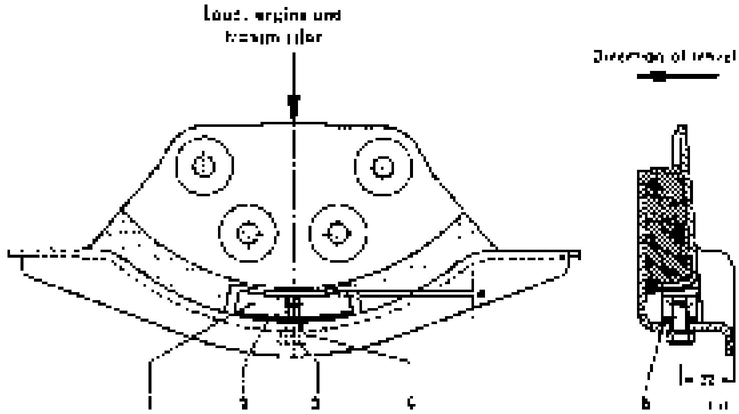


Fig. 26–2/7

However, the rubber coating should be removed at the point where the stop piece is attached (Fig. 26–2/7).

8. Shift Rod and Shift Lever

In order to reduce shift noises recent practice is to install ball cup connectors with Vulkollan insert Part No. 000 991 04 22 on the selector and shift rods and Vulkollan bushings Part No. 000 992 00 10 in the selector and shift levers in the transmission case cover. These parts can also be installed subsequently.

Subsequent Installation:

1. Remove the transmission and mark the position of the shift and selector levers on the shifting shaft and on the selector finger. After loosening the clamping screws, remove the two levers.

2. Remove the shift and selector rods from their levers.

3. Drill the brass elements out of the rubber bushings on the levers and press out the rubber bushings.

4. Press the Vulkollan bushings into the levers.

5. Attach the selector and shift levers to the shifting shaft and the selector finger, paying attention to the marks made during removal.

6. Measure the length of the shift rod and the selector rod and unscrew the ball cup connectors on the two rods.

7. Install ball cup connectors with Vulkollan inserts on the shift rod and the selector rod and lock by means of the lock nuts.

Note: Both the shift and the selector rod must be adjusted to their appropriate length.

8. Attach the shift and selector rods to the shift and selector levers.

9. Install the transmission. The ball cup connectors with Vulkollan inserts on the shift and selector rods are no longer secured against slipping out by spring clips on the levers at the bearing assembly. When reassembling the levers make sure that the ball studs of the levers form an angle of approx. 90° with the shift and selector rods on the bearing assembly. If necessary, bend the shift and selector rods slightly.

Note: Be careful when bending the rods and make sure that they do not foul the transmission tunnel or each other.

II. Model 190 SL

Shift Tube with Rubber Bushing

In order to reduce shift noises and to avoid vibrations of the shift lever recent cars have been provided with rubber-insulated shift tubes Part No. 121 260 08 82 (1st version) and Part No. 121 260 11 82 (2nd version). This rubber-insulated shift tube can also be installed subsequently.

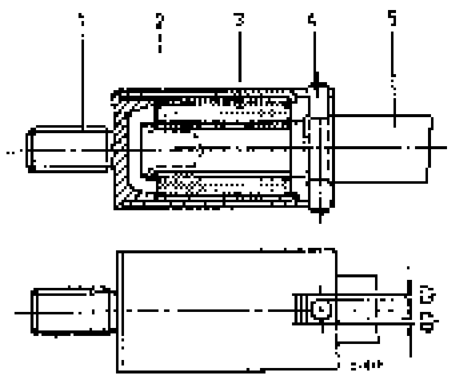


Fig. 26–2/8

1st version

1 Splines
2 Sleeve
3 Rubber bushing
4 Notched pin
5 Shift tube

Subsequent installation:

1. Remove the old shift tube (see Job No. 26–6).

2. Flare the transmission tunnel in such a way that the sleeve (2) of the shift tube cannot touch the tunnel.

3. Install the rubber-insulated shift tube (see Job No. 26–6).

Note: On the 1st version of the shift tube the notched pin (4) must be positioned in the center of the sleeve recess (2) (Fig. 26–2/8).

Job No.
26-3

Adjustment of Gear Shift Mechanism

On the various models the differences in the adjustment procedures for the gear shift mechanism are as follows:

A. Reversing Light Switch in the Bearing Assembly of the Steering Wheel Shift System

When adjusting the steering wheel shift system on Models 180, 180 D, and 220 a please note that in the case of the 1st version the reverse gear stop is located in the transmission case top cover but the reversing light switch is screwed into the bearing assembly of the steering wheel shift system. The action of the two stops, i. e. the stop for the reverse gear and the stop for actuating the switch must be coordinated. To adjust the steering wheel shift system push the selector lever (2) beyond the reverse gear stop. An assistant should then pull up the shift lever on the steering wheel as far as the stop and should then release it until there is a distance of approx. 1 mm between the lever (3) and the rubber mounting in the bearing assembly. When this position has been obtained tighten the clamping screw on the selector lever (see Fig. 26-12/1).

B. Reversing Light Switch in Transmission Case Top Cover

On Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 219, 220 a, 220 S, and 220 SE the gear shift mechanism is adjusted in the same way as on Model 190.

If there should be any difficulty in adjusting the shift mechanism especially in cases where the transmission has been removed, check the position of the shift lever on the transmission case cover. In the neutral position of the shift lever the following distance should obtain between the center in the bore of the shift lever on the transmission case cover and the front separating surface of the transmission case.

Model	Distance
180, 180 D, 219, 220 a, 220 S, 220 SE	58.0±5 mm
180 a, 190 D	70.0±5 mm
219, 220 S, 220 SE with hydraulic automatic clutch	83.0±5 mm

If the distance has to be modified, change the position of the lever on the splines of the shifting shaft accordingly.

C. Floor-Mounted Gear Shift Lever on Model 190 SL

On Model 190 SL the gear shift mechanism has to be adjusted if the shift tube touches the cover plate when the gears are engaged, since this may cause the gears to slip out (for adjustment procedure see Job No. 26-1, Section E).

Disassembly and Reassembly of Transmission

Job No.
26-4

A. Removal and Installation of Transmission Case Top Cover, including Disassembly and Reassembly

I. Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 220 a, 219, 220 S, and 220 SE

The removal and installation as well as the disassembly and reassembly procedures for the transmission case top cover are the same as described for Model 190, with the difference that the position of the lever should be checked when it has been installed on the shifting shaft (see Job No. 26-3, Section B).

On the first cars of Models 180, 180 D, and 220 a the reversing light switch was installed in the bearing assembly of the steering wheel shift system and not in the transmission case cover.

II. Model 190 SL

In the case of Model 190 SL the transmission case cover differs from the cover installed in models with steering wheel shift system in the location of the shifting shaft and in the design of the guide plate and the shifting finger. Furthermore the selector finger is superfluous. The removal and installation procedures of the shift forks are the same as in the case of transmissions with steering wheel shift system.

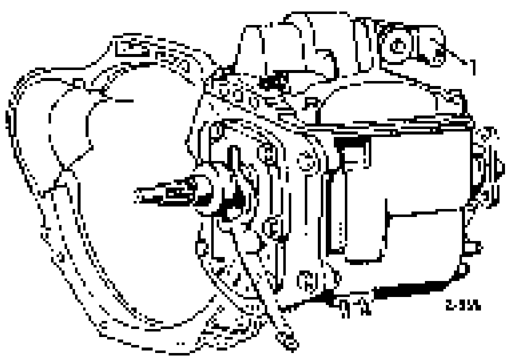


Fig. 26-4/1

1 Shifting shaft with yoke end

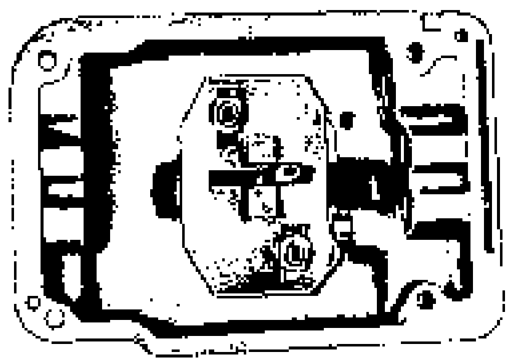


Fig. 26-4/2

Removal:

1. Unscrew the four hexagon screws on the transmission case cover and remove the cover.

Disassembly:

2. Remove the shift forks (see Workshop Manual Model 190, Job No. 26-4).

Unscrew the reversing light switch (4) and remove the pressure pin (2), the pressure spring (3), the bar (6), and the shim (Fig. 26-4/5).

3. Unscrew the guide plate and remove it (Fig. 26-4/2).

4. Unscrew the hexagon socket screw of the shifting finger, pull out the shifting shaft and remove the shifting finger (see Fig. 26-4/3).

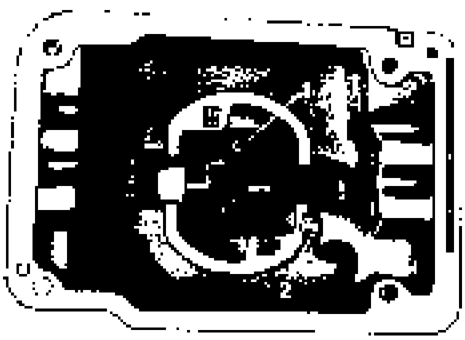


Fig. 26-4/3

1 Shifting finger
2 Bar for reverse gear

5. If necessary, drive out the sealing ring (6) (Fig. 26-4/4).

Reassembly:

6. Coat a new sealing ring (6) at the outside circumference with sealing compound and press it into the transmission case top cover (Fig. 26-4/4).

7. Install the shifting shaft (9) together with the shifting finger (5).

Note: When installing the shifting shaft (9) make sure that the yoke end (10) and the shifting finger (5) are properly aligned (see Fig. 26-4/4).

8. Screw in the hexagon socket screw (8) together with lock washer (7) and tighten (see Fig. 26-4/4).

9. Install the guide plate. The plate must be easy to move. First install the washer and then the spring washer. Screw in the nuts and lock them by compressing their collars at the top (see Fig. 26-4/2).

Note: When installing the guide plate (1) make sure that the plate has a spring riveted to it (guide plates without spring are only used for transmissions with steering wheel shift system) (Fig. 26-4/5).

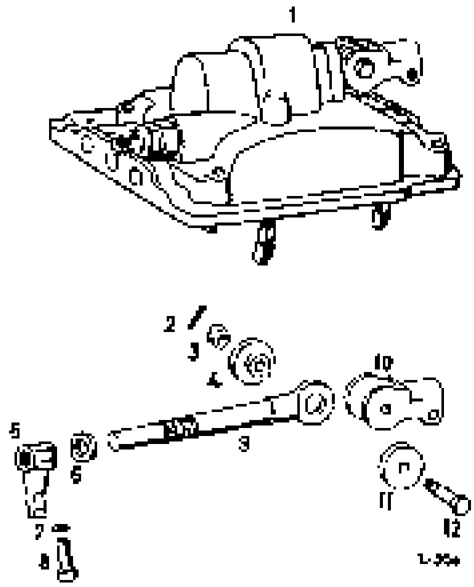


Fig. 26-4/4

1 Transmission case top cover
2 Cotter pin
3 Castle nut
4 Washer
5 Shifting finger
6 Sealing ring
7 Lock washer
8 Hexagon socket screw
9 Shifting shaft
10 Yoke end
11 Washer
12 Bolt

10. Install the bar (6) and the pressure spring (3) for the reverse gear stop as well as the pressure pin (2) for the reversing light switch in the transmission case cover and screw in the reversing light switch (4) (Fig. 26-4/5).

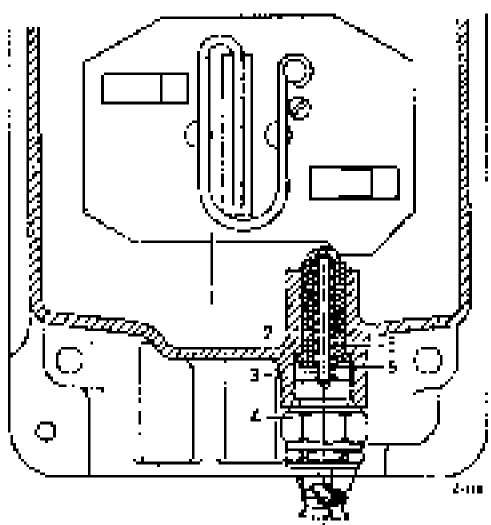


Fig. 26-4/5

1 Guide plate
2 Pressure pin
3 Pressure spring
4 Reversing light switch
5 Bushing
6 Bar

11. Install the shift forks and the shift rails (see Workshop Manual Model 190, Job No. 26-4).

Installation:

12. Install the transmission case cover (see Workshop Manual Model 190, Job No. 26-4).

13. Check the reversing light switch. To do this shift the shifting shaft to neutral and connect the reversing light switch to a battery and a testing light. In the neutral position the testing light must not light up. Then engage reverse gear. In this position the testing light must light up. If the testing light does not light up, install a longer pressure pin. If the testing light lights up also in the neutral position, install a shorter pressure pin. Pressure pins are available in the following sizes:

40 mm, 40.5 mm, 41 mm

B. Removal and Installation of Clutch Housing

On Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 190 SL, 219, 220 a, 220 S, and 220 SE with mechanical clutch the removal and installation procedures for the clutch housing are the same as described for Model 190.

For Models 219, 220 S, and 220 SE with hydraulic automatic clutch the removal and installation of the clutch housing was described in Workshop Manual Passenger Car Models as from August 1959, under Job No. 25-1B.

C. Removal, Installation, and Sealing of Transmission Case Front Cover

I. Models 180 and 180 D (1st Version)

Use Pliers 136 589 00 37 to remove the snap ring from the groove in the transmission case cover before the transmission case front cover itself is removed. When this has been done the cover can be removed as described for Model 190.

II. Models 180 a, 180 b, 180 D (2nd Version), 180 Db, 190 D, 190 Db, 190 SL, and 220 a as well as 219, 220 S, and 220 SE with Mechanical Clutch

Removal and installation procedures are the same as for Model 190.

III. Models 219, 220 S, and 220 SE with Hydraulic Automatic Clutch

The transmission case cover has no socket for the clutch throw-out bearing. On Model 220 SE and on Models 219 and 220 S 2nd version a seal is provided between the cover and the case by a round cord ring located in a groove of the transmission case cover. Removal and installation procedures are the same as for Model 190.

D. Removal, Installation, and Sealing of Transmission Case Rear Cover

On Models 180 to 220 SE the removal and installation procedures for the transmission case rear cover are the same as described for Model 190. Please note that on models with three-point engine suspension the rear rubber mounting must be removed first (see Job No. 24-1 and Job No. 26-1, Section A).

When replacing the transmission case rear cover or the speedometer drive gear, make sure that the proper drive gear and helical gear are installed. The gear ratio of the gears differs on the various models and furthermore on Models 220 a, 220 S, and 220 SE the drive gears rotate anti-clockwise, whereas on the other models they rotate clockwise.

E. Removal and Installation of Gear Train including Disassembly and Reassembly

On Models 180 to 220 SE the removal and installation procedures as well as the disassembly and reassembly procedures for the gear train are the same as on Model 190.

On the 3rd version transmission the third speed helical gear is carried in needle bearings and, as a result, the diameter of the main shaft is smaller at the bearing surface for the third speed gear (see Job No. 26–5). However, the disassembly and reassembly procedures for the gear train are the same as for the 1st and 2nd version transmission.

Inspection and Repair of Transmission

Job No.
26.5

For Models 180 to 220 SE the inspection and repair procedures for the transmission are essentially the same as described for Model 190. Deviations from these procedures are described in the following pages and the measurements required for checking and repair work are listed in tables.

Dimensions and Tolerances of Bearings in mm

Model	Bearing designation	External diameter	Internal diameter	Width	Radial play
Front and rear mounting of countershaft in transmission case					
180, 180 D, 190 SL, 220 a 1st version	Annular grooved bearing 6305 DIN 625	62	25	17	0.008 / 0.022
All models 2nd version	Annular grooved bearing 6305 C 3 DIN 625	62	25	17	0.017 / 0.032
Rear mounting of main shaft in transmission case					
All models	136 981 02 25 (previously 6306 N DIN 625)	72	30	19	0.008 / 0.022
Front mounting of drive shaft in crankshaft					
All models	Annular grooved bearing 6202 DIN 625	35	15	11	0.007 / 0.019
Rear mounting of drive shaft in transmission case					
All models	Annular grooved bearing 6306 2N DIN 625	72	30	19	0.008 / 0.022
Front mounting of main shaft in drive shaft					
180, 180 D, (1st version), 220 a	Roller cage 16×24×20 Part No. 000 981 03 12				
180 a, 180 b, 180 Db, 190 D, 190 Db, 190 SL, 219, 220 S, 220 SE, and 180 D (2nd version)	Roller cage 16×24×20 Part No. 000 981 08 12 Part No. 000 981 09 12 optional				
1st speed gear mounting on main shaft					
All models	Roller cage 3.5×8 DIN 5402 Part No. 120 981 02 12	42	35	21.40	0.030 / 0.045
2nd speed gear mounting on main shaft					
All models	Split roller cage 3.5×8 DIN 5204 Part No. 120 981 03 12	42	35	21.40	0.030 / 0.045
3rd speed gear mounting on main shaft					
180, 180 D, 190 SL, 220 a, 219, 220 S, 1st version	plain bearing				
180 a, 180 D, 190 SL, 219, 220 S, 2nd version	2 Needle cages 2.5×11.8 DIN 617 Part No. 000 981 28 12	42	35	15.50	0.030 / 0.058
180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 190 SL, 219, 220 S, 220 SE, 3rd version	1 Needle cage Part No. 000 981 29 12	40	35	31.00	0.010 / 0.038

All bearings with a ten-digit Part number deviate in one way or another from the standardized bearings and should therefore always be ordered with their particular part number.

1. Countershaft

Check countershaft for true running, max. eccentricity	0.02 mm
Shaft diameter for annular grooved bearing seating	$\frac{25.000}{24.987}$ mm
Shaft diameter for countergear seating	$\frac{35.033}{35.017}$ mm
Bore of 3rd speed countergear	$\frac{35.000}{35.025}$ mm
Countergear bore (Drive constant)	$\frac{34.994}{35.010}$ mm

Note: The shaft diameter for the annular grooved bearing seating was $\frac{25.009}{24.996}$ mm

2. Main Shaft

The main shafts differ in the bearing surfaces for the 3rd speed gear. On the 1st and 2nd versions the 3rd speed gear is carried in a plain bearing, whereas on the 3rd version it is carried in a needle bearing. As a result, there is a difference in the bearing surface diameter of the main shaft for the 3rd speed gear as shown in the table below.

A 1st or 2nd version main shaft can be replaced by a 3rd version shaft when repairs are carried out, provided that the 3rd speed gear is also replaced and that a needle cage is installed.

Dimensions and Tolerances of Bearing Surfaces of Main Shaft and Gears in mm

Model	Gear	Diameter main shaft	Bore of speed gear	Radial play of speed gears	End play of speed gears
All models	1st gear	$\frac{35.000}{34.987}$	$\frac{42.018}{42.033}$	0.03 — 0.045	0.10—0.13
All models	2nd gear				
1st version plain bearing 180, 180 D, 190 SL, 220 a	3rd gear	$\frac{37.972}{37.961}$	38.000 38.016	0.030—0.055	
2nd version plain bearing 180, 180 D, 190 SL, 220 a, 219, 220 S		$\frac{37.955}{37.946}$		0.045—0.070	
3rd version needle bearing 180 a, 180 D, 190 SL, 219, 220 S		$\frac{35.000}{34.987}$	40.030 40.045	0.030—0.058	
4th version needle bearing 180 a, 180 b, 180 D, 180 Da, 190 Db, 190 Db, 190 SL, 219, 220 S, 220 SE			40.009 40.025	0.010—0.038	

3. Speed gears

The back lash is

1st and 2nd gear = 0.10–0.16 mm
3rd and 4th gear = 0.06–0.12 mm
Reverse gear = 0.10–0.20 mm

Gear Ratios and Number of Teeth

Model	Gear ratio						Number of teeth				
	1st	2nd	3rd	4th	rev.	C	1st	2nd	3rd	rev.	C
180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db	1 : 4.05	1 : 2.36	1 : 1.53	1 : 1	1 : 3.92	1 : 1.58	13/28	19/24	27/22	12/25	17/32
190 SL 1st version	1 : 3.40	1 : 2.0	1 : 1.29	1 : 1	1 : 3.29	1 : 1.58	13/28	19/24	27/22	12/25	19/30
220 a 1st version	1 : 3.40	1 : 2.32	1 : 1.52	1 : 1	1 : 3.29	1 : 1.58	13/28	17/25	25/24	12/25	19/30
190 SL, 220 a 2nd version 219, 220 S, 220 SE	1 : 3.52	1 : 2.32	1 : 1.52	1 : 1	1 : 3.29	1 : 1.58	13/28	17/25	25/24	12/25	19/30

C = Drive constant, i. e. gear ratio between drive shaft and countershaft

4. Synchronizing Rings

See instructions given for Model 190.

5. Drive Shaft

The contact surface for the sealing ring is no longer provided on the whole circumference, but only over a length of 15 mm.

On Model 220 a 1st version the helical gear is secured on the drive shaft by means of a Woodruff key. In the case of the 2nd version and all other models drive shaft and helical gear are made in one piece.

a) Drive Shaft for Transmissions with Mechanical Clutch

Shaft diameter (1st version)
for annular grooved bearing seating 6306 ZN $= \frac{30.009}{29.996}$ mm

Shaft diameter (2nd version)
for annular grooved bearing seating 6306 ZN $= \frac{29.996}{29.991}$ mm

Shaft diameter
for annular grooved bearing seating 6202 $= \frac{14.994}{14.983}$ mm

b) Drive Shaft for Transmissions with Hydraulic Automatic Clutch

In the case of transmissions with hydraulic automatic clutch the drive shaft is no longer carried in the crankshaft, but in two needle bearings in the flange shaft of the hydraulic automatic clutch.

Shaft diameter for annular grooved bearing seating 6306 ZN $= \frac{29.996}{29.991}$ mm

Shaft diameter for front needle bearing $= \frac{12.000}{11.989}$ mm

Shaft diameter for rear needle bearing $= \frac{18.000}{17.989}$ mm

6. Three-Way Flange

Pay attention to the bolt hole circle when replacing the three-way flange.

Three-Way Flange Table

Model	Part No.	Bolt hole circle diameter mm	Applicable up to Chassis End No.
180, 220 a	180 262 36 45	80	all
180 D 1st version			up to 65 01919
190 SL 1st version			up to 65 00172
219 1st version			up to 65 00740
180 D 2nd version	186 262 09 45	90	as from 65 01920
190 SL 2nd version			as from 65 00173
219 2nd version			as from 65 00741
180 a, 180 b, 180 Db, 190 D, 190 Da, 220 S, 220 SE			all

Models 190 SL, 220 a, 219, and Model 180 D with single-jointed rear axle can subsequently be provided with a three-way flange with a bolt hole circle of 90 mm, provided that also the front propeller shaft is replaced at the same time (see also Job No. 41-4).

Check the contact surface of the sealing ring on the three-way flange. When repairs are carried out, the contact surface of the three-way flange can be refinished to a diameter of 37.34 mm. On new flanges the dimension is 37.840 – 38.000 mm. After refinishing, the contact surface should be given a right-hand thread pattern on approx. 20 mm of its circumference. On previous flanges the right-hand thread pattern extended over the whole circumference of the flange. Check the three-way flange for run-out.

7. **Transmission Case Top Cover**

Check the separating surface for unevenness and refinish if necessary. Replace worn shift forks, shift rails, and guide plates if necessary. Check the springs in the shift forks and the pressure springs for the synchronizing units (see table below).

Spring Testing Table

		External diameter	Free Length	Length under Load installed min	kg	under final load mm	kg	Wire gage	Load tolerance %
All models	Pressure springs Part No. 180 993 41 01	6.0	11.6	9.3	1.8	7.1	2.5	0.8	± 5
180, 180 a, 180 b, 180 D, 190 Db, 190 D, 190 Db, 219, 220 a, 220 S, 220 SE	Shift fork pressure spring for forward gears Part No. 186 993 13 01	7.6	20.2	15.5	3.2	13.0	5.0	1.1	± 8
180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 219, 220 a, 220 S, 220 SE, and 190 SL	Shift fork pressure spring for reverse gears Part No. 136 993 31 01	7.0	20.25	15.5	9.6	13.0	15.0	1.4	± 8
190 SL	Shift fork pressure spring for forward gears Part No. 198 993 07 01	7.75	20.6	15.5	6.7	13.0	10.0	1.25	± 8

Removal and Installation of Shift Lever and Shift Tube on Model 190 SL

Job No.
26-6

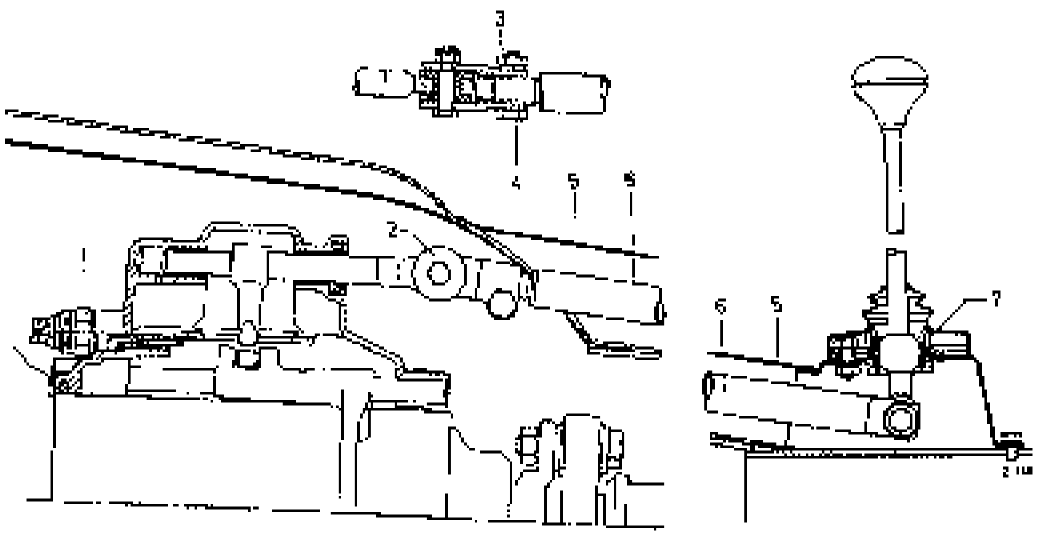


Fig. 26-6/1

1 Reversing light switch
2 Yoke end
3 Hexagon nut
4 Hexagon screw
5 Cover plate
6 Shift tube
7 Shift lever bearing

Removal:

1. Roll the rubber mat on the transmission tunnel back to the left. After unscrewing the six hexagon screws, remove the cover plate (5) for the shift linkage from the transmission tunnel (Fig. 26-6/1).

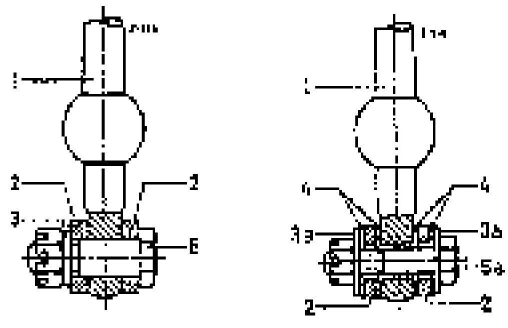
2. Loosen the hexagon nut (3) on the yoke end of the shifting shaft and pull the shift tube (6) out of the splines on the yoke end toward the rear (Fig. 26-6/1).

3. Unscrew the three hexagon screws on the housing for the shift lever mounting and remove the shift lever together with mounting and shift tube.

4. In the case of the 1st version shift tube with rigid shift lever attachment pull out the bolt (5) and remove the shift tube (2) together with the pressure spring after unscrewing the castle nut and removing the washer (3) (Fig. 26-6/2).

5. In the case of the 2nd version shift tube with flexible shift lever attachment remove the washers (3a), the bushings (4) and the shift tube (2) after unscrewing the castle nut and removing the hexagon screw (5a) (Fig. 26-6/2).

6. Unscrew the shift lever knob and pull off the sleeve (2) and the cover plate (3) (Fig. 26-6/3).



1st version　　2nd version

Fig. 26-6/2

1 Shift lever
2 Shift tube
3 Washer
3a Washer
4 Bushing
5 Bolt
5a Hexagon screw

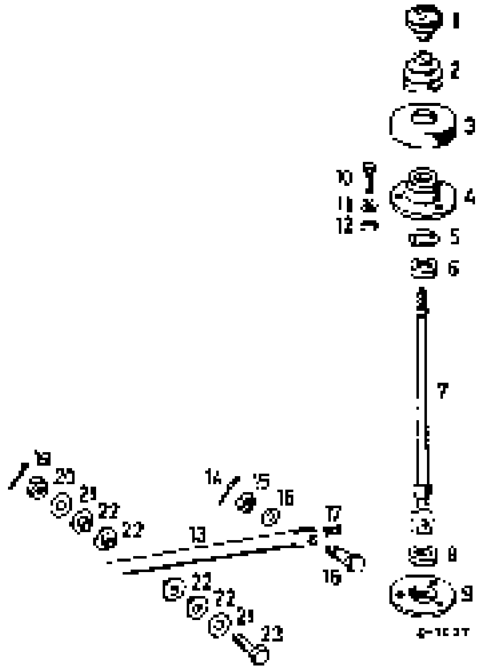


Fig. 26-6/3

1 Shift lever knob	1st Version
2 Sleeve	14 Cotter pin
3 Cover plate	15 Castle nut
4 Upper shift lever bearing	16 Washer
5 Spring washer	17 Pressure spring
6 Ball socket ring	18 Bolt
7 Shift lever	
8 Ball socket ring	2nd Version
9 Lower shift lever bearing	19 Cotter pin
10 Hexagon screw	20 Castle nut
11 Lock washer	21 Washer
12 Hexagon nut	22 Bushing
13 Shift tube	23 Hexagon screw

7. Loosen the three hexagon screws (10) on the shift lever mounting and remove them together with nuts and lock washers. Then remove the upper shift lever bearing (4), the shift lever and the lower shift lever bearing (9) (Fig. 26-6/3).

8. Press the ball socket rings (6 and 8) out of the shift lever bearings, paying attention to the spring washer (5) in the upper shift lever bearing (Fig. 26-6/3).

Installation:

9. Before reinstallation check all parts to see whether they are still serviceable and replace them if necessary. The ball socket rings and the bushings (22) require particular attention. The spring washer (5) must have sufficient tension to be able to exert the necessary contact pressure on the ball socket rings (see Fig. 26-6/3).

10. Insert the spring washer in the upper shift lever bearing and press the ball socket rings into the two shift lever bearings.

11. Grease the ball socket rings well and install the lower shift lever bearing on the ball socket of the shift lever from below and the upper shift lever bearing from the top. Install the shift lever with its bearing in the housing and fix it with the three hexagon screws.

12. Attach the shift tube to the shift lever.

    In the case of the 1st version install the pressure spring and insert the bolt. Put on the washer, tighten and lock the castle nut. In the case of the 2nd version install the bushing and the washers, insert the hexagon screw, install the castle nut and tighten until the shift lever moves easily and snugly in the yoke end of the shift tube.

13. Screw in and tighten the three hexagon screws fastening the housing for the shift lever mounting.

14. Adjust the gear shift mechanism (Job No. 26-1).

15. Screw on the cover plate for the shift linkage and roll the rubber mat back into place.

Removal and Installation of Shift Tube Guide Pin

Job No. 26-11

I. Models 180, 180 a, 180 D, 190 D, 220 a, 219, 220 S, and 220 SE

On Models 180 to 220 SE the removal and installation procedures for the shift tube guide pin are the same as described for Model 190.

On older cars of Models 180, 180 D, and 220 a, 1st version guide pins were installed with a one-sided groove for the locking washer. If one of these guide pins has to be replaced, use a 2nd version guide pin with double-sided grooves and a corresponding locking washer.

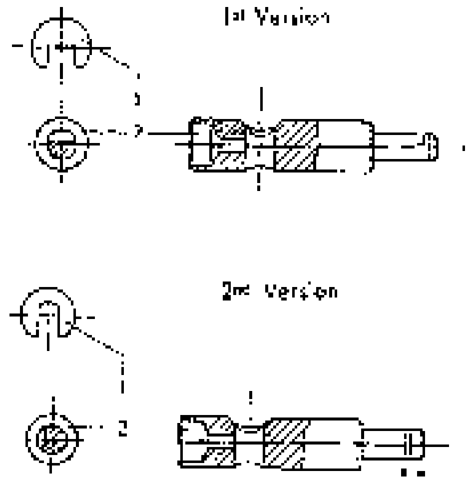


Fig. 26-11/1

II. Models 180 b, 180 Db, and 190 Db

The guide pin can only be removed and installed if the steering tube has been removed first (see Job No. 46-7). Further procedures are as described for Model 190.

Removal and Installation of Bearing Assembly for Steering Wheel Shift System

Job No. 26-12

Two versions of the bearing assembly are available. The 1st version, which was only installed in Models 180, 180 D, and 220 a was attached to the support plate of the steering column jacket by four screws (see Fig. 26-12/1). The 2nd version which has been installed on Model 180 D as from Chassis End No. 55 19057, on Model 220 a as from Chassis End No. 55 18045, and on all cars of Models 180 a, 190 D, 219, 220 S, and 220 SE is clamped to the steering column jacket by means of a bearing cover (Fig. 26-12/2).

I. Models 180, 180 D, and 220 a with 1st Version Bearing Assembly

The removal and installation procedure is essentially the same as described for Model 190, but the following details need attention:

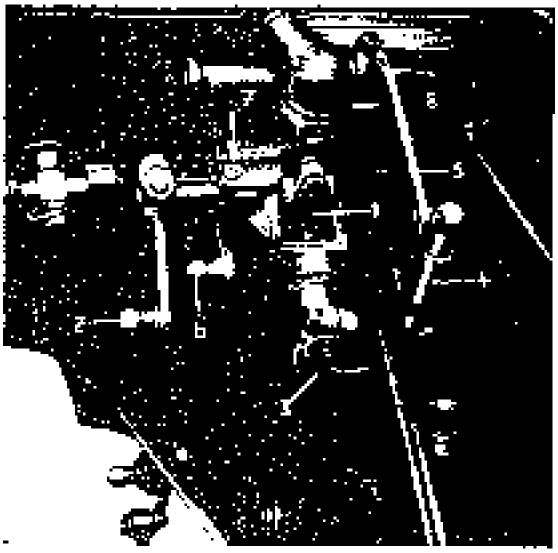


Fig. 26-12/1

2nd Version

1 Selector lever with claw
2 Selector lever
3 Lever
4 Connector
5 Relay lever
6 Relay shaft
7 Bearing assembly
8 Steering column jacket support

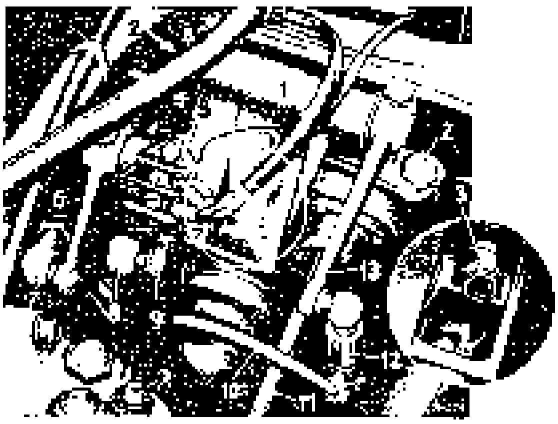


Fig. 26-12/2

3rd Version

1 Bearing assembly
2 Hexagon screw
3 Selector lever on shift tube
4 Dust cover
5 Cable connector
6 Selector lever
7 Ball cup connector of selector rod
8 Ball cup connector of shift rod
9 Relay shaft lever
10 Lever on shift tube
11 Steering tube
12 Spring-centre ball cup connector
13 Relay lever

Removal:

1. Disconnect the cable at the reversing light switch and unscrew the switch. Remove the pressure pin, the stop sleeve and the bushing from the bearing assembly. The reversing light switch must be removed because the stop sleeve projects into the recess of the shift tube which would make it very difficult to pull the bearing assembly out over the shift tube.

2. Unscrew the four hexagon screws fixing the bearing assembly to the support plate of the steering column jacket.

Installation:

3. Attach the bearing assembly to the support plate of the steering column jacket by means of the four hexagon screws. Use only hexagon screws M 6 x 25 S with castle nuts M 6 and cotter pins 2 x 15 in order to prevent the bearing assembly from working loose, as this would make gear shifting difficult. Install the castle nuts on the bearing assembly side.

4. Install the reversing light switch in the bearing assembly. Before screwing in the switch, oil the bushing, the stop sleeve and the pressure pin and install them in the bearing assembly. Both pressure pin and stop sleeve must slide easily. Connect the cable to the reversing light switch.

II. Models 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 219, 220 a, 220 S, and 220 SE with 2nd Version Bearing Assembly

For these models, installation and removal procedures of the bearing assembly are the same as for Model 190.

Repair of Bearing Assembly

(Bearing assembly removed from vehicle)

Job No.
26-14

A. Removal and Installation of Selector Lever and Needle Bearings

I. Models 180, 220 a, and 1st Version Model 180 D

The 1st version selector lever shaft was originally carried in a plain bearing, but in later models a bronze bushing was pressed in on the linkage (engine) side in order to prevent scoring and running out of the shaft.

To improve the lubrication of the shaft the lubricator has been replaced by a grease fitting. Since the selector lever shaft, especially the type without bearing bushing and with a lubricator, has a tendency to become scored, the shaft and the bore in the bearing assembly must be checked for wear. Worn parts should be replaced. When the shaft is provided with a bearing bushing, the bushing can be removed and replaced by a new bushing. After pressing in the bushing ream it up to the prescribed dimension.

Mounting of Selector Lever Shaft

Dimensions in mm

Shaft diameter	Bore of bearing assembly	Bore of bearing bushings	Radial play of shaft
11.905 / 11.878	12.000 / 12.027	12.000 / 12.027	0.095—0.149

II. Models 180 a, 180 b, 180 Db, 190 Db, 219, 220 S, 220 SE, and 2nd Version Model 180 D

The 2nd version selector lever shaft is carried in needle bearings. Removal and installation procedures are the same as described for Model 190.

B. Removal and Installation of Relay Shaft and Needle Bearings

On Models 180, 180 a, 180 b, 180 Db, 190 D, 190 Db, 219, 220 a, 220 S, and 220 SE the bearings of the relay shaft and the removal and installation procedures are the same as in the case of Model 190.

C. Removal and Installation of Rubber Mounting and Shift Tube

On Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 219, 220 a, 220 S, and 220 SE the removal and installation procedures for the rubber mountings are the same as in the case of Model 190. The shape and dimensions of the rubber mountings are identical and they are interchangeable on all models.

Removal and Installation of Shift Tube and Steering Column Jacket

Job No
26-15

I. Models 180, 180 D, and 220 a with 1st Version Bearing Assembly

Removal:

1. Disconnect the ground cable at the battery.
2. Disconnect the cables for the flash direction signals and for the horn at the cable connector on the wheel arch assembly.
3. Loosen and remove the upper clamping screw of the steering coupling. Unscrew the grub screw from the steering column jacket (Fig. 26-15/1)
4. Set the steering lock to the "garage" position to prevent the lock bolt from engaging in the steering tube and remove the ignition key. Pull the steering tube out of the steering coupling.
5. Disconnect the cables from the reversing light switch and screw the reversing light switch out of the bearing assembly. Remove the pressure pin, the stop sleeve and the bushing from the bearing assembly. The reversing light switch must be removed since the stop sleeve engages in the recess of the shift tube and this would make it difficult to remove the shift tube.
6. Detach the hand brake cable at the hand brake lever. Detach the gear shift linkage at the ball-heads of the shift levers after having removed the spring clips.
7. Remove the selector lever (2) and detach the spring-loaded ball connector (14) (Fig. 26-15/3)
8. Fold back the rubber and felt mats in the vehicle and unscrew all screws holding the steering column jacket to the cowl.
9. Loosen the tightening strap holding the steering column jacket to the steering column bracket. To do this loosen the hexagon nut until the tightening strap can be removed out of the steering column bracket by pushing it toward the front.
10. Turn the steering column jacket together with the gear shift mechanism slightly toward the left, push the bearing assembly downward and pull out the steering column jacket together with the gear shift mechanism and the bearing assembly. Pull the steering tube together with the steering wheel out of the steering column jacket.
11. Remove the selector lever with claw (1) from the selector lever shaft. Remove the relay lever (3) from the splines of the shift tube (Fig. 26-15/3) Remove the bearing

Fig 26-15/1

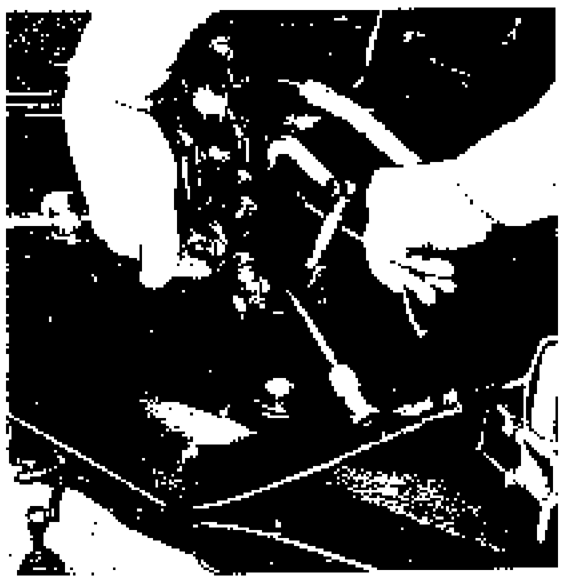


Fig. 26-15/2

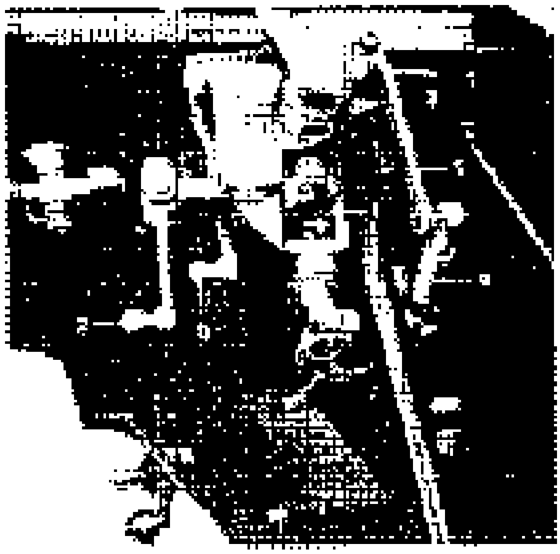


Fig. 26-15/3

1 Selector lever with claw
2 Selector lever
3 Lever
4 Ball connector
5 Relay lever
6 Relay lever shaft with lever
7 Bearing assembly
8 Steering column jacket support

assembly from the attaching plate of the steering column jacket by unscrewing the four fixing screws.

12. Remove the shift tube and check. The procedures are the same as described for Model 190.

Installation:

13. Install the shift tube in the steering column jacket.

14. Put the rubber cuff on the attaching plate of the steering column jacket and fix the bearing assembly by means of the four hexagon screws. In order to prevent loosening of the bearing assembly use hexagon screws M 6 x 25 5 together with castle nuts M 6 and cotter pins 2 x 15.

15. Install the steering tube together with the steering wheel in the steering column jacket.

16. Install the steering column jacket and attach it to the cowl by means of the six hexagon screws. Insert the tightening strap in the steering column bracket and attach the steering column jacket to the steering column bracket by tightening the hexagon nut.

    Make sure that the steering lock is in the "garage" position.

17. Pull the cable through the cable guide tube of the steering assembly and install the steering tube in the steering coupling with the front wheels in the straight fore and aft position and the steering wheel in the center position. Use Center Check Screw 186 589 00 23 to check the center position of the steering assembly.

18. Screw in the top clamping screw on the steering coupling and the grub screw on the steering column jacket.

19. Put the selector lever with shifting claw (1) and the selector lever (2) on the selector lever shaft. Insert the relay lever (3) on the splines of the shift tube and fix it in position by means of the clamping screw. Attach the ball connector (4) and the shifting rods and fix them in position by means of the spring clips (Fig. 26-15/3).

20. Install the reversing light switch and connect the cables. The pressure pin and the stop sleeve must slide easily in the bushing.

21. Connect the cable for the flash direction signals and for the horn to the cable connector on the wheel arch assembly.

22. Adjust the gear shift mechanism and check whether it is working properly (see Job No. 26–3).

23. Attach the hand brake cable and adjust the hand brake.

24. Connect the battery cable and check whether the horn and flash direction signals are working properly.

II. Models 180, 180 a, 180 D, 190 D, 219, 220 a, 220 S, and 220 SE with 2nd Version Bearing

Removal and installation procedures are the same as described for Model 190.

III. Models 180 b, 180 Db, and 190 Db

On these models the cables to the combined switch for the direction indicator and the headlight upper beam flash signal system must be disconnected at the cable connector. Further procedures are the same as described for Model 190.

Pedals

Pedals Group 29

Clutch Actuating Mechanism

Job No.
29-1

A. 1st Version

Model 180

The clutch is actuated by the clutch pedal (1) via the clutch pedal shaft (2). The clutch linkage (4) is attached to the clutch pedal shaft which is not supported on the transmission (Fig. 29–1/1). The clutch pedal is mounted on a tube on the chassis base panel. Axial support of the engine is provided by the stay rod (5) which is attached to the clutch housing and to a tube on the chassis base panel (Fig. 29–1/2).

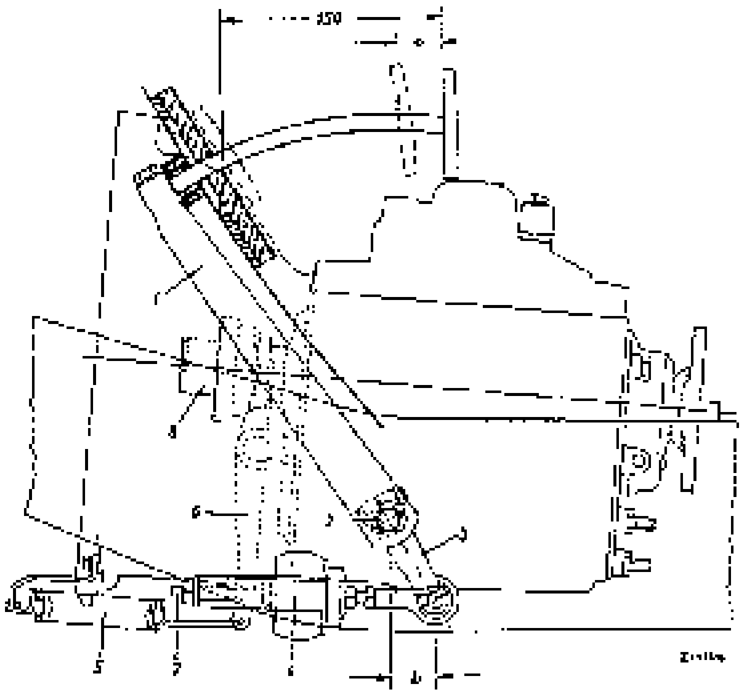


Fig. 29–1/1

1 Clutch pedal
2 Clutch pedal shaft
3 Relay lever
4 Clutch linkage
5 Tension spring
6 Clutch throw-out fork
7 Adjustment screw
8 Throw-out bearing
a = Clutch pedal free play
b = Adjusting dimension for relay lever

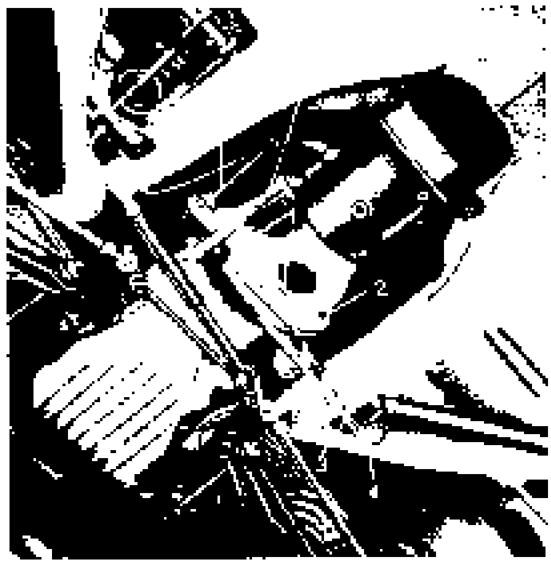


Fig. 29–1/2

1 Hexagon screw
2 Hexagon screw
3 Hexagon nut
4 Hexagon nut
5 Clutch linkage
6 Engine stay rod

B. 2nd Version

Models 180, 180 D, 190 SL, and 220 a

As in the case of the 1st version the clutch is actuated via a shaft by the clutch pedal. The clutch pedal (11) is mounted on a tube on the chassis base panel. The left side of the clutch pedal shaft (1) is attached to the clutch pedal by means of a jointing disk (9). On the right side the clutch

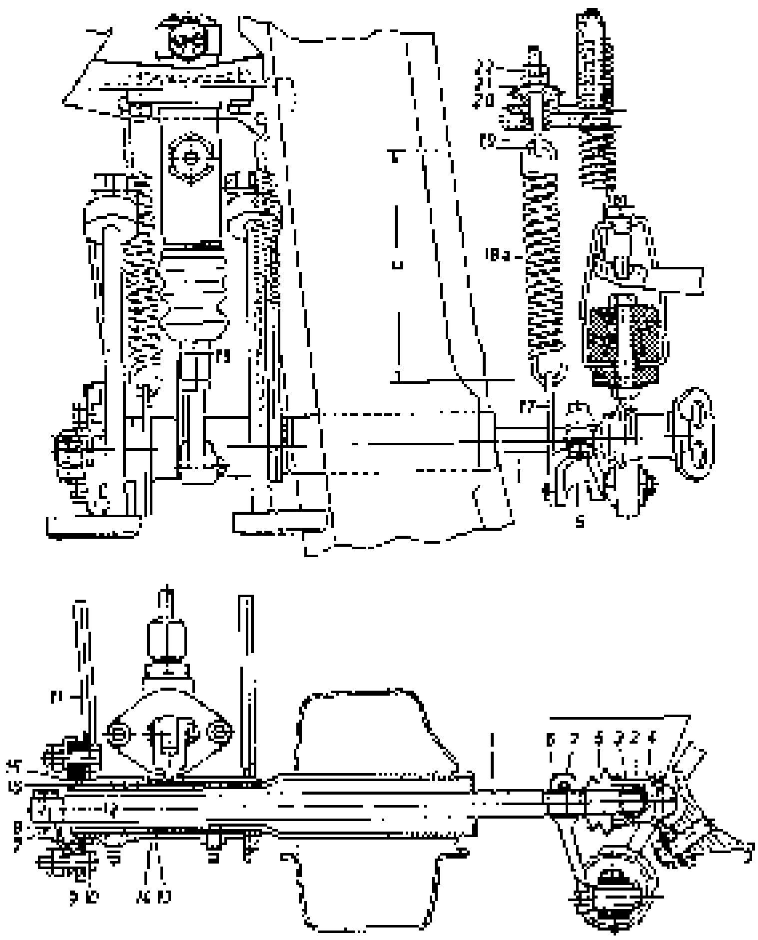


Fig. 29-1/3

1 Clutch pedal shaft
2 End plate with bushing
3 Ball
4 Snap ring
5 Cuff
6 Relay lever
7 Clamping screw
8 Flange
9 Jointing plate
10 Pressure plate with screw, hexagon nut and cut nut
11 Clutch pedal
12 Bushing
13 Stop rod
14 Spring washer
15 Washer
16 Snap ring
17 Shackle
18 1st version compensating spring
18a 2nd version compensating spring
19 Pull rod
20 Rubber buffer
21 Cup washer
22 Nut
a = Adjusting dimension for compensating spring

pedal shaft is carried in a ball (3) in an end plate (2) attached to the transmission. The compensating spring (18) (dead center spring) which reduces the clutch pedal pressure on declutching is arranged on the right side of the clutch pedal in this version (Fig. 29-1/3).

C. 3rd Version

Models 180, 180 D, 220 a, and 190 SL

The clutch pedal shaft is mounted in the same way as the 2nd version, except that the compensating spring (18 a) is attached on the right side to the relay lever and the clutch housing (Fig. 29-1/3).

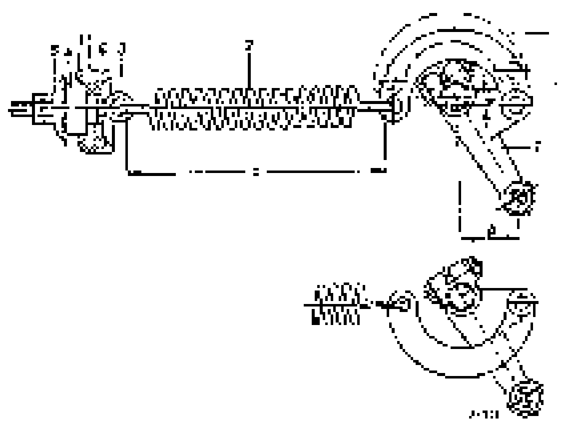


Fig 29-1/4

1 Relay lever with shackle
2 Compensating spring
3 Pull rod
4 Rubber buffer
5 Cup washer
6 Clutch housing
b = Adjusting dimension for relay lever
a = Adjusting dimension for compensating spring

The shackle has been repositioned in order to prevent the hand brake cable from touching the relay lever (1) shackle. The relay lever with top shackle can be replaced by the lever with reversed shackle (Fig. 29-1/4).

D. 4th Version

Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, and 190 SL as well as Models 219, 220 S, and 220 SE with Mechanical Clutch

The 4th version clutch pedal shaft is carried in a swivel support as on Model 190. On Models 180 a, 180 b, 190 D, and 190 Db the swivel support bracket is elastically mounted on the clutch housing as on Model 190 (Fig. 29-1/5). On all other models the bracket is rigidly screwed to the clutch housing (Fig. 29-1/6).

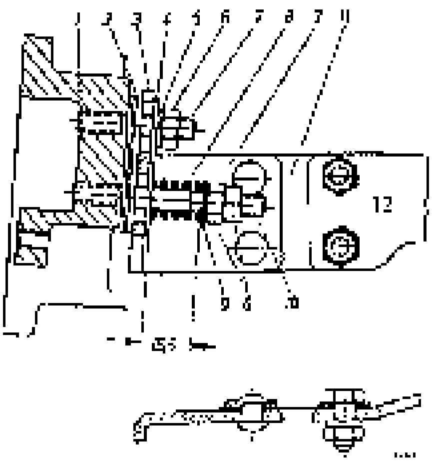


Fig. 29-1/5

1 Clutch housing
2 Spacer washer
3 Bracket
4 Washer
5 Lock washer
6 Hexagon nut
7 Stud bolt
8 Damping spring
9 Washer
10 Stud bolt
11 Spring plate
12 Swivel support

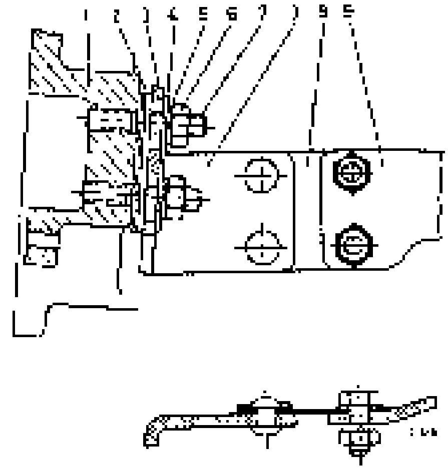


Fig. 29-1/6

1 Clutch housing
2 Spacer washer
3 Bracket
4 Washer
5 Lock washer
6 Hexagon nut
7 Stud bolt
8 Spring plate
9 Swivel support

On later models modified brackets (3) have been installed on which the two slots have been replaced by bores. The washer (4) is no longer required.

For vertical adjustment of the clutch pedal shaft the two bores in the swivel support (12) have been increased in diameter from 6.4 mm to 7.0 mm. If a new bracket is installed subsequently the two holes in the swivel support must be bored to 7 mm diameter (Figs. 29-1/5 and 29-1/6).

In order to prevent knocking noises in the clutch actuating mechanism the washer previously installed between clutch and brake pedal boss has been replaced by a Vulkollan damper washer (16) (Fig. 29-1/7).

The Vulkollan washer can be installed subsequently in all cars which are no longer provided with the stay rod between the mounting tube and the retaining plate of the brake master cylinder. When installing the Vulkollan washer remember that spacer washers are required on both sides of the Vulkollan washer. The shim (17 a) is a compensating shim for the adjustment of the prescribed end play of the pedals "a" = 0.1-0.2 mm. The spacer washer (17 b) has the same thickness as the thinnest compensating shim. The shims (17 a) are available in the following sizes:

Part No.	Thickness mm
120 990 38 40	0.38 ± 0.05
120 990 39 40	0.75 ± 0.07
120 990 40 40	0.88 ± 0.08
120 990 41 40	1 ± 0.09

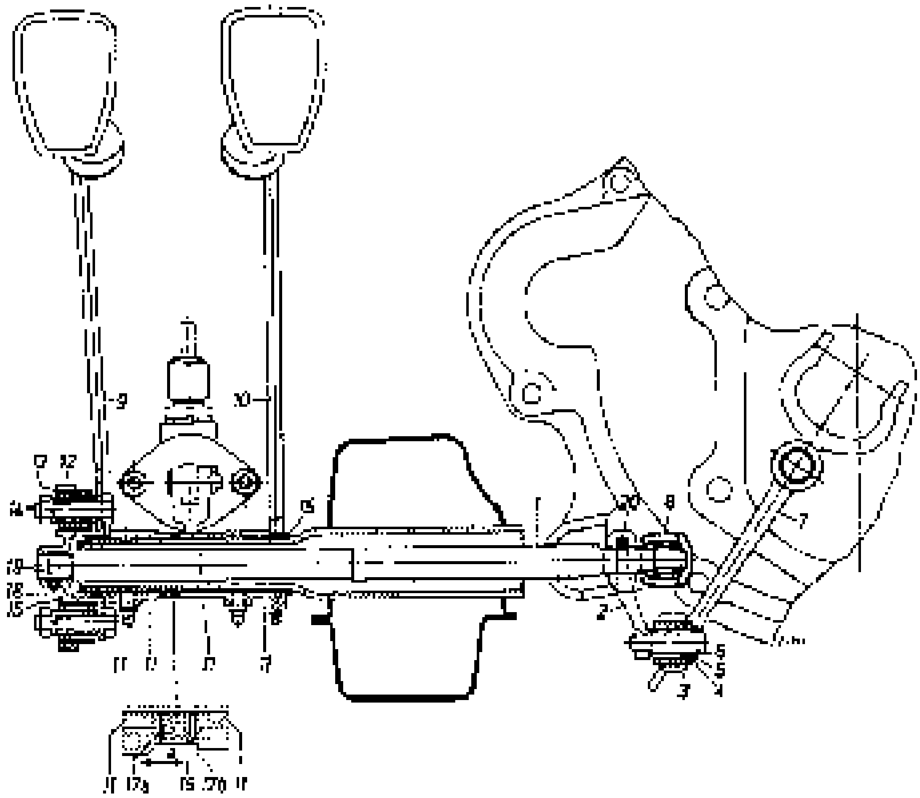


Fig. 29–1/7

1 Pedal shaft
2 Lever with bolt
3 Pull rod end
4 Silentbloc
5 Washer
6 Cotter pin
7 Throw-out fork
8 Swivel support
9 Clutch pedal
10 Brake pedal
11 Bushing
12 Flange
13 Silentbloc
14 Hexagon screw
15 Washer
16 Vulkollan washer
17a Shim
17b Spacer washer
18 Snap ring
19 Clamping screw
20 Clamping screw

a = End play of pedals on mounting tube 0.1–0.3 mm

Adjustment of Clutch Pedal Free Play

Job No.
29–3

A. 1st, 2nd and 3rd Versions

Models 180, 180 D, 190 SL, and 220 a

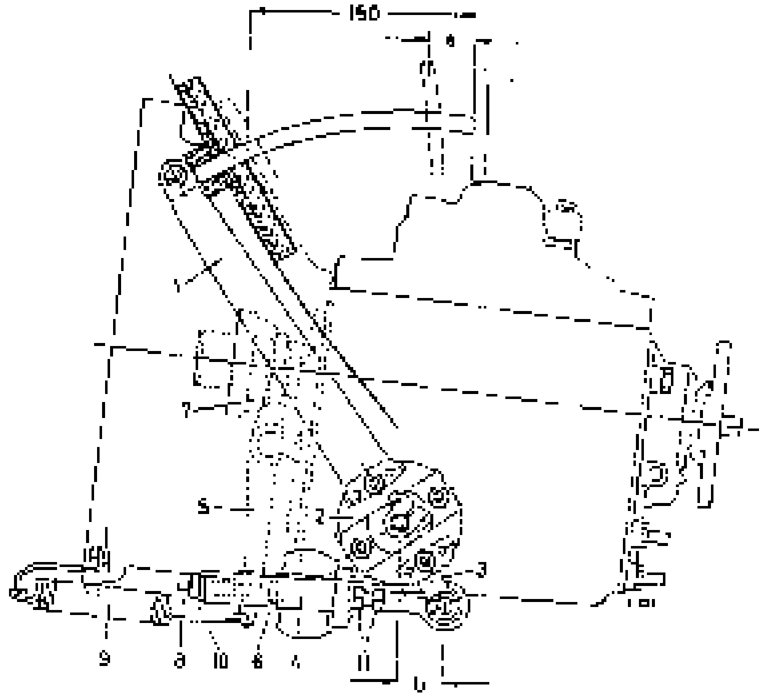


Fig. 29–3/1

1 Clutch pedal lever and pedal
2 Jointing disk
3 Relay lever with bolt
4 Shackle with pull rod and pull rod end
5 Clutch throw-out fork
6 Pull rod
7 Clutch throw-out bearing and throw-out unit
8 Threaded bolt
9 Return spring
10 Hexagon nut for threaded bolt
11 Hexagon nut for pull rod
a = Clutch pedal free play
b = Adjusting dimension for relay lever

1. Loosen the hexagon nut (10) on the threaded bolt (8) of the clutch actuating mechanism. Turn the threaded bolt in and back it out again until the clutch pedal free play "a" = 25 mm (Fig. 29–3/1).

Note: This corresponds to a clearance between release lever and throw-out bearing of 2 mm. When new rubber parts (jointing disk etc.) have been installed in the clutch actuating mechanism, the clutch pedal free play should be adjusted to "a" = 15 mm because newly installed rubber parts are compressed when the clutch has been used a few times.

2. Retighten the hexagon nut (10) for the threaded bolt of the clutch actuating mechanism.

Note: At least one or two threads of the threaded bolt (8) must be visible after the hexagon nut (10) has been tightened. If this is not the case, the length of the pull rod (6) should be adjusted accordingly by loosening the hexagon nuts (11) (see Fig. 29–3/1).

3. If necessary, check the position of the relay lever (3) on the clutch pedal shaft. The distance from center pedal shaft to center relay lever bolt should be "b" = 32 ± 4 mm on Models 180, 180 D, and 190 SL, and "b" = 29 ± 4 mm in the case of Model 220 a.
The clutch pedal shaft (1) must always rest against the top of the rubber stop (see Fig. 29–3/1). The distance "b" can be varied by changing the position of the relay lever (3) on the splines of the clutch pedal shaft (see Job No. 29–5).

Note: Please note that on the 2nd and 3rd versions of the clutch pedal shaft the distance from center pedal shaft downward to center compensating spring should be 4 mm when the clutch is engaged (see Fig 29–3/4). If the distance is too large

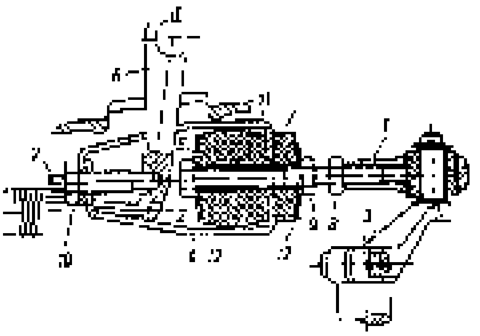


Fig. 29–3/2

1 Pull rod end
2 Pull rod
3 Lever with ball
4 Shackle
5 Spacer sleeve
6 Clutch throw-out fork
7 Threaded bolt
8, 9 and 10 Hexagon nut
11 Front rubber buffer
12 Cup washer
13 Rear rubber buffer

the clutch pedal will be difficult to depress since the pull of the compensating spring increases.

With the inside type of compensating spring, the installed length "c" should be 137 mm in the case of Models 180, 180 D, and 190 SL, and 155 mm in the case of Model 220 a (see Fig. 29–1/4).

Check whether the rubber buffers (11) and (13) have sufficient initial tension. The cup washers (12) should rest against the spacer sleeve (5), but the spacer sleeve must not be deformed when the hexagon nut (9) is tightened (see Fig. 29–3/2).

B. 4th Version with Swivel Suport

Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 190 SL, and 220 a as well as Models 219, 220 S, and 220 SE with Mechanical Clutch

The clutch pedal free play is adjusted in the same way as on Model 190.

C. Adjustment of Free Play of the Mechanical Clutch

Models 219, 220 S, and 220 SE with Hydraulic Automatic Clutch

(see Workshop Manual Passenger Car Models as from August 1959, Job No. 25–10, Section VI, A).

Removal and Installation of Clutch Pedal Shaft

Job No.
29–4

Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 190 SL, and 220 a as well as Models 219, 220 S, and 220 SE with Mechanical Clutch

Removal:

1. Unscrew the protective plate for the pedal system.

2. Unscrew the hexagon screw for the clutch pedal shackle (1) and pull out the shackle (see Fig. 29–3/1).

3. Unscrew the clamping screw (19) from the clutch pedal flange. Then remove the two hexagon nuts (14) and pull the flange from the clutch pedal shaft (see Fig. 29–1/7).

Note: Mark the relative position of the flange and the clutch pedal shaft (1) before removal in order to ensure that the clutch pedal is correctly reinstalled on the pedal shaft.

3 a. On the 2nd and 3rd versions with end plate detach the return spring for the clutch throw-out fork and the compensating spring (18) or (18 a) (see Fig. 29–1/3). Then unscrew and remove the jointing disk (9) with flange (8) from the clutch pedal.

Note: Mark the position of the flange on the pedal shaft before removing it (see Fig. 29–1/3).

4. Remove the snap ring (16) from the mounting tube and remove the clutch pedal together with washer (15) (see Fig. 29–1/3).

Checking:

5. Check the bearing bushings (12) in the clutch pedal (11) for wear (Fig. 29–1/3). Worn bushings must be replaced. The bushings are pressed into the clutch pedal bore with an oversize of 0.02 to 0.06 mm.

   After new bushings have been pressed in, the bore must be reamed to the finished size. Internal diameter of bearing bushings (finished size): 27.040–27.073 mm.

   External diameter of mounting tube 26.959–26.980 mm.

6. In the case of the 2nd and 3rd versions check the jointing disk to see whether it is still serviceable. Cracked jointing disk should always be replaced.

6 a. In the case of the 4th version also check the silentblocs (13) in the flange (12) and if necessary press in new silentblocs (Fig. 29–1/7).

Installation:

7. Slide the clutch pedal onto the mounting tube.

8. The clutch pedal end play on the mounting tube must be adjusted to 0.1–0.2 mm by installing one or several spring washers (14) (see Fig. 29–1/3). The spring washers are available in thicknesses of 0.2 mm (Part No. 120 290 02 40) and 0.4 mm (Part No. 120 290 03 40). The pivot point should be well greased.

Note: To prevent knocking noises in the clutch actuating mechanism the spring washer between the clutch pedal and brake pedal boss can be replaced by a Vulkollan damper washer (16) (Fig. 29–1/7) on all cars without a stay rod (see Job No. 29–1, Section D).

9. Install the snap ring (18), making sure that it is properly seated in the groove. Then slide the flange (12) onto the pedal shaft in such a way that the marks made during removal are aligned on the shaft and the flange. Screw the clutch pedal (9) to the flange (12) (see Fig. 29–1/7).

10. Clamp the flange to the clutch pedal shaft by means of the clamping screw (19) (see Fig. 29–1/7).

11. On the 2nd and 3rd versions with end plate (see Fig. 29–1/3) screw the jointing disk (9) with flange (8) to the clutch pedal and attach the compensating spring (18) or (18 a) and the return spring for the clutch throw-out fork.

12. Install the clutch pedal shackle and tighten the hexagon screw.

13. Adjust the clutch pedal free play (see Job No. 29–3).

14. Install the protective plate for the pedal system.

Removal and Installation of Clutch Pedal Shaft

Job No.
29–5

A. 1st Version

1. Remove the transmission (see Job No. 26–1).
2. Press the snap ring out of the clutch pedal shaft (2) (see Fig. 29–1/1).
3. Loosen the hexagon screw on the relay lever (3) and remove the relay lever (see Fig. 29–1/1).
4. Remove the clutch pedal shaft toward the middle of the car.
5. Installation is the reverse of the removal procedure. Please note that the distance "b" should be 32 ± 4 mm when the clutch pedal is in contact position (Fig. 29–1/1).

B. 2nd and 3rd Versions with End Plate

Models 180, 180 D, 190 SL, and 220 a

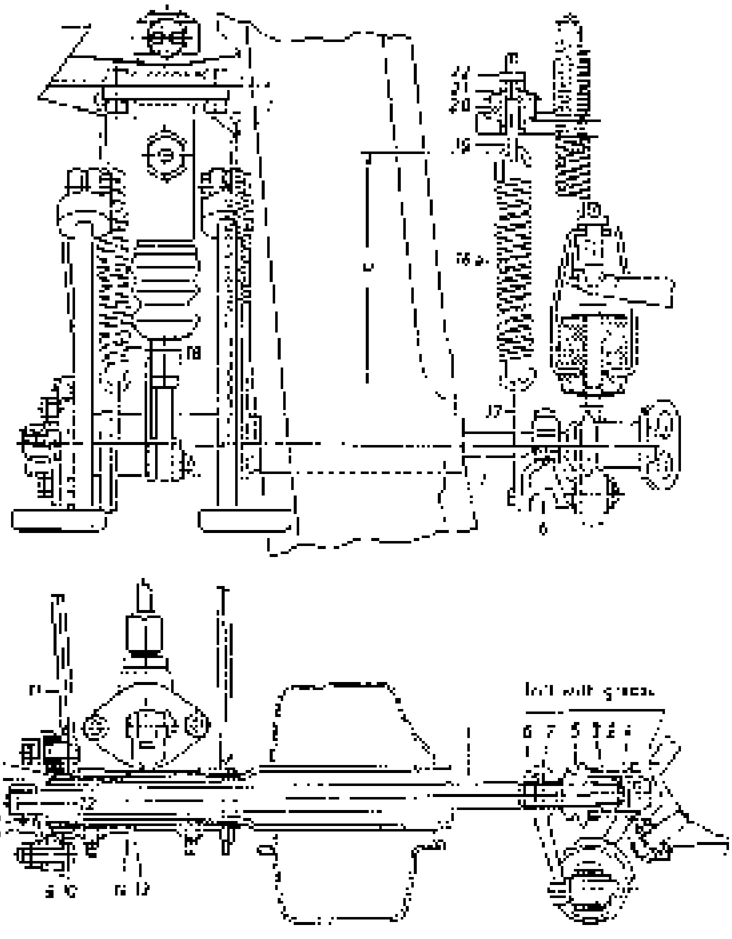


Fig. 29–5/1

1 Clutch pedal shaft
2 End plate with bushing
3 Bolt
4 Snap ring
5 Cuff
6 Relay lever
7 Clamping screw
8 Flange
9 Jointing disk
10 Pressure plate with screw, hexagon nut and pal nut
11 Clutch pedal
12 Bushing
13 Stop rod
14 Spring washer
15 Washer
16 Snap ring
17 Shackle
18 1st version compensating spring
18a 2nd version compensating spring
19 Pull rod
20 Rubber buffer
21 Cup washer
22 Nut
a = Adjusting dimension for compensating spring

Removal:

1. In the case of the 2nd version detach the compensating spring (18) at the clutch pedal and at the attaching plate for the brake master cylinder. In Fig. 29–5/1 this version is represented by dotted lines. In the case of the 3rd version loosen the nuts (22) of the pull rod (19) for the compensating spring (18 a) and detach the compensating spring at the shackle (17) of the relay lever (6) (Fig. 29–5/1).

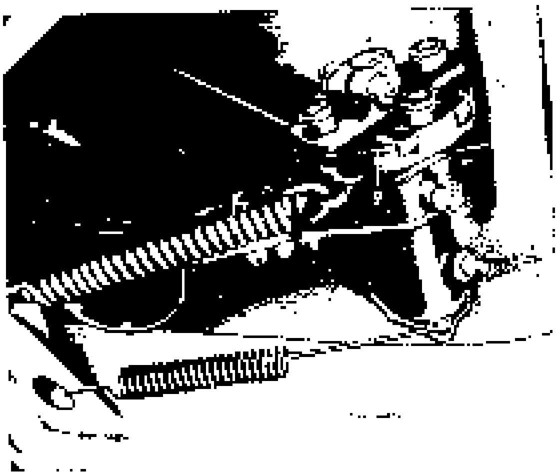


Fig. 29-5/2

8 Flange
9 Jointing disk

2. Detach the return spring for the clutch throw-out fork and the shackle of the clutch actuating mechanism after loosening the threaded bolt.

3. Unscrew the two hexagon and locking nuts attaching the flange (8) to the jointing disk (9) (Fig. 29-5/2).

4. Remove the rubber cuff (5) from the end plate (2) and pull the pedal shaft (1) out of the end plate toward the outside (see Fig. 29-5/1 and Fig. 29-5/3).

5. If the ball (3) on the pedal shaft (1) is worn, it should be replaced. To do this, remove the snap ring (4) and then remove the ball (Fig. 29-5/1). If the bore in the end plate (2) is worn, the end plate should be replaced.

Ball diameter	$= \frac{19.980}{19.947}$ mm
Bore in end plate	$= \frac{20.000}{20.021}$ mm

6. Remove the transmission (see Job No. 26-1).

7. Unscrew the protective plate for the pedal system.

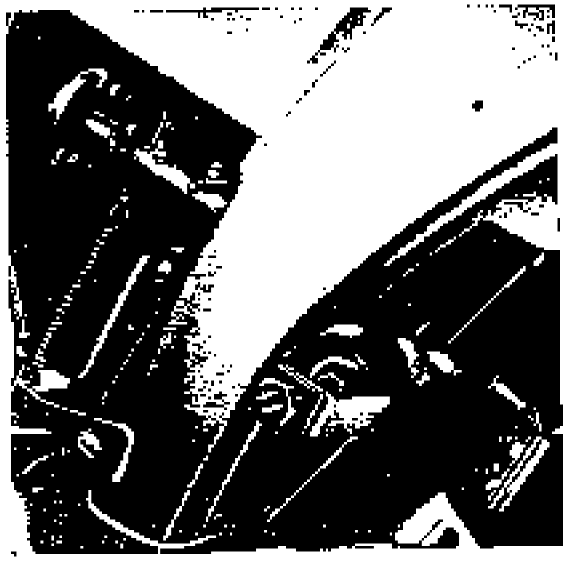


Fig. 29-5/3

8. Then unscrew the clamping screw (7) on the flange (8) (see Fig. 29-5/1) and remove the pedal shaft toward the inside.

9. Check all parts and if necessary replace.

Installation:

10. Install the clutch pedal shaft from the inside on the splines of the flange (8) and tighten the flange with the clamping screw (7) (Fig. 29-5/1).

11. Install the protective plate for the pedal system.

12. Slide the relay lever (3) on the splines of the pedal shaft and check the position of the relay lever. The distance from center ball of the relay lever to center clutch pedal shaft should be "b" = 32 ± 4 mm in the case of Models 180, 180 D, and 190 SL and "b" = 29 ± 4 mm in the case of Model 220 a. The clutch pedal (1) should always rest against the rubber stop. The distance "b" can be varied by changing the position of the relay lever (3) on the splines of the clutch pedal shaft (see Fig. 29-5/4).

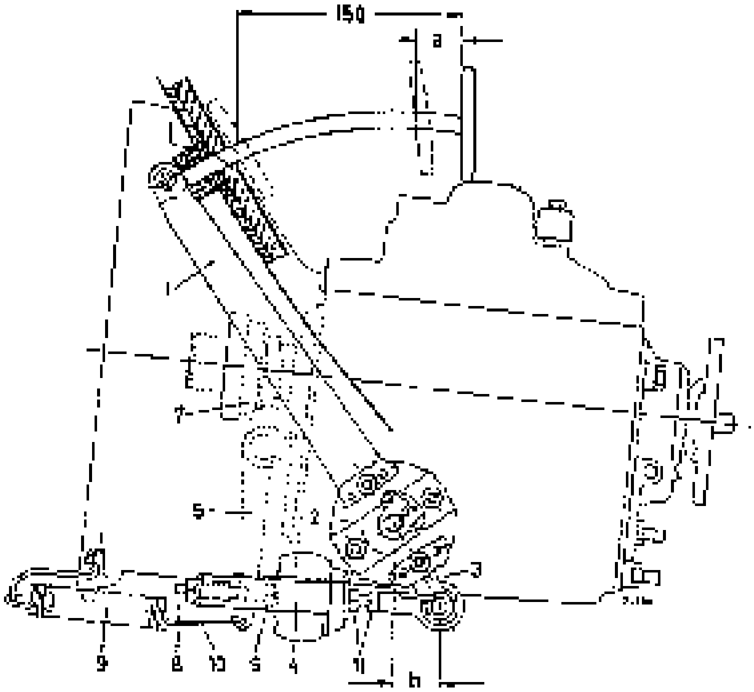


Fig. 29–5/4

1 Clutch pedal lever and pedal
2 Joining disk
3 Relay lever with bolt
4 Shackle with pull rod and pull rod end
5 Clutch throw-out fork
6 Pull rod
7 Clutch throw-out bearing and throw-out unit
8 Threaded bolt
9 Return spring
10 Hexagon nut for threaded bolt
11 Hexagon nut for pull rod

a = Clutch pedal free play
b = Adjusting dimension for relay lever

13. Clamp the relay lever (6) on the clutch pedal shaft (1) by means of the clamping screw (7) (see Fig. 29–5/1).

14. Install the rubber cuff (5) and the ball (3) of the clutch pedal shaft and install the snap ring (4) (see Fig. 29–5/1).

15. Install the transmission (see Job No. 26–1).

16. Fill the bore in the end plate with grease. Install the pedal shaft in the bore of the end plate, attach the flange (8) to the jointing disk (9) and slide the rubber cuff (5) onto the end plate (2) (Fig. 29–5/1).

17. Install the clutch linkage. Attach the compensating spring (18) on the 2nd version and (18a) on the 3rd version and the return spring for the throw-out fork (Fig. 29–5/1). The distance between center pedal shaft downward to center compensating spring should be 4 mm in the case of the 3rd version shaft when the clutch is engaged (see Fig. 29–5/5).

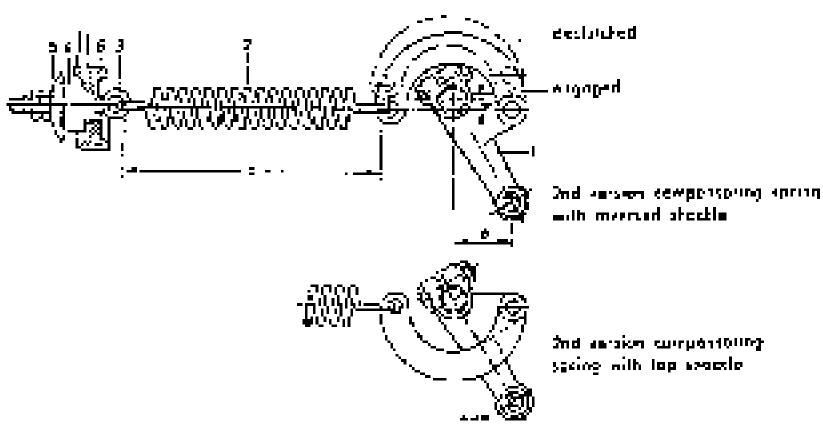


Fig. 29–5/5

1 Relay lever with shackle
2 Compensating spring
3 Pull rod
4 Rubber buffer
5 Cup washer
6 Clutch housing
b = Adjusting dimension for relay lever
c = Adjusting dimension for compensating spring

The distance can be varied by changing the position of the end plate in relation to the transmission (see Fig. 29–5/1).

If the distance is too large the clutch pedal will be difficult to operate because the pull of the compensating spring increases.

With the inside type of compensating spring the installed length "c" should be 137 mm in the case of Models 180, 180 D, and 190 SL and 155 mm in the case of Model 220 a.

16. Adjust the clutch pedal free play (see Fig. Job No. 29–3).

C. 4th Version with Swivel Support

Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, and 190 SL as well as 219, 220 S, and 220 SE with Mechanical Clutch

On these models the removal and installation procedures for the clutch pedal shaft are the same as on Model 190.

Removal and Installation of Brake Pedal

Job No.
29–10

I. Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 190 SL, and 220 a as well as 219, 220 S, and 220 SE with Mechanical Clutch

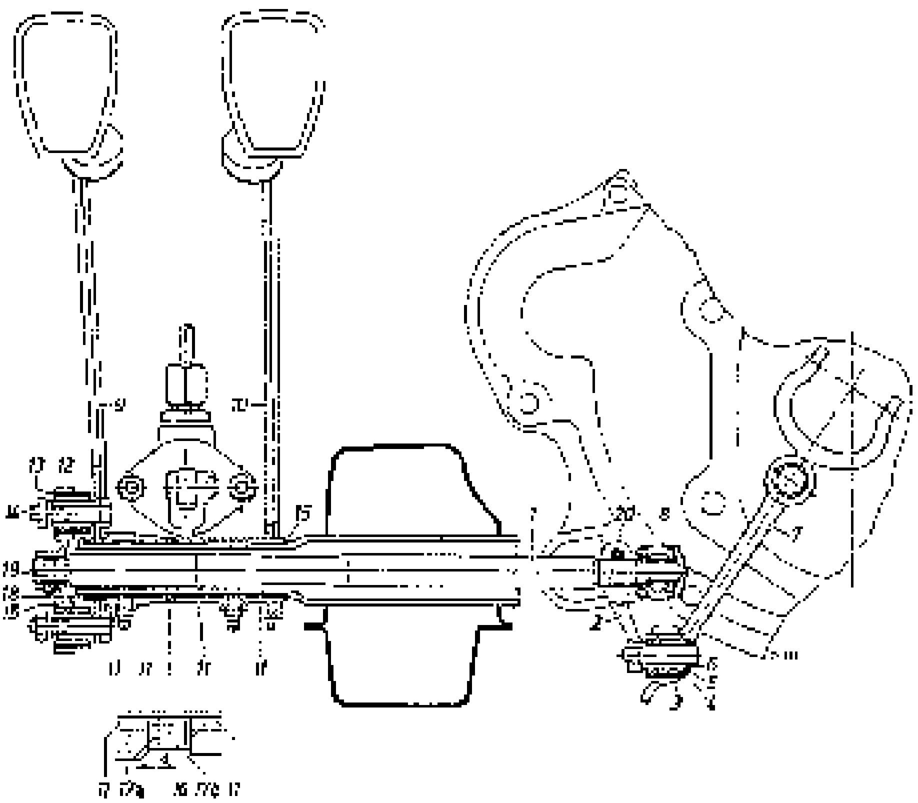


Fig. 29-10/1

1	Pedal shaft	12	Flange
2	Lever with nut	13	Silentbloc
3	Pull rod end	14	Hexagon screw
4	Silentbloc	15	Washer
5	Washer	16	Vulkollan washer
6	Cotter pin	17a	Shim
7	Throw-out fork	17b	Spacer washer
8	Swivel support	18	Snap ring
9	Clutch pedal	19	Clamping screw
10	Brake pedal	20	Clamping screw
11	Bushing		

a = End play of pedals on mounting tube 0.1—0.2 mm

Removal:

1. Unscrew the protective plate for the pedal system.
2. Remove the hexagon screws for the shackles at the clutch and brake pedals and remove both shackles. Remember the washer and the sealing ring.
3. On the 2nd and 3rd versions with end plate detach the return spring for the clutch throw-out fork and the compensating spring (18) or (18 a). Unscrew the jointing disk (9) with flange (8) from the clutch pedal (see Figs. 29-5/1 and 29-5/2).

3 a. In the case of the 4th version with swivel support unscrew the two hexagon nuts (14) on the flange (12) of the clutch pedal (9) and remove together with the lock washers (see Fig. 29-10/1).

4. Mark the relative position of the flange (12) and the pedal shaft (1). Unscrew the clamping screw (19) on the flange and press the flange off the clutch pedal shaft.

5. Remove the snap ring (18) and washer (15) from the mounting tube and pull off the clutch pedal.

6. Remove the washers (17) and (16) from the mounting tube (Fig. 29–10/1).

7. Detach the return spring at the brake pedal. Pull the cotter pin out of the collar pin and press out the collar pin. On cars provided with a stay rod (13) between the mounting tube and the retaining plate of the brake master cylinder, remove the stay rod (see Fig. 29–5/1).

8. Remove the brake pedal from the mounting tube.

9. Check the bearing bushings (11) in the brake pedal for wear. Worn bushings must be replaced. The bushings are pressed into the brake pedal bore with an oversize of 0.02 to 0.06 mm.

After new bushings have been pressed in, the bore must be reamed to the finished size. Internal diameter of bearing bushings after reaming (finished size): 27.040–27.073 mm.

Installation:

10. Install the brake pedal on the mounting tube; do not forget the rear washer (15) (see Fig. 29–10/1).

Note: In the case of the 1st version brake pedal the boss with the actuating lever was fastened to the brake pedal at an angle of 50°. In order to increase the efficiency of the brake the 2nd version boss is brazed at an angle of 42°. If the 1st version brake pedal is replaced by the 2nd version a shorter push rod for the brake master cylinder must be installed.

11. Re-attach the push rod of the brake master cylinder to the brake pedal. Attach the return spring to the brake pedal.

Note: In the case of cars provided with a stay rod reinstall the stay rod.

12. On cars not provided with a stay rod slide a spacer washer (17b), the Vulkollan washer (16) and a shim (17a) together with the clutch pedal onto the mounting tube instead of the washer and the spring washer. Install the washer (15) and install the snap ring (18) in the groove of the mounting tube (see Fig. 29-10/1).

13. Check the end play of the clutch pedal on the mounting tube; it should be 0.1–0.2 mm. If necessary, adjust the end play by installing shims of the necessary size (see also Job No. 29-1, Section D).

Note: In the case of cars provided with a stay rod, the end play of the clutch lever must be adjusted by means of spring washers which are available in two sizes (see Job No. 29-4, para 8).

14. Install the flange on the pedal shaft and fasten by means of the hexagon screw; check with the markings made on removal.

15. Screw the flange to the clutch pedal.

15 a. In the case of the 2nd and 3rd versions with end plate screw the jointing disk (9) with flange (8) to the clutch pedal and attach the compensating spring (18) or (18a) (see Fig. 29-5/1) as well as the return spring for the clutch throw out fork.

16. Insert the two shackles into the clutch and brake pedals and screw down. Between the pedals and the toeboard there is a

washer and a rubber washer on each shackle.

17. Check the free play of the brake and clutch pedals and, if necessary, correct (see Job No. 29-3 and Job No. 42-3).

18. Grease the brake and clutch pedals.

19. Install the protective plate for the pedal system.

II. Models 219, 220 S, and 220 SE with Hydraulic Automatic Clutch

Cars with hydraulic automatic clutch have no clutch pedal system.

a) 1st Version Brake Pedal

The 1st version brake pedal was a double lever construction consisting of two levers on one boss and a pedal with two shackles.

The removal and installation as well as the mounting of the brake pedal on the mounting tube are essentially the same as in the case of cars with a mechanical clutch. However, spacer sleeves are installed on either side of the lever boss in order to compensate for the difference in boss length as compared with standard levers. The end play is adjusted by means of spring washers or, if a Vulkollan washer is installed, by means of shims.

b) 2nd Version Brake Pedal

The 2nd version brake pedal, its removal and installation and its mounting is the same as in the case of cars with a mechanical clutch. The clutch pedal is replaced by a spacer sleeve.

The end play is adjusted by means of spring washers or, if a Vulkollan washer is installed, by means of shims.

On older cars the 2nd version brake pedal can be installed subsequently. The bore in the dashboard should be closed by a rubber disk Part No. 000 987 32 41.

Control Adjustments

30

Control Adjustments Group 30

Removal and Installation of Control Shaft

Job No.
30-1

I. Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, and 190 Db

The removal and installation procedures for the control shaft are essentially the same as described for Model 190. The only differences are in the attachment of the return spring. On Models 180, 180 D, and 180 Db the return spring is attached to the fixing bolt of the accelerator pedal and is supported by the toeboard. On all other Models the return spring is attached to a bracket fastened to the accelerator pedal by a fixing bolt and to the toeboard.

II. Model 190 SL

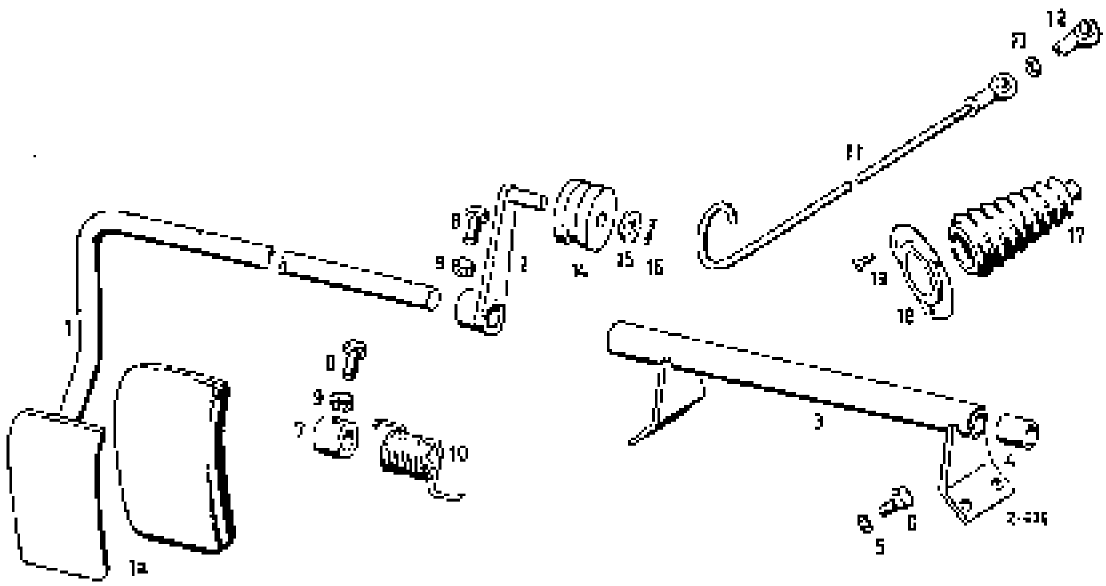


Fig. 30-1/1

1 Accelerator pedal
1a Pad with fabric layer for accelerator pedal
2 Control lever
3 Mounting tube
4 Bushing
5 Lock washer
6 Hexagon screw
7 Boss for return spring
8 Fixing bolt
9 Hexagon nut
10 Return spring
11 Pull rod
12 Ball-cup connector
13 Hexagon nut
14 Damper ring
15 Washer
16 Cotter pin
17 Bellows
18 Cover plate
19 Oval-head countersunk tapping screw

Removal:

1. Lift the rubber mat of the transmission tunnel on the right side and roll it back toward the left. If necessary unscrew the plate to the left of the transmission tunnel.

2. Pull the cotter pin (16) out of the control lever (2), remove the washer (15) and pull the pull rod (11) together with the damper ring (14) off the control lever.

Note: On the 2nd version the washer (15) and the cotter pin (16) are no longer required. The bolt riveted to the control lever takes the form of a button bolt. On this version the pull rod with the damper ring can simply be pressed off.

3. Loosen the nut (9) on the control lever (2) and unscrew it together with the fixing bolt (8). Pull the control lever off the control lever shaft (1).

4. Pull the control shaft out of the mounting tube (3) and detach the return spring (10) from the mounting tube.

5. Loosen the nut (9) on the boss (7) and unscrew together with the fixing bolt (8). Remove the boss.

6. If the bushings (4) and the mounting tube (3) are worn, the mounting tube should be removed. To do this, unscrew the four fixing screws (6) and remove them together with the lock washers (5). Knock the bushings out of the mounting tube using a rod approx. 8 mm in diameter and 250 mm long and press new bushings into the mounting tube as far as they will go. The length of the mounting tube with bushings must be 219 – 0.2 mm.

   Ream the bushings up to 12.032-12.059 mm.

Note: On recent Models the aluminum bushings have been replaced by brass bushings.

Installation:

7. Install the mounting tube (3).

8. Install the return spring on the mounting tube.

9. Slide the boss (7) on the control shaft (1), screw in the fixing bolt (8) and tighten the hexagon nut (9).

10. Slide the control shaft into the mounting tube.

11. Put the control lever (2) on the control shaft and align it on the shaft with the locating center. Screw in the fixing bolt (8) and lock it by means of the nut (9).

12. Attach the return spring (10).

13. Install the pull rod together with a damper ring on the control lever and lock by means of a washer (15) and a new cotter pin (16) or in the case of the 2nd version (with button bolt) press on the damper ring.

14. Check the accelerator pedal for ease of movement and correct position.

Note: If the mechanism is noisy although the bearing bushings are in a good condition, the noises are due to end play of the control shaft in the mounting tube (3). The end play can be compensated by adding steel washers.

III. Models 220 a and 219

Removal:

1. On the 1st version pull the cotter pin out of the pull rod and remove the pull rod.

2 a. Remove the spacer and the rubber bushings from the control lever.

2 b. On the 2nd version pull the cotter pin (13) out of the control shaft lever (8) and pull the pull rod (9) together with a damper ring (15) and the washers (14) off the control shaft lever (Fig. 30-1/2).

Note: On recent cars of Models 219 a button bolt has been riveted to the control shaft lever. On this version the pull rod (9) and the damper ring (15) need only be pressed off.

3. Press the locking plate (2) off the control shaft (8).

4. Loosen the nut (5) on the accelerator pedal (1) and unscrew together with the fixing bolt (6).

5. Pull out the control shaft (8) from the left bearing (3) and remove the accelerator pedal (1) and the return spring (7).

6. Unscrew the two hexagon screws (18) of the bearing (3), pull out the control shaft together with the bearing and remove the bearing from the control shaft.

Note: The left bearing (3) need only be removed if it is worn and must be replaced.

Installation:

7. Slide the right bearing (3) onto the control shaft (8) and attach it to the toeboard by means of the hexagon screws (18).

8. Slide the return spring (7) and the accelerator pedal (1) onto the control shaft and slide the control shaft into the left bearing (3).

9. Press the snap ring (2) onto the control shaft (8).

10. Align the accelerator pedal with the locating center of the control shaft. Screw in the fixing bolt (6) and lock it with the nut (5).

11. Attach the return spring.

12 a. On the 1st version slide the two rubber bushings and the spacer onto the control lever, turning the spacer in such a way that the pull rod is positioned in the recess of the bracket.

Install the pull rod in the spacer and lock by means of a cotter pin.

12 b. On the 2nd version slide the pull rod together with a damper ring onto the control shaft lever, install the washer and lock by means of a cotter pin.

12 c. On the 3rd version press the pull rod together with a damper ring onto the button bolt of the control shaft.

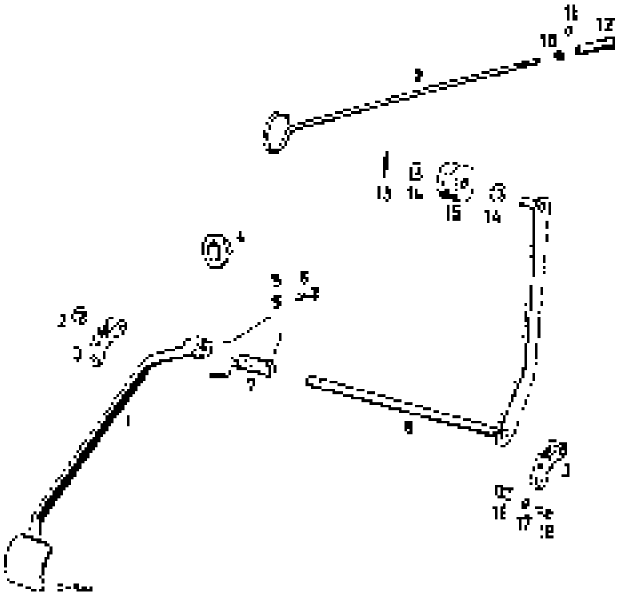


Fig. 30-1/2

1 Accelerator pedal	10 Hexagon nut
2 Snap ring	11 Lock washer
3 Bearing for control shaft	12 Ball-cup connector
4 Rubber grommet	13 Cotter pin
5 Hexagon nut	14 Washer
6 Fixing bolt	15 Damper ring
7 Return spring	16 Cage nut
8 Control shaft	17 Spring washer
9 Pull rod	18 Hexagon screw

IV. Model 220 S

The removal and installation procedures for the control shaft are the same as described for Model 190

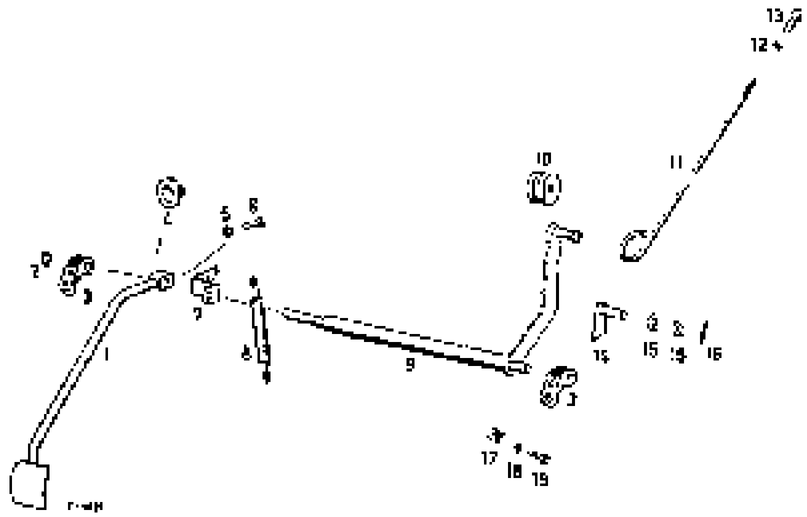


Fig. 30–1/3

1 Accelerator pedal	11 Push rod
2 Snap ring	12 Hexagon nut
3 Bearing for control shaft	13 Ball cup connector
4 Rubber grommet	14 Control shaft lever [illegible]
5 Hexagon nut	15 Washer
6 Fixing bolt	16 Cotter pin
7 Return spring lever	17 Cage nut
8 Return spring	18 Spring washer
9 Control shaft	19 Hexagon screw
10 Damper ring	

V. Model 220 SE

Removal:

1. Press the push rod (12) together with the damper ring (11) off the button bolt of the control shaft lever (9) (Fig. 30–1/4).

2. Detach the return spring (8) from the toe-board and the lever (6).

3. Loosen the hexagon nut (17) and unscrew the fixing bolt (16) from the accelerator pedal and remove together with the lever (6) for the return spring (30–1/4).

4. Remove the snap ring (10) from the control shaft (9). Unscrew the two bearings (5) from the toeboard and push the control shaft toward the left until the accelerator pedal can be removed from the shaft.

Installation:

5. Installation is the reverse of the removal procedure.

Note: Make sure that the end play between the control shaft and the bearings is not excessive.

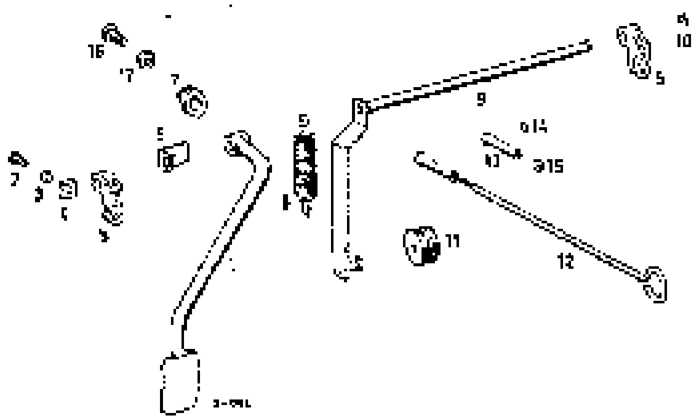


Fig. 30-1/4

1 Accelerator pedal	10 Snap ring
2 Hexagon screw	11 Damper ring
3 Spring washer	12 Push rod
4 Cage nut	13 Ball-cup connector
5 Control shaft bearing	14 Lock washer
6 Return spring lever	15 Hexagon nut
7 Rubber grommet	16 Fixing bolt
8 Return spring	17 Hexagon nut
9 Control shaft	

Adjustment of Accelerator Pedal

Job No.
30–3

A. Position of Accelerator Pedal

Check the distance of the accelerator pedal from the rubber floor mat in the idle and in the full load position.

Correct distance in the idle position is necessary for correct foot position.

A minimum distance in the full load position is necessary since otherwise there is a danger that the accelerator pedal may rest against the rubber floor mat too early with the result that the throttle valve cannot be fully opened.

The check must be made with the help of a second mechanic.

Models	180 180 D 180 Db	180 a 180 b	190 D 190 Db	190 SL	220 a 219	220 S	220 SE
Distance between rubber floor mat and accelerator pedal in the idle position in mm	70	95	75	70	75	85	65
Minimum distance between rubber floor mat and accelerator pedal in full load position in mm	15	8	15	15	15	8	10

B. Adjustment of Push and Pull Rod Length

The measurements given in the tables below always refer to the distance between center ball-cup connector and center ball-cup, or center ball-cup connector and center eye.

I. Model 180

Push rod from control shaft lever to angle lever 398 mm
Pull rod from angle lever to throttle valve lever (carburetor) 270 mm

II. Models 180 D and Db

Push rod (5) from control shaft lever (4) to angle lever (7) 398 mm
Pull rod (9) from angle lever (7) to relay lever (11) (cylinder head cover) 192 mm
Pull rod (12) from relay lever (11) to throttle valve lever (13) (venturi control unit) 198 mm

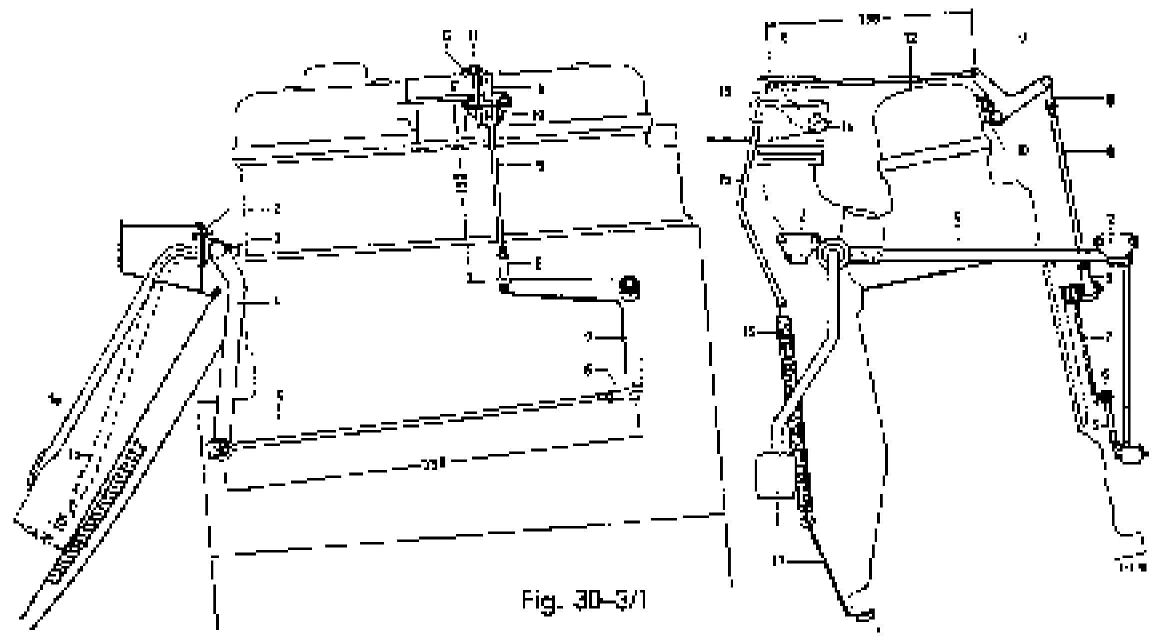


Fig. 30–3/1

1a Accelerator pedal in idle position
1b Accelerator pedal in full load position
2 Control shaft bearing
3 Fixing bolt for accelerator pedal bearing
4 Control shaft
5 Push rod
6 Ball-cup connector
7 Angle lever
8 Ball-cup connector
9 Pull rod
10 Relay lever bearing
11 Relay lever
12 Pull rod
13 Throttle valve lever
14 Adjusting ring
15 Connecting rod
16 Return spring
17 Bracket for return spring

III. Models 180 a and 180 b

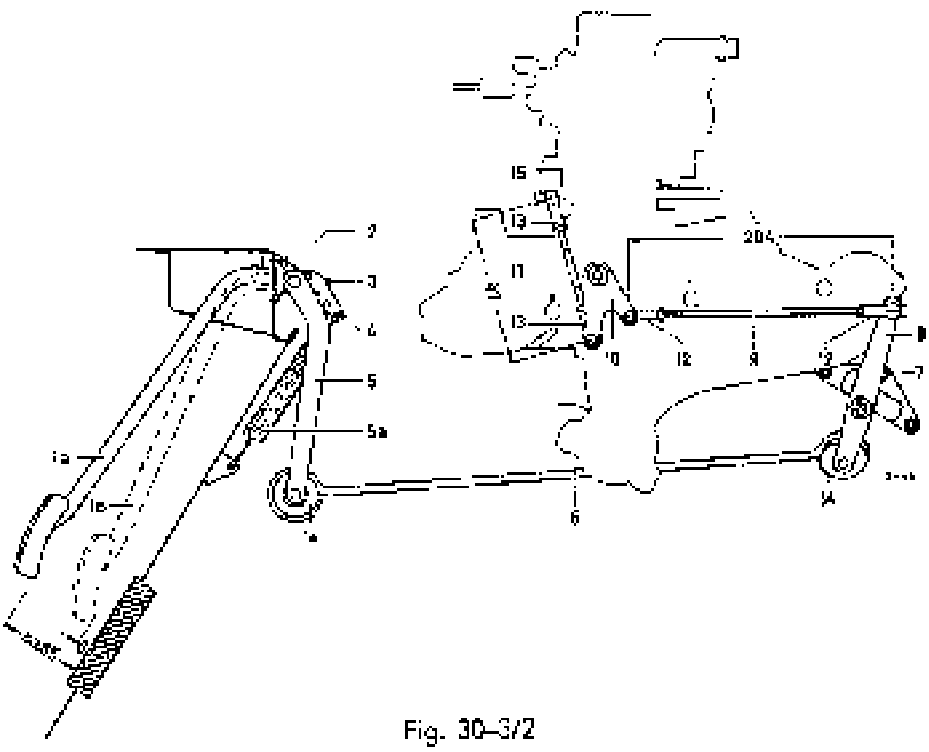


Fig. 30–3/2

1a Accelerator pedal in idle position
1b Accelerator pedal in full load position
2 Control shaft bearing
3 Fixing bolt for accelerator pedal
4 Return spring lever
5 Control shaft
5a Return spring
6 Push rod
7 Double lever bearing
8 Double lever
9 Push rod
10 Relay lever
11 Pull rod
12 Ball-cup connectors on push rod for double lever and relay lever
13 Ball-cup connectors on pull rod for relay lever and throttle valve lever
14 Damper ring
15 Throttle valve lever

Push rod (6) from control shaft lever to double lever (8)	413 mm
Push rod (9) from double lever (8) to relay lever (10)	204 mm
Pull rod (11) from relay lever (10) to throttle valve lever (15)	97 mm

IV. Models 190 D and 190 Db

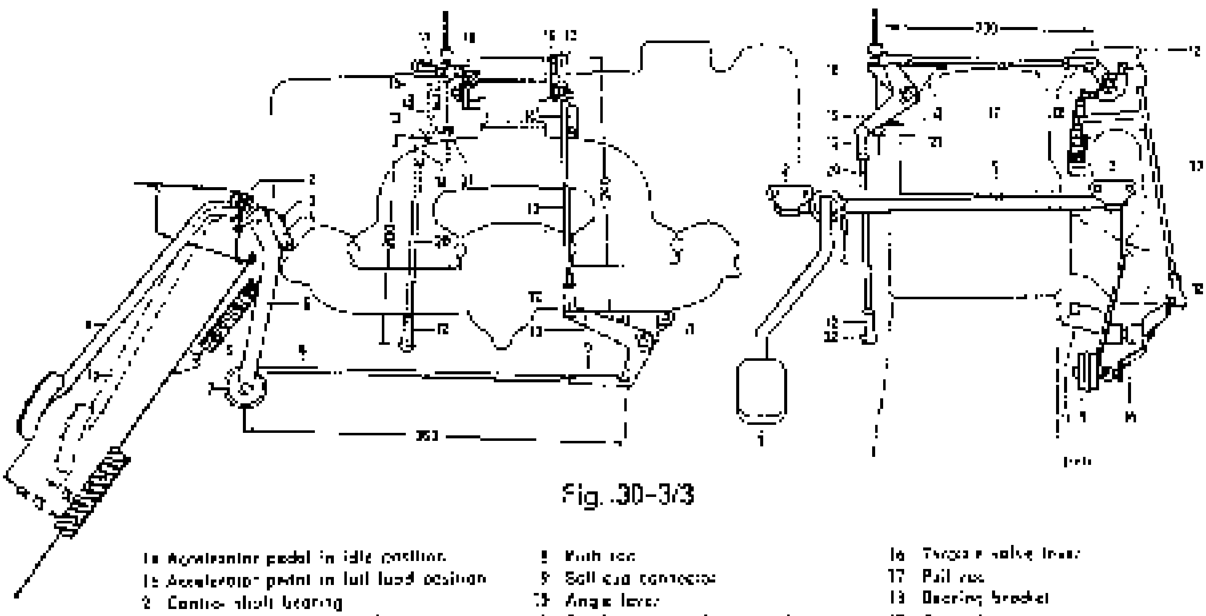


Fig. 30-3/3

1a Accelerator pedal in idle position
1b Accelerator pedal in full load position
2 Control shaft bearing
3 Fixing bolt for return spring
4 Bracket for return spring
5 Control shaft
6 Return spring
7 Damper ring
8 Push rod
9 Ball cup connector
10 Angle lever
11 Bearing bracket for angle lever
12 Ball-cup connector
13 Pull rod
14 Return spring
15 Throttle valve lever
16 Throttle valve lever
17 Pull rod
18 Bearing bracket
19 Angle lever
20 Pull rod
21 Adjusting ring
22 Lever for additional adjustment

Push rod (8) from control shaft lever (5) to angle lever (10)	360 mm
Pull rod (13) from angle lever (10) to throttle valve lever (15) (throttle valve control)	240 mm
Pull rod (17) from throttle valve lever (16) to angle lever (19) (cylinder head cover)	200 mm

Adjustment of pull rod length (20) from angle lever (19) to lever (22) of the mechanical additional adjustment:

1. With the engine at normal working temperature adjust the idle by means of the idle adjustment screw on the throttle valve control to an idle speed of 700 to 800 r.p.m.

Note: When the idle is being adjusted, the idle adjustment control knob on the instrument panel must be turned fully to the right so that the wire cable is almost slack in this position; if necessary loosen the clamping screw in the adjusting ring (21) and retighten it.

2. Now adjust to its correct length the pull rod (20) from the angle lever (19) on the cylinder head cover to the lever (22) for the mechanical additional adjustment on the injection pump as follows:

Detach the pull rod (20) from the angle lever (19) and push it downward as far as the idle stop.

In this position, when the throttle valve is in its idle position and the lever on the injection pump control rests against the idle stop, the distance between the ball-cup connector and the ball head should be approx. 1 mm, that is it must be possible to lift the pull rod (20) by about 1 mm in order to attach the ball head of the angle lever.

V. Model 190 SL

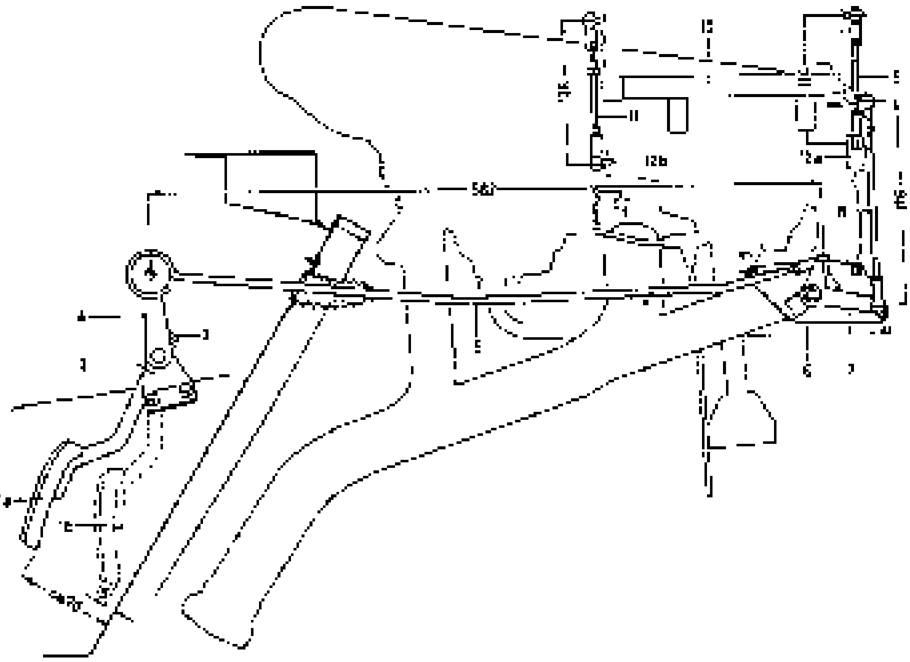


Fig. 30-3/4

1a Accelerator pedal in idle position	7 Angle lever
1b Accelerator pedal in full load position	8 Push rod
2 Control shaft bearing	9 Push rod
3 Fixing bolt for control shaft lever	10 Control shaft bearing at the carburetor
4 Control shaft lever	11 Push rod
5 Pull rod	12a Throttle valve lever for carburetor I
6 Angle lever bearing	12b Throttle valve lever for carburetor II

Pull rod (5) from control shaft lever (4) to angle lever (7)	582 mm
Push rod (8) from angle lever to control shaft lever	176 mm
Push rod (9) from control shaft lever to throttle valve lever (12 a) for carburetor I	114 mm
Push rod (11) from control shaft lever to throttle valve lever (12 b) for carburetor II	128 mm

Note: The push rod (11) is provided with a right hand and a left hand thread and has a hexagon collar in the center so that the two carburetors can be adjusted to one another without the push rod having to be removed.

VI. Models 220 a and 219

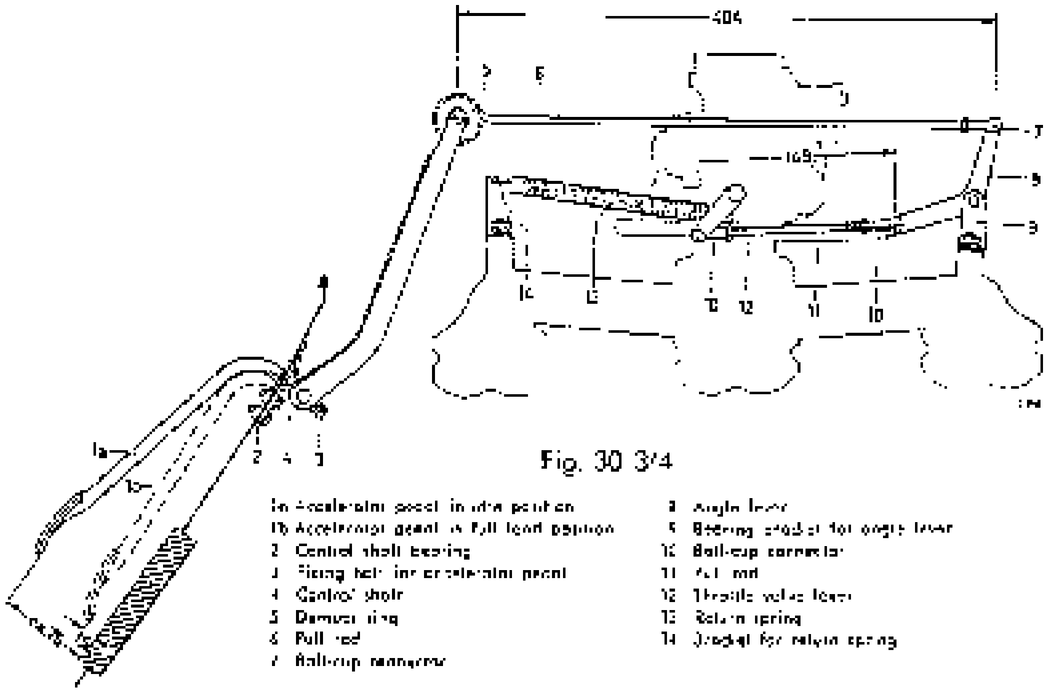


Fig. 30-3/4

1a Accelerator pedal in idle position
1b Accelerator pedal in full load position
2 Control shaft bearing
3 Fixing bolt for accelerator pedal
4 Control shaft
5 Damper ring
6 Pull rod
7 Ball-cup connector
8 Angle lever
9 Bearing bracket for angle lever
10 Ball-cup connector
11 Pull rod
12 Throttle valve lever
13 Return spring
14 Bracket for return spring

Pull rod (6) from control shaft lever (4) to angle lever (8)	404 mm
Pull rod (11) from angle lever (8) to throttle valve lever (12)	149 mm

VII. Model 220 S

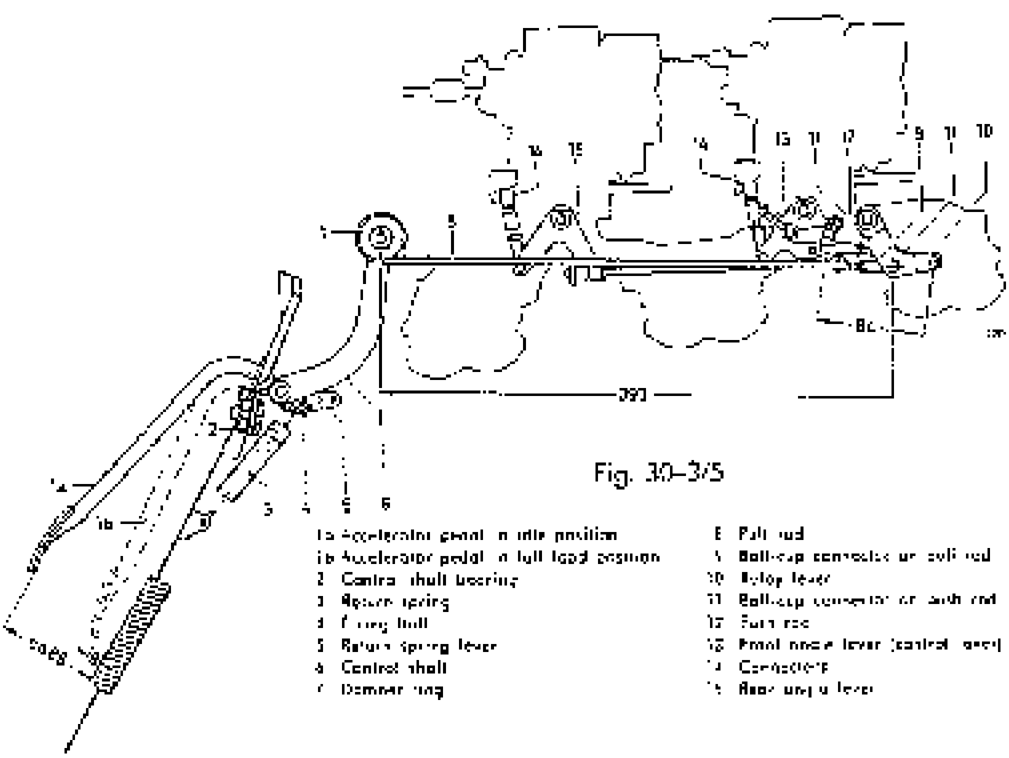


Fig. 30-3/5

1a Accelerator pedal in idle position
1b Accelerator pedal in full load position
2 Control shaft bearing
3 Return spring
4 Fixing bolt
5 Return spring lever
6 Control shaft
7 Damper ring
8 Pull rod
9 Ball-cup connector on pull rod
10 Relay lever
11 Ball-cup connector on push rod
12 Push rod
13 Pivot angle lever (control unit)
14 Connectors
15 Rear angle lever

Pull rod (8) from control shaft lever (6) to relay lever (10)	393 mm
Push rod (12) from relay lever to front angle lever (13)	84 mm

VIII. Model 220 SE

Push rod from control shaft lever to adjustment lever of the injection pump 382 mm

For the adjustment of the push and pull rods from the adjustment lever to the relay lever and the venturi control unit see Job No. 01–3, Section O.

Note: After adjusting the push and pull rods recheck on all models the distance between the accelerator pedal and the rubber floor mat. If the distance is excessive, check whether the accelerator pedal is bent. If that is the case, correct the distance by straightening the accelerator pedal.

Removal and Installation of Choke Control

Length of Control Cables

Model	Spring steel wire length in mm	Coil spring length in mm
180, 180 a, 180 b	990	900
190 SL	1180	1100
	Hot start control 960	860
220 a	980	900
219	1080	990
220 S	875	775

The choke control cables (Part No. 180 300 18 30) are only supplied in lengths of 1180 mm. If necessary they must be cut to the required length.

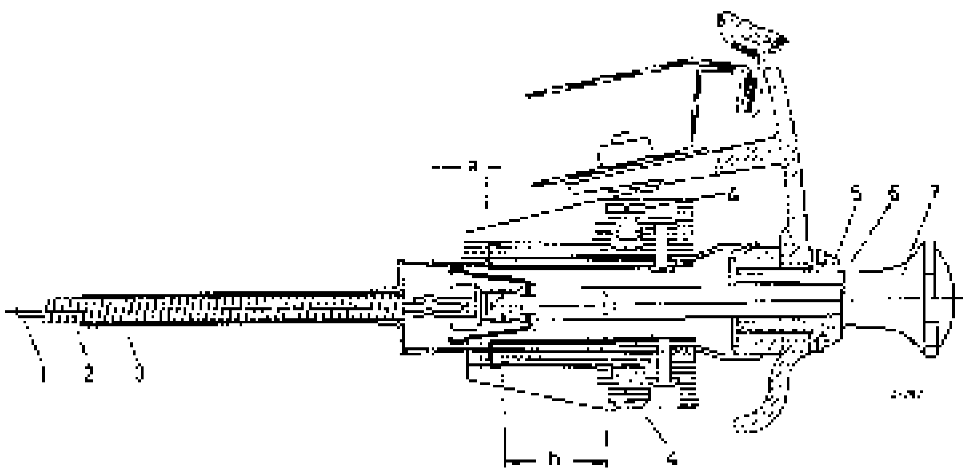


Fig. 30–6/1

1 Spring steel wire
2 Coil spring
3 Insulating conduit
4 Connections for electric cables
5 Guide screw
6 Felt ring
7 Control knob

I. Models 180, 180 a, and 180 b

The removal and installation procedures for the choke control are essentially the same as described for Model 190 with the difference, however, that on these Models the choke control (2) is not held in rubber bushings but is clamped to the starter housing by means of the hexagon screw (1) (Fig. 30–6/2).

Fig. 30-6/2

1 Clamping screw for coil spring
2 Choke control
3 Aperture limiting screw
4 Idle adjustment screw
5 Return spring
6 Throttle valve lever
7 Push rod
8 Idle mixture adjusting screw
9 Relay lever
10 Push rod
11 Double lever
12 Clamping screw for choke control

II. Model 190 SL

a) Cold start control

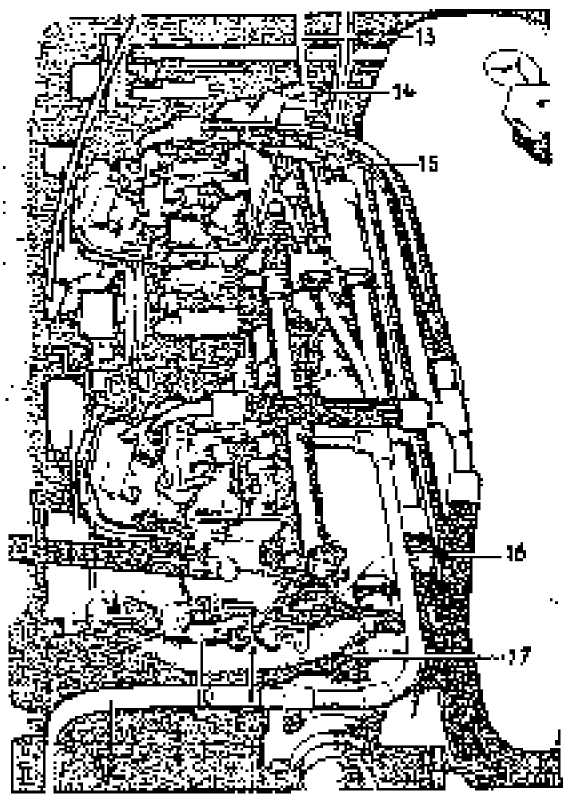


Fig. 20–6/3

1 Cold start control
2 Clamping screw for choke control sheath
3 Clamping screw for choke control
4 Return spring for carburetor linkage
5 Idle mixture adjusting screw of stage 2
6 Idle mixture adjusting screw of stage 1
7 Push rod for rear carburetor
8 Push rod for front carburetor
9 Idle adjustment screw
10 Throttle valve lever
11 Aperture limiting screw
12 Fuel overflow line
13 Hot start control
14 Clip for hot start control
15 Threaded union for vacuum connection of ATE power brake
16 Control shaft
17 Push rod from angle lever to control shaft

Removal:

1. Unscrew the choke control knob (7) and remove the felt ring (6) (see Fig. 30-6/1).

2. Use Hook Wrench 136 589 02 05 to unscrew the guide screw (5) of the choke control. Then push the choke control out of the mounting plate toward the front and remove it downward (see Fig 30-6/1).

3. Disconnect the two electric cables at the connections (4) on the choke control (see Fig. 30-6/1).

4. Loosen the two clamping screws (3) for the spring steel wire of the cold start control (1) from the choke valve levers on the two carburetors (see Fig. 30-6/3).

5. Loosen the clamping screw (2) for the coil spring at the fixing eye of the intake manifold and pull out the choke control (see Fig. 30-6/3).

6. Loosen the cheese-head tapping screw on the fixing clip for the cold and hot start controls on the front panel.

Installation:

7. Push the choke control cable through the rubber grommet in the front panel into the engine compartment.

8. Connect both electric cables to the connections (4) on the control and push the choke control from the front into the mounting plate (Fig. 30-6/1).

9. Screw the guide screw (5) into the choke control and tighten by means of Hook Wrench 136 589 02 05. Install the felt ring (6) and screw in the choke control knob (7) (see Fig. 30-6/1).

10. Insert the choke control into the fixing eye on the intake manifold and clamp the coil spring to the eye by means of the clamping screw (2) (see Fig. 30-6/3).

11. Insert the spring steel wire into the bore of the clamping screws (3) on the choke valve levers of the two carburetors (see Fig. 30-6/3).

12. Install the cheese-head tapping screw of the fixing clip for the choke control on the front panel. Then press the choke control together with the knob (7) toward the inside until there is a distance of approx. 2 mm between the control knob (7) and the guide screw (5) (see Fig 30-6/1).

14. Check the choke control and the choke valves for correct adjustment and ease of movement.

Note: With the ignition switched on and the choke control pulled out the pilot light should light up.

In the warm-up position (control knob pulled out half way) the start mixture is so lean that proper idling conditions are ensured.

On earlier cars the choke control cables were installed without warming-up position.

b) Hot Start Control

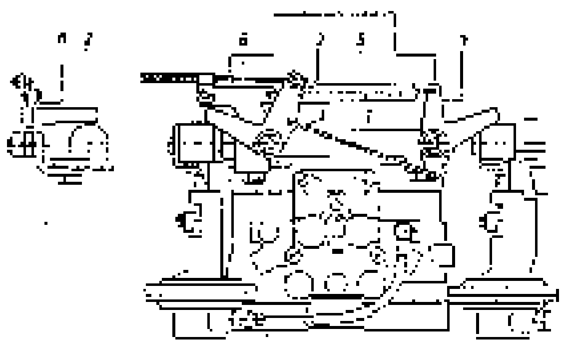


Fig. 30-6/4

1 Bearing bracket
2 Angle lever
3 Angle lever
4 Shackle
5 Return spring
6 Bowden cable and outer spring mounting on bearing bracket

Removal:

1. Unscrew the control knob (7) of the hot start control and remove the felt ring (6) (see Fig. 30-6/1).

2. Use Hook Wrench 136 589 02 05 to unscrew the guide screw (5) of the hot start control. Then remove the hot start control downward toward the front (see Fig. 30-6/1).

Note: The hot start control has no pilot light.

3. Loosen the clamping screw for the spring steel wire of the hot start control at the rear angle lever (2) of the hot start control (Fig. 30-6/4).

4. Loosen the coil spring of the hot start control at the bearing bracket and remove the hot start control.

5. Loosen the cheese-head tapping screw of the fixing clip for the cold and hot start control on the front panel and pull out the hot start control toward the inside through the front panel.

Installation:

6. Push the hot start control through the rubber grommet in the front panel into the engine compartment.

7. Install the hot start control from the front through the mounting plate.

8. Screw the guide screw (5) into the hot start control and tighten by means of Hook Wrench 136 589 02 05. Slide on the felt ring (6) and screw on the control knob (7) (see Fig. 30-6/1).

9. Attach the coil spring of the hot start control to the bearing bracket.

10. Insert the spring steel wire into the bore of the clamping screw on the rear angle lever (2) of the hot start control (Fig. 30-6/4).

11. Screw in the cheese-head tapping screw for the fixing clip of the cold and hot start control on the front panel.

12. Push the hot start control toward the inside by means of the control knob (7) until there is a distance of approx. 2 mm between the control knob (7) and the guide screw (5) (see Fig. 30-6/1).

13. Clamp the spring steel wire in position by means of the clamping screw.

14. Work the hot start control and check it for ease of movement.

Note: The hot start control can only be worked if the throttle valves of the carburetors are fully opened.

III. Model 219

The removal and installation procedures of the choke control on the mounting plate are the same as described for Model 190.

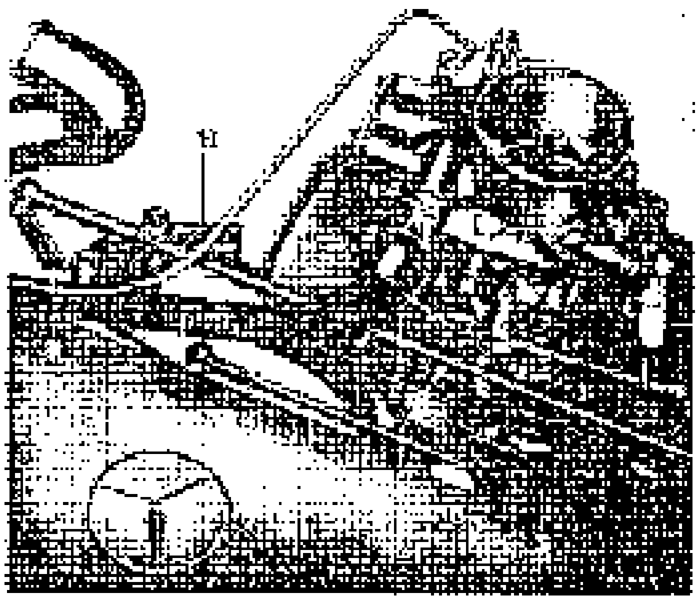


Fig. 30-6/5

1 Clamping screw for choke control
2 Choke control
3 Accelerator limiting screw
4 Idle adjustment screw
5 Return spring
6 Throttle valve lever
7 Pull rod
8 Idle mixture adjusting screw
9 Angle spring
10 Pull rod

To disconnect the choke control from the carburetor loosen the clamping screw (1) for the spring steel wire of the choke control at the angle lever and loosen the hexagon screw on the carburetor housing for the coil spring. Remove the choke control. When connecting the choke control make sure that the control knob has a distance of approx. 2 mm from the guide screw and that the starter rotary slide valve is completely closed.

IV. Models 220 a and 220 S

a) Removing and Attaching the Choke Control on the Model 220 a Carburetor

The procedures for detaching the choke control at the carburetor and for re-attaching it are the same as described for Model 219 (see Job No. 30-6, Section III).

b) Removing the Choke Control on the Model 220 S Carburetor

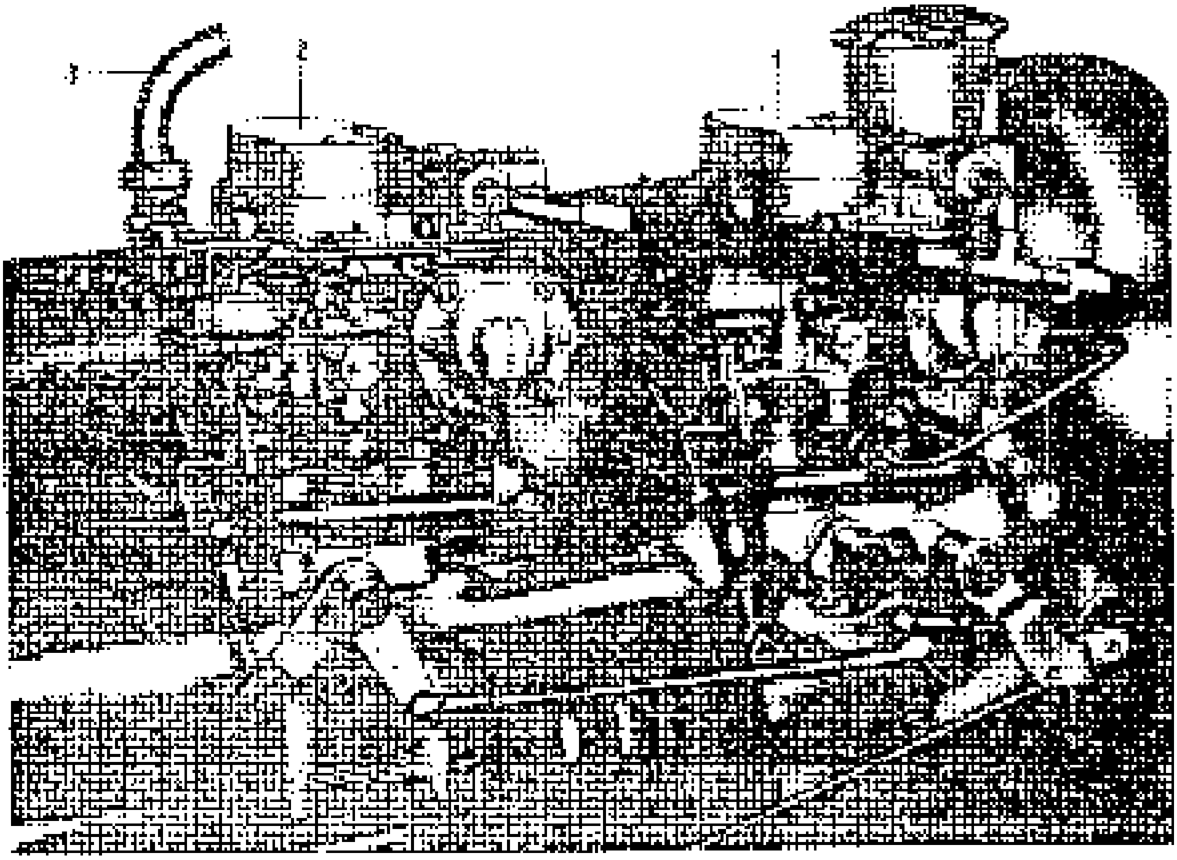


Fig. 30-6/6

1 Front carburetor
2 Rear carburetor
3 Vent tube
4 Pull rod
5 Relay lever
6 Push rod
7 Control lever
8 Stop bolt
9 Idle stop screw
10 Aperture limiting screw
11a, 11b Ball socket
12 Hexagon nut
13 Push rod
14 Angle lever
15 Spring-loaded push rod
16 Throttle valve lever
17 Return spring
18 Tension spring
19 Idle adjustment screw
20 Idle mixture adjusting screw
21 Vacuum line to distributor
22 Fuel line
23 Coil spring
24 Rubber bushing
25 Adjusting nut
26 Spring steel wire
27 Angle lever
28 Clamping screw
29 Rubber bushing
30 Hexagon nut
31 Connecting rod
32 Hexagon screw

1. Loosen the hexagon nut (30) of the clamping screw (28) for the spring steel wire (26) of the choke control at the angle lever (27) (Fig. 30-6/6).

2. Unscrew the clamp fastening the coil spring.

3. Back out the adjusting nut (25) and the two rubber bushings (24) of the coil spring (23) (see Fig. 30-6/6).

4. Loosen the cross-recess head screw for the fixing clip of the choke control and the flexible drive shaft of the speedometer at the cowl.

c) Removal of the Choke Control at the Mounting Plate on Models 220 a and 220 S

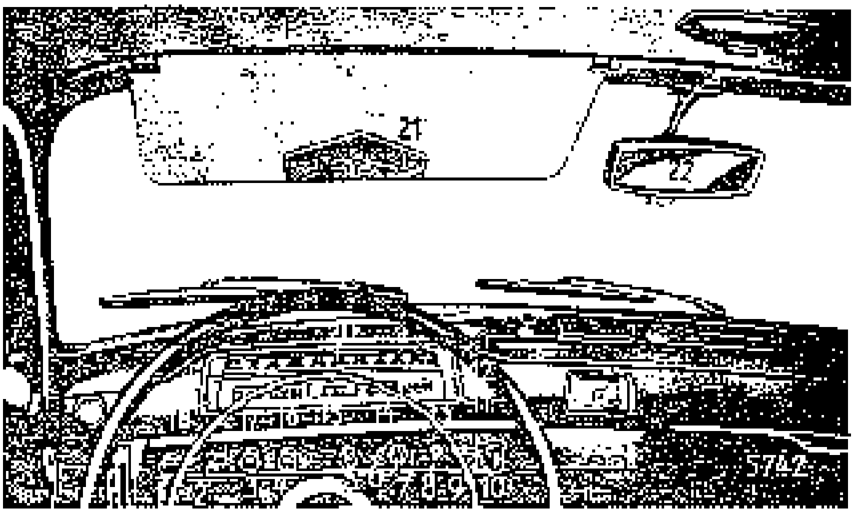


Fig. 30-6/7

1 Pull switch for roof light
2 Rotary light switch
3 Pull knob for instrument lighting
4 Pull knob for return mechanism of trip recorder
5 Pull knob for defrosting blower
6 Charging light
7 Steering lock
8 Starter knob
9 Choke control knob
10 Ignition control knob
11 Green pilot light for demisting blower
12 Red pilot light for flash direction signal
13 Fuel reserve indicator
14 Trip recorder
15 Cumulative mileage counter
16 Oil pressure gage
17 Cooling water thermometer
18 White starter pilot light
19 Blue upper beam pilot light
20 Speedometer

1. Use a short screw driver to push down the cable cover (cardboard) in the left glove compartment and remove it.

2. Unscrew the control knob on the pull switches (1, 3, 4, and 5) and remove the felt ring (Fig. 30-6/7).

3. Use Hook Wrench 136 589 02 05 to unscrew the guide screw of the pull switches (1, 3, 4, and 5) and of the rotary light switch (2) and remove the guide screw from the mounting plate toward the rear (Fig. 30-6/7).

4. Unscrew the control knob (9) for the choke control and remove the guide screw (Fig. 30-6/7).

5. Loosen the wing nuts of the two adjusting screws on the right side of the mounting plate at the lower part of the cowl and remove them together with the spring washers.

6. Carefully pull out the mounting plate about 10 cm, making sure that the rib of the mounting plate is not damaged.

7. Pull out the choke control and disconnect the two electric cables at the connections (4) on the choke control (see Fig. 30-6/1).

Installation of the Choke Control in the Mounting Plate on Models 220 a and 220 S:

8. Push the choke control through the rubber grommet in the front panel into the engine compartment and connect the two cables to the connections (4) (see Fig. 30-6/1).

9. Install the choke control in the mounting plate and screw on the guide screw and the control knob.

10. Install the mounting plate and tighten the wing nuts, making sure that the adjusting screws on the right side of the mounting plate are adjusted to the correct height.

11. Install the pull switch and the rotary light switch and install the cable cover in the left glove department.

Attaching the Choke Control to the Model 220 S Carburetor:

12. Slide the one rubber bushing (24) onto the coil spring (23). Then screw the adjusting nut (25) onto the coil spring and slide on the other rubber bushing (24) (see Fig. 30-6/6).
Insert the spring steel wire through the bore of the clamping screw (28) at the angle lever (see Fig. 30-6/6).

13. Fix the coil spring (26) or the two rubber bushings (24) to the carburetor (see Fig. 30-6/6).

14. Adjust the choke control so that there is a distance of approx. 2 mm between the control knob and the guide screw.

15. Tighten the hexagon nut (30) on the angle lever **making sure that the starter rotary slide valve on the carburetor is completely closed,** i.e. the angle lever (27) must rest against the front stop (see Fig. 30-6/6).

16. Check the choke control and the starter rotary slide valve for correct adjustment and ease of movement.

Note: When the choke control is pulled right out the pilot light must light up.

In the warm-up position (control knob pulled half-way out) the start mixture is so lean that proper idling conditions are ensured.

Removal and Installation of Ignition Control Knob (Octane Number Compensator) and Cable

Job No.
30-8

The ignition control knob (octane number compensator) is no longer installed. The igniton can only be adjusted at the distributor bearing (see Job No. 01-4, Section F).

I. Model 190 SL (1st Version only)

The removal and installation procedures for the cable are essentially the same as described for Model 190. However, the cable can only be removed and installed if the speedometer and revolution counter have been removed or installed first (see Job No. 54-11).

II. Model 219 (1st Version only)

The removal and installation procedures for the cable are the same as described for Model 190.

III. Models 220 a and 220 S (1st Version)

The ignition control knob can only be removed and installed when the mounting plate for the control knobs has been removed (for removal and installation of the mounting plate see Job No. 30-6, Section IV). Apart from that removal procedures are the same as described for Model 190.

Removal and Installation of Idle Adjustment Knob and Cable

Job No.
30-10

I. Models 180 D and 180 Db

Removal:

Loosen the cheese-head screw in the adjusting ring and remove the adjusting ring from the control cable at the throttle valve lever.
The other removal procedures are essentially the same as described for the removal of the ignition control knob and cable on Model 190.

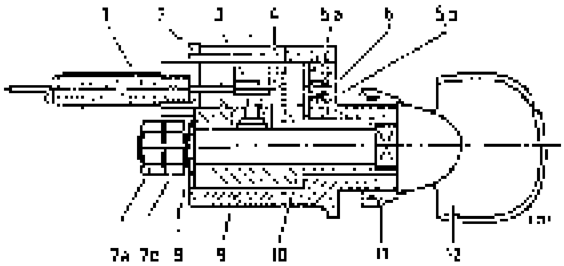


Fig. 30-10/1

1 Coil spring
2 Closing slide
3 Nipple with soldered-on cable
4 Guide
5a Detent ball for closing slide
5b Detent ball for adjusting sleeve
6 Pressure spring
7a Hexagon nut
7b Hexagon nut
8 Spring washer
9 Ignition control housing
10 Actuating sleeve
11 Escutcheon or fixing nut
12 Control knob

Installation:

Before clamping the control cable to the throttle valve lever, turn the knob to the right against the stop and then fasten the adjusting ring to the control cable in such a way that there is a distance of approx. 0.5 mm between the throttle valve lever and the adjusting ring.

II. Models 190 D and 190 Db

The removal and installation procedures for the control knob and cable are essentially the same as for Model 180 D with the difference that the idle adjustment control cable (3) is attached to the angle lever (4) instead of to the throttle valve lever of the venturi control unit. An adjusting screw has been installed on the bearing bracket of the angle lever on the cylinder head cover to make it easier to adjust the control cable accurately (Fig. 30-10/2).

Note: After installing the control cable make sure that the cable can move freely in the slot of the stop lever on the angle lever when the accelerator pedal is depressed.

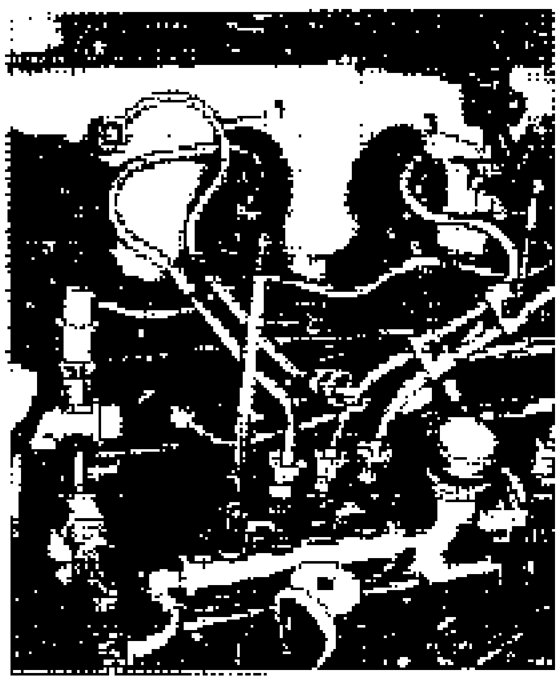


Fig. 30-10/2

1 Injection pipe
2 Glass capillary
3 Idle adjustment control cable
4 Angle lever
5 Connection rod to lever for additional mechanical adjustment

Removal and Installation of Control Cable from Heater Plug Starting Switch to Injection Pump

Job No.
30-11

I. Models 180 D and 180 Db

Removal:

1. Remove the front plate for the glow plug starting switch, the ashtray, and the guides of the ashtray.

2. Pull the cotter pin out of the control cable lever of the glow plug starting switch and remove the washer.

3. Unscrew the hexagon nut fastening the fixing clip of the wire coil to the bracket of the starter switch and remove the cable from the glow plug starting switch.

4. Press the fixing clips for the control cable out of the front panel cover.

5. Pull the cotter pin out of the lever on the injection pump, remove the washer and the control cable.

6. Unscrew the hexagon nut fastening the fixing clip of the wire coil to the stop bracket of the injection pump.

7. Pull the control cable out of the cowl toward the front.

Installation:

8. Push the control cable through the cowl from the front and attach the eye of the control cable to the lever of the glow plug starting switch, install the washer and lock it by means of a cotter pin.

9. Screw the fixing clip together with the wire coil to the bracket.

10. Install the front plate of the glow plug starting switch, the guides of the ashtray and the ashtray itself. Put the control lever in a horizontal position.

11. Attach the wire coil to the front panel cover by means of the clips.

12. Attach the slotted eye of the control cable to the lever of the injection pump.

13. Screw the wire coil with the fixing clip to the stop bracket in such a way that when the control lever is in the horizontal position there is a clearance of 0.5–1.0 mm between the bolt of the lever on the injection pump and the front part of the slotted eye.

Note: This clearance must be adjusted accurately in order to ensure that, when the engine is switched off, the control lever on the injection pump can be pulled far enough in the direction "stop" and, when the engine is started, it can be pulled far enough in the direction "voll" (full on).

14. Install the rubber grommet in the cowl.

II. Models 190 D and 190 Db

a) Removal and Installation:

Removal:

1. Detach the glow plug starting switch from the cowl and pull it slightly toward the front. Remove the cotter pin from the collar bolt and remove the collar bolt.

2. Unscrew the wire coil from the bracket of the glow plug starting switch.

3. Pull the cotter pin out of the lever of the injection pump and remove the dished washer and the control cable.

4. Unscrew the fixing clip on the stop bracket and remove the wire coil.

5. Pull the control cable through the cowl toward the front.

Installation:

6. Check the elastic-metal buffers between the injection pump and the stop bracket to find out if they are still serviceable.

7. Push the control cable together with the wire coil through the cowl and attach the wire coil to the bracket and the control cable to the glow plug starting switch.

8. Install the glow plug starting switch and put it in the position „Fahrt" (driving position)

9. Attach the eye of the control cable to the lever on the injection pump, install the dished washer and secure by means of a cotter pin.

Note: The rubber strap of the end piece should have some lateral play between the lever on the injection pump and the dished washer in order to prevent jamming of the control cable.

10. Use the fixing clip to attach the wire coil to the stop bracket of the injection pump in such a way that there is a clearance of 1.0–1.5 mm between the bolt of the injection pump lever and the top stop of the slotted hole.

Note: This clearance must be adjusted accurately in order to ensure that when the engine is switched off the control lever can be pulled far enough in the direction "stop" and when the engine is started it can be pulled far enough in the direction "voll" (full on).

b) Subsequent Installation of Rubber-Mounted Control Cable for Glow Plug Starting Switch

1. Replace the control cable (2) for the glow plug starting switch.

2. Replace the stop bracket on the injection pump by the stop bracket (1) with three elastic-metal buffers (4). Correct positioning of the stop bracket can be ensured if necessary by installing a washer between the spotfaced holes in the injection pump housing and the stop bracket.

3. Install a longer bolt (6) to take the rubber-insulated end piece (7) of the control cable; this bolt is located on the start and stop lever (8) of the injection pump. To do this remove the lever and remove the riveted bolt. Install the new screw bolt together with a nut and lock washer. When installing the lever make sure that there is a sufficient distance between the injection pump housing and the fixing nut of the bolt.

4. Attach the control cable, using fixing clip, screw and nut of the old stop bracket.

   Attach the cable to the clip so as to leave a clearance of 1.0–1.5 mm between the bolt of the adjusting lever and the top stop of the end piece of the control cable. Install a dished washer (5) Part No. 621 990 00 40 between the rubber strap (7) of the end piece of the control cable and the cotter pin.

Note: Do not install a spring washer since such a washer would increase the tension so much that the cable might jam on the lever. The rubber strap (7) of the end piece should in fact have some lateral play between the lever (8) and the dished washer (5) in order to prevent jamming in any case (Fig. 30-11/1).

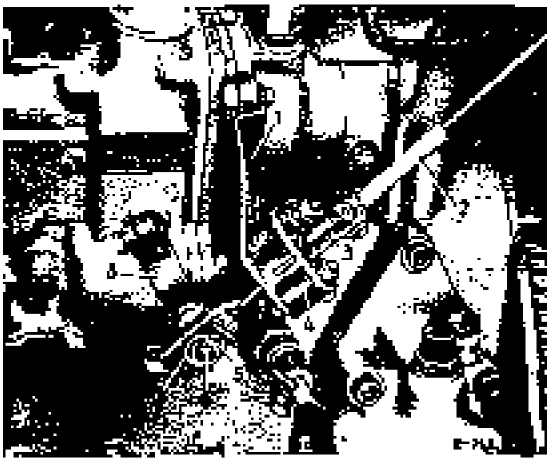


Fig. 30-11/1

1 Stop bracket
2 Control cable
3 Fixing angle
4 Elastic [illegible]
5 Washer
6 Bolt

Fig. 30-11/2

7 Rubber strap
8 Start and stop lever
9 Support
10 Threaded union
11 Drain valve
12 Ball-shaped [illegible]

Springs and Shock Absorbers

3

Springs and Shock Absorbers Group 32

Springs

Job No.
32-0

A. General

Tolerances are unavoidable in the manufacture of springs. However, in order to obtain properly balanced springing, the manufacturer can allow for the tolerances by varying the spring length (trim dimension). To indicate the various lengths, springs are supplied with a color code marking on the bottom coil. Color marks in the middle of the spring are check marks and do not refer to their length.

The part numbers of the springs are stamped on the bottom coil.

B. Front Springs

The different lengths of the front springs (trim dimensions) are indicated by the following colors:

white — short springs

red = medium springs

blue — long springs

Since differences in the trim dimensions of the two springs on the front axle are not compensated, only springs with the same color coding should be installed on both sides.

C. Rear Springs

In contrast to the color coding system used on the front springs the color coding of the rear springs is further subdivided by lines which provides the following system:

white 1 line	red 1 line	blue 1 line
white 2 lines	red 2 lines	blue 2 lines
white 3 lines		blue 3 lines

In this coding system white 1 line represents the shortest spring and blue 3 lines represents the longest spring. The maximum difference between the shortest and the longest springs is 16 mm, the difference between the individual grades is 2 mm. The left and right rear springs differ in the case of cars with single-jointed rear axle. Left and right springs are identified by the Part No. which is stamped on the bottom coil as follows:

L = left spring

R = right spring

Adjustment of Rear Springs

To maintain the prescribed rear-wheel camber (see Job No. 40–3) allowance must be made for the variation in trim dimension of the rear springs by changing the notch position of the spring plate and installing or removing the compensating rubber ring.

The adjustment of the rear springs varies on the individual models according to the type of rear springs and associated shock absorbers installed (see also Job No. 32–7).

The survey table on the following page shows which individual table applies for the adjustment of the rear springs.

Note: When **reinforced rear springs** are installed on Models 180 to 220 SE, it may happen that when the springs are adjusted in accordance with table 1 the rear-wheel camber does **not** correspond to the prescribed values. If this should be the case, the rear-wheel camber must be adjusted to the prescribed values by changing the notch position of the spring plates and if necessary also by removing or installing a rubber compensating ring (see Job No. 40–3).

Spring and Shock Absorber Survey

Date: Dec. 12, 1959

Bold numbers = present version

Explanation of numbers and signs: 1 = Table 1; 2 = Table 2; 1* = Table 3;
x = On the particular model, this combination of springs and shock absorber is not possible

Model	Shock absorber make	Part No. of Rear Springs: 120 324 11 04 (only with twin-jointed rear axle)	120 324 15 04 (only with twin-jointed rear axle)	121 324 20 04/21 04 (for Models 180 and 180 D only with single-jointed rear axle)	128 324 18 04/19 04	105 324 06 04/07 04 (for Models 180 and 180 D only with single-jointed rear axle)	180 324 15 04/15 04	180 324 28 04/29 04	120 324 17 04 (only with twin-jointed rear axle)	120 324 23 04 (only with twin-jointed rear axle)	121 324 22 04/23 04 (for Models 180 and 180 D only with single-jointed rear axle)	180 324 26 04/27 04 (for Models 180 and 180 D only with single-jointed rear axle)	180 324 23 04/24 04	120 324 21 04 (only with twin-jointed rear axle)	121 324 15 04/13 04 (for Models 180 and 180 D only with single-jointed rear axle)	120 324 22 04 (only with twin-jointed rear axle)	120 324 20 04 (only with twin-jointed rear axle)	121 324 24 04 (for Models 180 and 180 D only with single-jointed rear axle)
180, 180 D	Fichtel & Sachs	1	1	1	x	1	x	x	1	1	1	1	x	1	1	1	1	1
	Stabilus	x	x	1	x	1	x	x	1	1	1	1	x	1	x	1	1	x
190	Fichtel & Sachs	x	x	1	x	1	x	x	x	x	1	1	x	x	1	x	x	1
	Stabilus	x	x	1	x	1	x	x	x	x	1	1	x	x	x	x	x	x
180 a, 180 b, 180 Db 190 b, 190 D, 190 Db	Fichtel & Sachs	x	x	x	x	x	x	x	x	x	x	x	x	x	1	x	x	1
	Stabilus	x	x	x	x	1	x	x	x	x	x	1*	x	x	x	x	x	x
190 SL	Fichtel & Sachs	x	x	x	1	x	x	x	x	x	x	x	x	x	x	x	x	x
219	Stabilus	x	x	x	x	1	x	x	x	x	1	1	1	x	1	x	x	x
	Bilstein	x	x	x	x	2	x	x	x	x	x	1	1	x	x	x	x	x
220 a, 220 S 220 SE, 220 S Cabr. and Coupé 220 SE Cabr. and Coupé	Fichtel & Sachs	x	x	x	x	x	1	1	x	x	x	1	1	x	x	x	x	x
	Stabilus	x	x	x	x	x	1	1	x	x	x	x	1	x	1	x	x	x
	Bilstein	x	x	x	x	1	2	2	x	x	x	1	1	x	x	x	x	x

* For Models 180 Db rear axle TABLE 3 applies.

Rear Spring Adjustment Tables

Table 1

Color code of rear springs		Notch position of the spring plate	Compensating rubber ring
white	1 line	4	yes
white	2 lines	3	yes
white	3 lines	2	yes
red	1 line	1	yes
red	2 lines	4	no
blue	1 line	3	no
blue	2 lines	2	no
blue	3 lines	1	no

Table 2

Color code of rear springs		Notch position of the spring plate	Compensating rubber ring
white	1 line	2	yes
white	2 lines	1	yes
white	3 lines	4	no
red	1 line	3	no
red	2 lines	2	no
blue	1 line	1	no
blue	2 lines	Springs cannot be used	
blue	3 lines	Springs cannot be used	

Table 3

Color code of rear springs		Notch position of the spring plate	Compensating rubber ring
white	1 line	4	no
white	2 lines	3	no
white	3 lines	2	no
red	1 line	1	no
red	2 lines	Springs cannot be used	
blue	1 line	Springs cannot be used	
blue	2 lines	Springs cannot be used	
blue	3 lines	Springs cannot be used	

D. Checking of Springs

On Models 180 to 220 SE the springs are checked in the same way as described for Model 190 (for test values see Job No. 32-7).

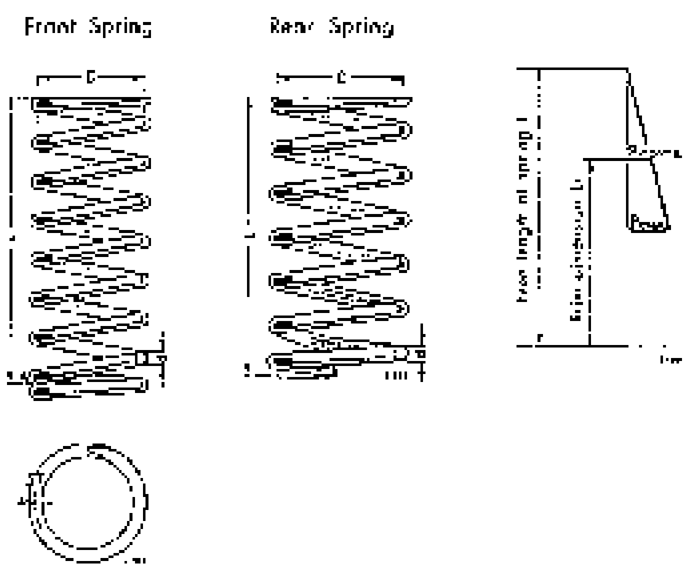


Fig. 32-0/[illegible]

L Free length of spring
L1 Spring length i.e. the dimension under normal load
Pmax Spring load, maximum
d Wire gage
D Mean coil diameter
A Bottom measuring point for front springs

E. Additional Rubber Buffers for Rear Axle

On Models 180 to 220 SE various versions have recently been installed of the additional rubber buffers screwed to the chassis base panel (see Table).

Rubber Buffers for Rear Spring

Rubber buffers Part No.	Application
180 320 01 44	For standard rear springs
180 320 00 44	For harder rear springs for normal roads, bad roads, and export rear springs as well as for police radio cars
120 320 04 44	For harder rear springs for special-purpose vehicles such as ambulances and light trucks, etc.

Note: Since harder rear springs cannot be installed on Model 190 SL, only the first two columns in the above table apply.

When harder rear springs are installed subsequently, make sure that they are matched by the appropriate rubber buffers.

When repairs are carried out on cars with standard rear springs, only soft rubber buffers Part No. 180 320 01 44 should be installed. The rubber buffers carry the Part No. on the side.

If the rubber buffers are to be replaced with the rear springs installed in the vehicle, use an 11 mm socket with ratchet of the ½" "Hazet"-Set 000 589 53 07.

Shock Absorbers

Job No.
32-1

A. General

The adjustment of the shock absorbers always closely corresponds to the type of spring installed. When installing the springs make sure that the shock absorbers match the springs.

The various types of shock absorbers can easily be distinguished by the make and the DB Part No. marked on the shock absorber housing. Furthermore the front shock absorbers are painted black and the rear shock absorbers are painted red.

B. Checking of Shock Absorbers

Shock absorbers can only be checked satisfactorily on a test stand. Checking the shock absorber by hand is very inaccurate and makes it impossible to assess the condition and necessary adjustment of the shock absorber correctly.

The test values for shock absorbers are listed in Job No. 32–7, Sections G and H.

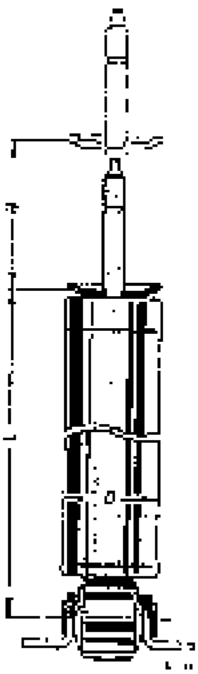


Fig. 32–1/1

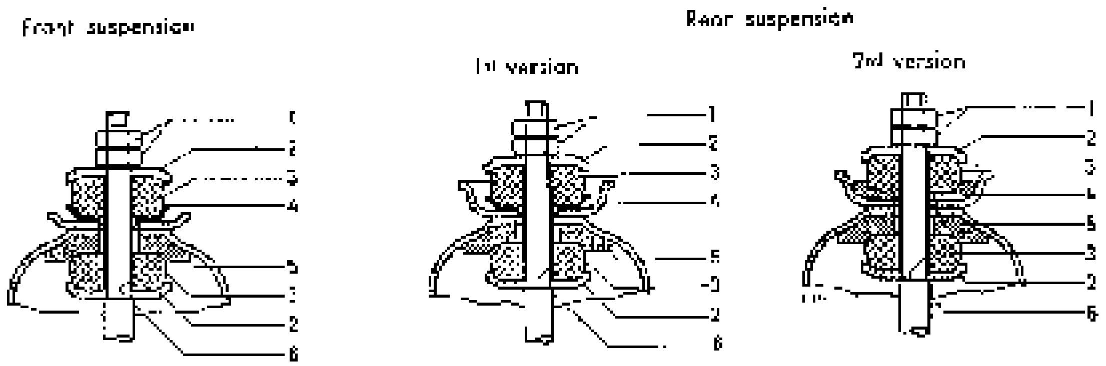
H = Stroke
L = Length compressed
D = External diameter

C. Bilstein Shock Absorbers

On Model 220 SE and Model 220 S as from chassis end No. 85 09110 and from chassis end No. 75 10452 to 75 11075 rear Bilstein shock absorbers were installed as standard parts. The front shock absorbers are F. & S., Tov 36 × 130, Part No. 180 323 00 00. However, a number of cars were also provided with Bilstein front shock absorbers.

a) Suspension of Bilstein Shock Absorbers

The suspension of the Bilstein shock absorbers differs from that of the F. & S. and the Stabilus shock absorbers (Figs. 32–1/2 and 32–1/3).



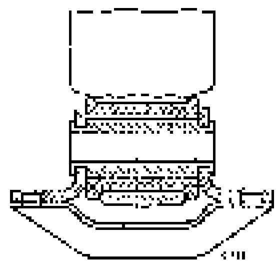


Fig. 32–1/2

1 Hexagon nut
2 Cup
3 Rubber ring
4 Cup
5 Rubber cup
6 Spacer sleeve

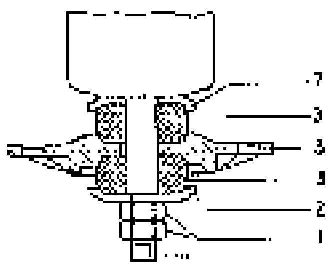


Fig. 32–1/3

1 Hexagon nut
2 Cup
3 Rubber ring
4 Cup
5 Rubber cup
6 Spacer sleeve
7 Cup
8 Adaptor

Note: Models 220 SE and 220 S as from chassis end No. 85 10200 have the 2nd version rear shock absorber suspension. The 2nd version differs from the 1st version in that the sheet metal cup (4) has been replaced by a rubber cup Part No. 000 323 11 52 in order to prevent suspension noises.

b) Installation Hints for Bilstein Shock Absorbers

Close attention should be paid to the following points when installing Bilstein shock absorbers.

1. Before installing the shock absorber check whether the top and bottom suspension points on the vehicle are satisfactory and free from burrs, welding projections, deformation, and foreign bodies.

2. Check the surface of the shock absorber piston rod for damage; damaged piston rods cut into the seal and thus make the shock absorber unserviceable. For the same reason the shock absorbers should be treated with the utmost care during installation.

3. The cup (4) of the 1st version rear shock absorber suspension must lie flat and must be centered in the cup on the chassis base panel to prevent rattling. The hexagon nuts (1) should be tightened firmly. The spacer sleeve (5) and the shoulder of the piston rod (bottom) prevent excessive initial stress of the rubber buffers (see Figs. 32–1/2 and 32–1/3).

4. After installation check whether the shock absorbers work properly.

c) Subsequent Installation of Bilstein Shock Absorbers

As a result of the initial stress of Bilstein shock absorbers the rear-wheel camber is changed by approx. plus 0° 30'; before Bilstein shock absorbers are installed, the rear-wheel camber should therefore be changed by minus 0° 30' (see also Job No. 32–0, Section C).

d) Checking of Bilstein Shock Absorbers

1. When complaints are received about noise or changes in the riding qualities of the car, check the shock absorbers and their suspension. Rattling noises can usually be traced to the shock absorber suspension. Make sure that the initial stress of the rubber buffers is correct and that all suspension parts are installed properly.

2. If rumbling noises can be heard with the car stationary, when getting into the car or at slow speed, the piston rods are running dry and should be given an extra coat of oil.

3. To check the shock absorbers themselves remove them from the vehicle and depress the piston rod by hand. If a hissing or clicking noise can be heard during the final leg of the power stroke before the piston rod comes to rest against the bottom stop, the shock absorber should be replaced.

   When the shock absorber has been depressed by hand and the piston rod does not extrude when the pressure is released, the shock absorber does not work properly and is no longer serviceable.

4. If Bilstein shock absorbers lose oil, check the oil reserve. To do this depress the piston rod as far as the stop and measure the remaining length as far as the shoulder at the piston rod (Fig. 32–1/4). When this test is being made, the temperature of the shock absorber should be approx. +15 to +20° C.

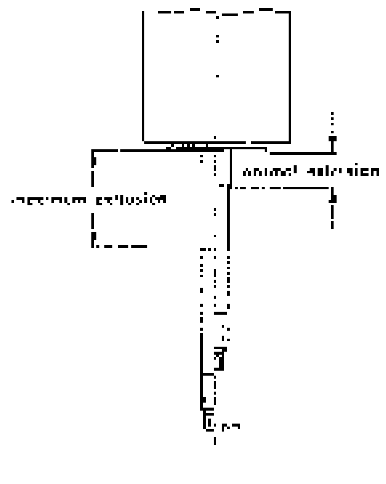


Fig. 32 1/4

The stop position of the piston rod and the position of the intermediate piston between gas pad and oil depends on the amount of oil in the shock absorber.

When oil has been lost the gas pressure forces the intermediate piston outward and increases the piston rod extrusion. If the maximum extrusion of the piston rod is exceeded, the shock absorber will become unserviceable.

The piston rod extrusion values are listed in the table below.

	Front shock absorber	Rear shock absorber
Type designation	Bilstein Type 062	Bilstein Type 063
Part No.	180 323 05 00	180 326 04 00
Normal extrusion of piston rod in mm	12 ± 1	15 ± 1
Maximum extrusion of piston rod in mm	33	37

Note: Shock absorbers with excessive piston rod extrusion are noisy (see Para 3) and should be replaced

5. Light oil desposits on the shock absorber or on the lower suspension parts do not necessarily indicate that the shock absorber is unserviceable. Always check the oil reserve

6. If these checking methods prove unsatisfactory the shock absorber should be checked on a tester.

7. Bilstein shock absorbers cannot be repaired with the tools and equipment available in garages and repair shops

Because of the over-pressure obtaining in Bilstein shock absorbers, they must never be opened.

Removal and Installation of Front Shock Absorbers

Job No.
32–2

The removal and installation procedures for the front Fichtel & Sachs and Stabilus shock absorbers on Models 180 to 220 SE are the same as on Model 190.

When removing or installing Bilstein shock absorbers, please note the additional instructions given in Job No. 32–1.

Removal and Installation of Rear Shock Absorbers

Job No.
32–3

The removal and installation procedures for the rear Fichtel & Sachs and Stabilus shock absorbers on Models 180 to 220 SE are the same as on Model 190.

When removing or installing Bilstein shock absorbers, please note the additional instructions given in Job No. 32-1.

Removal and Installation of Front Springs

Job No.
32–4

The removal and installation procedures for the front springs on Models 180 to 220 SE are the same as on Model 190.

Removal and Installation of Rear Springs

Job No.
32–5

The removal and installation procedures for the rear springs on Models 180 to 220 SE are the same as on Model 190.

When installing rear springs together with Bilstein shock absorbers, please note the instructions given in Job No. 32–0, Section C.

Removal and Installation of Torsion Bar

Job No.
32–6

The removal and installation procedures for the torsion bar on Models 180 to 220 SE are the same as on Model 190 with the difference, however, that on Model 190 SL the attachment of the torsion bar to the chassis base panel differs from that used on the other models (Fig. 32–6/1).

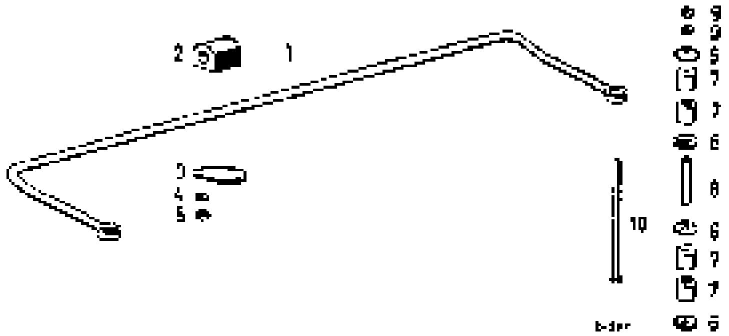


Fig. 32–6/1

1 Torsion bar
2 Rubber mounting
3 Link
4 Lock washer
5 Hexagon nut
6 Cup washer
7 Rubber buffer
8 Spacer sleeve
9 Hexagon nut
10 Hexagon screw

Different torsion bars have been installed on the individual models (see Table).

List of Torsion Bars

Model	Torsion bar		Remarks
	Part No.	Diameter	
180, 180 D	120 321 05 07	19 mm	On Model 180 D 1st Version
180 a, 180 b, 180 D, 180 Db, 190, 190 b, 190 D, 190 Db	121 321 00 07	19 mm	On Model 180 D 2nd Version
190 SL	121 323 02 07	20 mm	
220 a	180 321 06 06	20 mm	1st Version
220 a, 219, 220 S, 220 SE	180 321 07 07	20 mm	On Model 220 a 2nd Version On Model 220 SE 1st Version
220 SE	180 321 08 07	22 mm	2nd Version

Tables on Springs and Shock Absorbers

A. Front Springs and Associated Front Shock Absorbers

Model	Front spring Part No.	Remarks	Associated shock absorbers Part No. Designation
Standard Front Springs			
180, 180 a, 180 b, 190, 190 b	120 321 14 04		To fit control arms with a 48 mm ⌀ through bore: 121 323 00 00 F. & S. Sav 26 x 130; 121 323 01 00 Stabilus T 40 x 130
180 D, 180 Db	120 321 15 04		To fit control arms with a 58 mm ⌀ through bore: 190 323 00 00 F. & S. Sav 26 x 130
190 D, 190 Db	121 321 06 04		120 323 00 00 F. & S. Sav 26 x 130
190 SL	121 321 04 04		121 323 02 00 F. & S. Tov 36 x 130
219	180 321 10 04		180 323 00 00 F. & S. Tov 36 x 130; 180 323 02 00 Stabilus T 40 x 130
220 a, 220 S	180 321 07 04	On Model 220 S 1st Version	180 323 00 00 F. & S. Tov 36 x 130; 180 323 02 00 Stabilus T 40 x 130; 180 323 05 00 Bilstein Type 052
220 S	180 321 15 04	2nd Version	
220 S — Convertible and Coupé	180 321 14 04	1st Version	
	180 321 13 04	2nd Version	
	180 321 16 04	3rd Version	
220 SE	180 321 15 04		
220 SE — Convertible and Coupé	180 321 18 04		

Harder Front Springs for Normal Road Conditions

Model	Front spring Part No.	Remarks	Associated shock absorbers Part No. Designation
180, 190	120 321 16 04	1st Version	To fit control arms with a 48 mm ⌀ through bore: 121 323 00 00 F. & S. Sav 26 x 130; 121 323 01 00 Stabilus T 40 x 130. To fit control arms with a 58 mm ⌀ through bore: 120 323 00 00 F. & S. Sav 26 x 130
180, 190	120 321 19 04	2nd Version	
180 D	120 321 17 04	1st Version	
180 D	120 321 20 04	2nd Version	
180 a, 180 b, 190 b	120 321 19 04		120 323 00 00 F. & S. Sav 26 x 130
180 Db, 190 D, 190 Db	120 321 20 04		
219	180 321 09 04	1st Version	180 323 00 00 F. & S. Tav 36 x 130; 180 323 02 00 Stabilus T 40 x 130
219	180 321 12 04	2nd Version	
220 a, 220 S, 220 S — Convert. and Coupé	180 321 16 04	On Models 220 S, 220 S — Convertible and Coupé 1st Version	180 323 00 00 F. & S. Tav 36 x 130; 180 323 02 00 Stabilus T 40 x 130; 180 323 05 00 Bilstein Type 062
220 S, 220 S — Convert. and Coupé 220 SE, 220 SE — Convert. and Coupé	180 321 17 04	On Models 220 S, 220 S — Convertible and Coupé 2nd Version	

Harder Front Springs for Bad Road Conditions and Export Front Springs

Model	Front spring Part No.	Remarks	Associated shock absorbers Part No. Designation
180, 190	120 321 15 04	1st Version	180 323 03 00 Stabilus T 50 x 130/5 In the case of cars with control arms with a 48 mm ⌀ through bore new control arms with a 38 mm ⌀ through bore should be installed
	120 321 19 04	2nd Version	
180 D	120 321 17 04	1st Version	
	120 321 20 04	2nd Version	
190 a, 180 b, 190 b	120 321 19 04		180 323 23 00 Stabilus T 50 x 130/5
180 Dh, 190 D, 190 Db	120 321 20 04		
219	180 321 09 04	1st Version	
	180 321 12 04	2nd Version	
220 a, 220 S 220 S — Convert. and Coupe	180 321 15 04	On Models 220 S 220 S — Convertible and Coupé 1st Version	
220 S, 220 S — Convert. and Coupe 220 SE, 220 SE — Convert. and Coupe	180 321 17 04	On Models 220 S 220 S — Convertible and Coupé 2nd Version	

Harder Front Springs for Police Radio Cars

Model	Front Spring Part No.	Remarks	Associated shock absorbers Part No. Designation
180, 190	120 321 16 04	1st Version	To fit control arms with a 48 mm ⌀ through bores: 121 323 00 00 F. & S. Sav 26 x 130; 121 323 01 00 Stabilus T 40 x 130
	120 321 19 04	2nd Version	
180 D	120 321 17 04	1st Version	To fit control arms with a 58 mm ⌀ through bore: 120 323 00 00 F. & S. Sav 26 x 130
	120 321 20 04	2nd Version	
180 a, 180 b, 190 b	120 321 19 04		120 323 00 00 F. & S. Sav. 26 x 130
180 Db, 190 D, 190 Db	120 321 20 04		
219	180 321 09 04	1st Version	180 323 00 00 F. & S. Tav 36 x 130
	180 321 12 04	2nd Version	
220 a, 220 S	180 321 16 04	On Model 220 S 1st Version	180 323 00 00 F. & S. Tav 36 x 130
220 S, 220 SE	180 321 17 04	On Model 220 S 2nd Version	

Harder Front Springs for Special-Purpose Vehicles

Model	Front Spring Part No.	Remarks	Associated shock absorbers Part No. Designation
180, 190	120 321 16 04	1st Version	To fit control arms with a 48 mm ⌀ through bore: 121 323 00 00 F. & S. Sav 26 x 130; 121 323 01 00 Stabilus T 40 x 130
	120 321 15 04	2nd Version	
180 D	120 321 17 04	1st Version	To fit control arms with a 58 mm ⌀ through bore: 120 323 00 00 F. & S. Sav 26 x 130
	120 321 20 04	2nd Version	
180 a, 180 b, 190 b	120 321 19 04		120 323 00 00 F. & S. Sav 26 x 130
180 Db, 190 D, 190 Db	120 321 20 04		

Harder Front Springs for the Needs of Sports Enthusiasts

Model	Front spring Part No.	Remarks	Associated shock absorbers Part No. Designation
190 SL	121 321 05 04		121 323 23 00 F. & S. Tov 36 x 130
219, 220 a 220 S	180 321 09 04	1st Version	180 323 31 00 F. & S. Tov 36 x 130
	180 321 12 04	2nd Version	
220 SE 220 S — Convert. and Coupé 220 SE — Convert. and Coupe	180 321 12 04		

6. Rear Springs and Associated Rear Shock Absorbers

Model	[illegible]	Rear spring Part No.	Load capacity (maximum load) axle load kp	Remarks	Associated shock absorbers Part No. Designation
Standard Rear Springs					
180, 180 D	L	120 324 17 04	880	For cars with twin-jointed rear axle 1st Version	000 326 55 00 F. & S. Sev 25 x 130
	R				
	L	120 324 15 04		For cars with twin-jointed rear axle 2nd Version	
	R				
180, 180 D	L	121 324 20 04	880	For Model 180 D with single-jointed rear axle 1st Version	121 326 00 00 F. & S. Tov 30 x 140 (1st Version)
	R	121 324 21 04			
180 D	L	105 324 00 04	900	For Model 180 D with single-jointed rear axle 2nd Version	
	R	105 324 01 04			
190	L	121 324 20 04	880	1st Version	121 326 01 00 Stabilus T 40 x 140 (2nd Version)
	R	121 324 21 04			
	L	105 324 00 04	900	2nd Version	
	R	105 324 01 04			
180 c, 180 a, 180 Db, 190 b, 190 D, 190 Db	L	105 324 00 04	900		121 326 01 00 Stabilus T 40 x 140
	R	105 324 01 04			
190 SL	L	121 324 18 04	700		121 326 02 00 F. & S. Tov 36 x 130
	R	121 324 19 04			
219	L	105 324 00 04	900		121 326 01 00 Stabilus T 40 x 140 180 326 04 00 Bilstein Type 053
	R	105 324 01 04			

Model	Left "L" right "R"	Rear spring Part No.	Load capacity (maximum per axle load), kg	Remarks	Associated shock absorbers Part No. Designation
220 a, 220 S	L	180 324 15 04	940	1st Version	180 326 00 00 F. & S. Tov 36 x 140 121 326 01 00 Stabilus T 40 x 140 180 326 04 00 Bilstein Type 063 (In case of repairs only Bilstein Shock-Absorbers must be installed.)
	R	180 324 16 04			
	L	105 324 00 04		2nd Version (only in connection with Bilstein Shock Absorbers)	
	R	105 324 01 04			
220 S Convertible and Coupé	L	180 324 28 04	925	1st Version	
	R	180 324 27 04			
	L	180 324 15 04	940	2nd Version	
	R	180 324 16 04			
	L	105 324 00 04		3rd Version (only in connection with Bilstein Shock Absorbers)	
	R	105 324 01 04			
220 SE Convertible and Coupé	L	105 324 00 04	940		180 326 04 00 Bilstein Type 063
	R	105 324 01 04			

Harder Rear Springs for Normal Road Conditions

Model	left "L" right "R"	Rear spring Part No.	Load capacity (maximum rear axle load in kg)	Remarks	Associated shock absorbers Part No. Designation
180, 180 D	L R	120 324 17 04	880	For cars with twin-jointed rear axle 1st Version	000 326 55 00 F. & S. Sov 26 x 130
	L R	120 324 23 04		For cars with twin-jointed rear axle 2nd Version	
180, 180 D	L	121 324 22 04	940	For cars with single-jointed rear axle 1st Version	121 326 00 00 F. & S. Tov 30 x 140 (1st Version) 121 325 01 00 Stabilus T 40 x 140 (2nd Version)
	R	121 324 23 04			
	L	180 324 26 04		For cars with single-jointed rear axle 2nd Version	
	R	180 324 27 04			
190	L	121 324 22 04	940	1st Version	
	R	121 324 23 04			
	L	180 324 26 04		2nd Version	
	R	180 324 27 04			
180 a, 180 b, 180 Db, 190 b, 190 D, 190 Db	L	180 324 26 04	940		121 326 01 00 Stabilus T 40 x 140
	R	180 324 27 04			
219	L	121 324 22 04	940	1st Version	121 326 01 00 Stabilus T 40 x 140 180 326 04 00 Bilstein Type 063
	R	121 324 23 04			
	L	180 324 26 04	940	2nd Version	
	R	180 324 27 04			
220 a, 220 S, 220 S Convertible and Coupé	L	180 324 23 04	940	1st Version	180 326 00 00 F. & S. Tov 36 x 140 121 326 01 00 Stabilus T 40 x 140 180 326 04 00 Bilstein Type 063
	R	180 324 24 04			
220 a, 220 S, 220 S Convertible and Coupé	L	180 324 26 04	940	2nd Version	
	R	180 324 27 04			
220 SE, 220 SE Convertible and Coupé	L	180 324 26 04	940		180 326 04 00 Bilstein Type 063
	R	180 324 27 04			

Harder Rear Springs for Bad Road Conditions

Model	Left "L" right "R"	Rear spring Part No.	Load capacity (maximum rear axle load) kg	Remarks	Associated shock absorbers Part No. Designation
180, 180 D	L R	120 324 17 04	880	For cars with twin-jointed rear axle 1st Version	120 320 08 31 F. & S. Tov 30 x 120
	L R	120 324 23 04		For cars with twin-jointed rear axle 2nd Version	120 320 11 31 Stabilus T 40 x 120
180, 180 D	L	121 324 22 04	940	For cars with single-jointed rear axle 1st Version	180 326 02 00 Stabilus T 50 x 100/5
	R	121 324 23 04			
	L	180 324 26 04		For cars with single-jointed rear axle 2nd Version	
	R	180 324 27 04			
190	L	121 324 22 04	940	1st Version	
	R	121 324 23 04			
	L	180 324 26 04		2nd Version	
	R	180 324 27 04			
180 a, 180 b, 180 Db 190 b, 190 D, 190 Db	L	180 324 26 04	940		
	R	180 324 27 04			
219	L	121 324 22 04	940	1st Version	
	R	121 324 23 04			
	L	180 324 26 04		2nd Version	
	R	180 324 27 04			
220 a, 220 S, 220 S Convertible and Coupé	L	180 324 23 04	940	1st Version	
	R	180 324 24 04			
220 a, 220 S, 220 S Convertible and Coupé 220 SE, 220 SE Convertible and Coupé	L	180 324 26 04	940	On Models 220 a, 220 S, and 220 S Convertible and Coupé 2nd Version	
	R	180 324 27 04			

Harder Rear Springs for Police Radio Cars

Model	left L / right R	Rear spring Part No.	Load capacity (maximum axle load) kp	Remarks	Associated shock absorbers Part No. Designation
180, 180 D	L	120 324 17 04	880	On cars with twin-jointed rear axle 1st Version	120 320 08 31 F. & S. Tov 30 x 120; 120 320 11 31 Stabilus T 40 x 120
	R				
	L	120 324 23 04		On cars with twin-jointed rear axle 2nd Version	
	R				
	L	120 324 21 04	1000	On cars with twin-jointed rear axle 3rd Version	
	R				
180, 180 D, 180 a, 180 b, 180 Db, 190, 190 b, 190 D, 190 Db	L	121 324 12 04	1100	On Models 180 and 180 D only for cars with single-jointed rear axle	121 326 03 00 F. & S. Tov 36 x 130
	R	121 324 13 04			
219, 220 a, 220 S, 220 SE	L	180 324 23 04	940	1st Version	180 326 02 00 Stabilus T 50 x 130/6
	R	180 324 24 04			
	L	180 324 26 04	940	2nd Version	
	R	180 324 27 04			
	L	121 324 12 04	1100	3rd Version	
	R	121 324 13 04			

Harder Rear Springs for Special-Purpose Vehicles

Model	left hand / right hand	Rear spring Part No.	Load capacity (maximum rear axle load) kg	Remarks	Associated shock absorbers Part No. Designation
180, 180 D	L / R	120 324 22 04	1100	For cars with twin-jointed rear axle (rear axle load "in curb condition" less than 650 kg)	120 320 38 31 F. & S. Tov 30 x 140 120 320 11 31 Stabilus T 40 x 120
	L / R	120 324 21 04	1000	For cars with twin-jointed rear axle (rear axle load "in curb condition" more than 650 kg) 1st Version	
	L / R	120 324 20 04	1100	For cars with twin-jointed rear axle (rear axle load "in curb condition" more than 650 kg) 2nd Version	
180, 180 a, 180 b, 180 D, 180 Db, 190, 190 b, 190 D, 190 Db	L	121 324 12 04	1100	On Models 180 and 180 D only for cars with single-jointed rear axle	121 326 03 00 F. & S. Tov 36 x 130
	R	121 324 13 04			
	L / R	121 324 24 04	1250		
219, 220 a, 220 S, 220 SE	L	121 324 12 04	1100		180 326 02 00 Stabilus T 50 x 120/S
	R	121 324 13 04			

Rear Springs and Shock Absorbers for the Needs of Sports Enthusiasts

219, 220 a, 220 S	L / R	Rear spring Part No.	940		180 326 01 00 F. & S. Tov 36 x 130
190 SL	L / R	Standard rear spring	700		121 326 04 00 F. & S. Tov 36 x 130

C. Test Values of Front Springs

Front spring Part No.	Test values							
	Free length of spring "L" mm	Trim dimension, i.e. spring length "L1" under normal load P mm	Load P normal kg	Load P maximum kg	Spring rate per 100 kg of load mm	Wire gauge "d" mm ⌀	Mean coil diameter "D" mm	Number of coils
120 321 14 04	339	216	570	819	21.7	15.1	110	8.5
120 321 15 04	344	216	623	996	20.5	15.1	110	8
120 321 16 04	328	216	570	944	19.7	15.25	110	8
120 321 17 04	322	216	623	913	18.65	15.35	109	8
120 321 19 04	334	222	570	984	19.7	15.25	110	8
120 321 20 04	399	222	623	910	18.8	15.5	108.5	8.5
121 321 04 04	328	208	555	805	21.6	15.0	111	8
121 321 05 04	305	208	560	872	17.3	15.5	110	7.5
121 321 06 04	349	216	614	863	21.7	15.1	110	8.5
180 321 07 04	327	216	540	952	17.3	15.5	110	7.5
180 221 09 04	311	216	540	1005	14.8	16.0	109	7.5
180 321 10 04	334	216	540	932	18.45	15.5	110	8
180 221 12 04	317	222	640	1005	14.8	16.0	109	7.5
180 321 13 04	340	216	714	1028	17.3	15.75	110	8
180 321 14 04	345	216	744	1056	17.3	15.75	110	8
180 321 15 04	331	216	666	978	17.3	15.75	110	8
180 321 16 04	320	221	670	1035	14.8	16.0	109	7.5
180 321 17 04	324	221	694	1059	14.8	16.0	109	7.5
180 321 18 04	335	216	688	1090	17.3	15.75	110	8

Note: Tolerance for spring length L1, i.e. trim dimension at P normal is for all front springs $^{+5}_{-2.5}$ mm

D. Color Code for Front Springs

Front spring Part No.	Color Code: white	red	blue
	Trim dimension measured at P normal in mm		
121 321 04 04 121 321 05 04	from 205.5—208	above 208—210.5	above 210.5—213
120 321 16 04 120 321 17 04 121 321 06 04 180 321 07 04 180 321 09 04 180 321 10 04 180 321 13 04 180 321 14 04 180 321 15 04 180 321 18 04	from 213.5—216	above 216—218.5	above 218.5—221
120 321 14 04 120 321 15 04	from 213—216	above 216—219	above 219—222
180 321 16 04 180 321 17 04	from 218.5—221	above 221—223.5	above 223.5—226
120 321 19 04 120 321 20 04 180 321 12 04	from 219.5—222	above 222—224.5	above 224.5—227

E. Test Values of Rear Springs

Rear spring Part No.	Test valves								
	left "L" right "R"	Free length of spring "L" mm	Trim dimension, i.e. spring length "L" under nominal load P mm	Load P nominal kg	Load P maximal kg	Spring rate per 100 kg of load mm	Wire gauge "d" mm Ø	Mean coil diameter "D" mm	Number of coils
120 324 11 04	L / R	285	182	648	976	15.55	16.5	130	5.25
120 324 15 04	L / R	281.4	180.4	648	966	15.55	16.5	130	5.25
120 324 17 04	L / R	265	183.5	734	1215	11.1	17.5	130	4.05
120 324 20 04	L / R	259	187.5	803	1482	8.09	17.0	130	4.8
120 324 21 04	L / R	270	189	798	1260	10.15	18.0	130	4.75
120 324 22 04	L / R	259.5	182	926	1412	8.35	16.8	130	4.75
120 324 23 04	L / R	270	188.5	734	1215	11.1	17.5	130	4.75
121 324 12 04	L	279	181.5	840	1168	11.62	18.0	135	4.95
121 324 13 04	R	277	182	864	1210	11.0	18.0	135	4.7
121 324 18 04	L	279	177	545	786	18.75	16.0	135	5.0
121 324 19 04	R	278	176	560	829	17.82	16.0	135	4.75
121 324 20 04	L	296	178.5	627	867	18.75	16.2	135	5.25
121 324 21 04	R	293.5	179	645	899	17.75	16.2	135	4.95

Rear spring Part No.	Left "L" or right "R"	Free length of spring "L" mm	Trim dimension, i.e. spring length "L1" under normal load P mm	Load P normal kg	Load P max. load kg	Spring rate per 100 mm of load mm	Wire gauge "d" mm	Mean coil diameter "D" mm	Number of coils
121 324 22 04	L	291	190	657	1065	13.05	17.2	135	4.65
121 324 23 04	R	279	190.5	716	1108	12.38	17.2	135	4.4
121 324 24 04	L R	264.5	190	915	1510	9.14	17.2	135	4.5
105 324 00 04	L	279.5	178.5	644	848	18.75	16.2	135	5.25
105 324 01 04	R	276	179	660	880	17.75	16.2	135	5.0
150 324 15 04	L	305	180	660	906	18.75	16.2	135	5.25
160 324 16 04	R	303.5	180.5	696	940	17.75	16.2	135	4.96
180 324 23 04	L	288	188.5	668	970	14.9	17.0	135	5.05
180 324 24 04	R	286	197	666	1005	14.1	17.0	135	4.8
180 324 25 04	L	294	194.5	668	970	14.9	17.0	135	5.05
180 324 27 04	R	292	195	686	1005	14.1	17.0	135	4.6
180 324 28 04	L	307	179	724	933	17.71	16.7	135	5.6
180 324 29 04	R	303	178	743	963	16.93	16.7	135	5.32

Note: Tolerance for spring length L1, i.e. trim dimension at P normal is for all rear springs ± 6 mm.

F. Color Code for Rear Springs

Color code		Left and right spring Part No. 120 324 11 04 Trim dimension measured at P normal in mm
white	1 line	from 174 — 176
	2 lines	above 176 — 178
	3 lines	above 178 — 180
red	1 line	above 180 — 182
	2 lines	above 182 — 184
blue	1 line	above 184 — 186
	2 lines	above 186 — 188
	3 lines	above 188 — 190

Color code		Left and right spring Part No. 120 324 15 04 Trim dimension measured at P normal in mm
white	1 line	from 172.4 — 174.4
	2 lines	above 174.4 — 176.4
	3 lines	above 176.4 — 178.4
red	1 line	above 178.4 — 180.4
	2 lines	above 180.4 — 182.4
blue	1 line	above 182.4 — 184.4
	2 lines	above 184.4 — 186.4
	3 lines	above 186.4 — 188.4

Color code		Left and right spring
		Part No. 120 324 17 04
		Trim dimension measured at P normal in mm
white	1 line	from 175.5 — 177.5
	2 lines	above 177.5 — 179.5
	3 lines	above 179.5 — 181.5
red	1 line	above 181.5 — 183.5
	2 lines	above 183.5 — 185.5
blue	1 line	above 185.5 — 187.5
	2 lines	above 187.5 — 189.5
	3 lines	above 189.5 — 191.5

Color code		Left and right spring
		Part No. 120 324 20 04
		Trim dimension measured at P normal in mm
white	1 line	from 179.5 — 181.5
	2 lines	above 181.5 — 183.5
	3 lines	above 183.5 — 185.5
red	1 line	above 185.5 — 187.5
	2 lines	above 187.5 — 189.5
blue	1 line	above 189.5 — 191.5
	2 lines	above 191.5 — 193.5
	3 lines	above 193.5 — 195.5

Color code		Left and right spring Part No. 120 324 21 04 Trim dimension measured at P normal in mm
white	1 line	from 181 — 183
	2 lines	above 183 — 185
	3 lines	above 185 — 187
red	1 line	above 187 — 189
	2 lines	above 189 — 191
blue	1 line	above 191 — 193
	2 lines	above 193 — 195
	3 lines	above 195 — 197

Color code		Left and right spring Part No. 120 324 22 04 Trim dimension measured at P normal in mm
white	1 line	from 174 — 176
	2 lines	above 176 — 178
	3 lines	above 178 — 180
red	1 line	above 180 — 182
	2 lines	above 182 — 184
blue	1 line	above 184 — 186
	2 lines	above 186 — 188
	3 lines	above 188 — 190

Color code		Left and right spring
		Part No. 120 324 23 04
		Trim dimension measured at F format in mm
white	1 line	from 180.5 — 182.5
	2 lines	above 182.5 — 184.5
	3 lines	above 184.5 — 186.5
red	1 line	above 186.5 — 188.5
	2 lines	above 188.5 — 190.5
blue	1 line	above 190.5 — 192.5
	2 lines	above 192.5 — 194.5
	3 lines	above 194.5 — 196.5

Color code		Left spring	Right spring
		Part No. 121 324 12 04	Part No. 121 324 13 04
		Trim dimension measured at F format in mm	
white	1 line	from 173.5 — 175.5	from 174 — 176
	2 lines	above 175.5 — 177.5	above 176 — 178
	3 lines	above 177.5 — 179.5	above 178 — 180
red	1 line	above 179.5 — 181.5	above 180 — 182
	2 lines	above 181.5 — 183.5	above 182 — 184
blue	1 line	above 183.5 — 185.5	above 184 — 186
	2 lines	above 185.5 — 187.5	above 186 — 188
	3 lines	above 187.5 — 189.5	above 188 — 190

Color code		Left spring	Right spring
		Part No. 121 324 18 04	Part No. 121 324 19 04
		Trim dimension measured at P normal in mm	
white	1 line	from 169 — 171	from 170 — 172
	2 lines	above 171 — 173	above 172 — 174
	3 lines	above 173 — 175	above 174 — 176
red	1 line	above 175 — 177	above 176 — 178
	2 lines	above 177 — 179	above 178 — 180
blue	1 line	above 179 — 181	above 180 — 182
	2 lines	above 181 — 183	above 182 — 184
	3 lines	above 183 — 185	above 184 — 186

Color code		Left spring	Right spring
		Part No. 121 324 20 04 Part No. 105 324 00 04	Part No. 121 324 21 04 Part No. 105 324 01 04
		Trim dimension measured at P normal in mm	
white	1 line	from 170.5 — 172.5	from 171 — 173
	2 lines	above 172.5 — 174.5	above 173 — 175
	3 lines	above 174.5 — 176.5	above 175 — 177
red	1 line	above 176.5 — 178.5	above 177 — 179
	2 lines	above 178.5 — 180.5	above 179 — 181
blue	1 line	above 180.5 — 182.5	above 181 — 183
	2 lines	above 182.5 — 184.5	above 183 — 185
	3 lines	above 184.5 — 186.5	above 185 — 187

Color code		Left spring	Right spring
		Part No. 121 324 22 04	Part No. 121 324 23 04
		Trim dimension measured at P normal in mm	
white	1 line	from 182 — 184	from 182.5 — 184.5
	2 lines	above 184 — 186	above 184.5 — 186.5
	3 lines	above 186 — 188	above 186.5 — 188.5
red	1 line	above 188 — 190	above 188.5 — 190.5
	2 lines	above 190 — 192	above 190.5 — 192.5
blue	1 line	above 192 — 194	above 192.5 — 194.5
	2 lines	above 194 — 196	above 194.5 — 196.5
	3 lines	above 196 — 198	above 196.5 — 198.5

Color code		Left and right spring
		Part No. 121 324 24 04
		Trim dimension measured at P normal in mm
white	1 line	from 182 — 184
	2 lines	above 184 — 186
	3 lines	above 186 — 188
red	1 line	above 188 — 190
	2 lines	above 190 — 192
blue	1 line	above 192 — 194
	2 lines	above 194 — 196
	3 lines	above 196 — 198

Color code		Left spring	Right spring
		Part No. 180 324 15 04	Part No. 180 324 16 04
		Trim dimension measured at P normal in mm	
white	1 line	from 172 — 174	from 172.5 — 174.5
	2 lines	above 174 — 176	above 174.5 — 176.5
	3 lines	above 176 — 178	above 176.5 — 178.5
red	1 line	above 178 — 180	above 178.5 — 180.5
	2 lines	above 180 — 182	above 180.5 — 182.5
blue	1 line	above 182 — 184	de 182,5 a 184,5
	2 lines	above 184 — 186	above 184.5 — 186.5
	3 lines	above 186 — 188	above 186.5 — 188.5

Color code		Left spring	Right spring
		Part No. 180 324 23 04	Part No. 180 324 24 04
		Trim dimension measured at P normal in mm	
white	1 line	from 180.5 — 182.5	from 181 — 183
	2 lines	above 182.5 — 184.5	above 183 — 185
	3 lines	above 184.5 — 186.5	above 185 — 187
red	1 line	above 186.5 — 188.5	above 187 — 189
	2 lines	above 188.5 — 190.5	above 189 — 191
blue	1 line	above 190.5 — 192.5	above 191 — 193
	2 lines	above 192.5 — 194.5	above 193 — 195
	3 lines	above 194.5 — 196.5	above 195 — 197

Color code		Left spring	Right spring
		Part No. 180 324 26 04	Part No. 180 324 27 04
		Trim dimension measured at P normal in mm	
white	1 line	from 186.5 — 188.5	from 187 — 189
	2 lines	above 188.5 — 190.5	above 189 — 191
	3 lines	above 190.5 — 192,5	above 191 — 193
red	1 line	above 192.5 — 194,5	above 193 — 195
	2 lines	above 194,5 — 196,5	above 195 — 197
blue	1 line	above 196,5 — 198.5	above 197 — 199
	2 lines	above 198.5 — 200.5	above 199 — 201
	3 lines	above 200.5 — 202.5	above 201 — 203

Color code		Left spring	Right spring
		Part No. 180 324 28 04	Part No. 180 324 29 04
		Trim dimension measured at P normal in mm	
white	1 line	from 171 — 173	from 170 — 172
	2 lines	above 173 — 175	above 172 — 174
	3 lines	above 175 — 177	above 174 — 176
red	1 line	above 177 — 179	above 176 — 178
	2 lines	above 179 — 181	above 178 — 180
blue	1 line	above 181 — 183	above 180 — 182
	2 lines	above 183 — 185	above 182 — 184
	3 lines	above 185 — 187	above 184 — 186

G. Test Values of Front Shock Absorbers

Part No.	Designation	Test values in kg at n = 100 rpm						External Diameter "D" mm	Length "L" Compressed mm
		Stroke 25 mm		Stroke 50 mm		Stroke 100 mm			
		Pull	Pressure	Pull	Pressure	Pull	Pressure		
120 323 00 00	F & S Sev 26 x 120	35	5	140	10	310	30	38.4	239
121 323 00 00	F & S Sev 26 x 120	35	5	140	10	310	30	38.4	239
121 323 01 00	Stabilus T 40 x 120	35	5	140	10	310	30	44.0	244.5
121 323 02 00	F & S Tov 36 x 130	40	5	160	10	340	20	55.0	242
121 323 03 00	F & S Tov 36 x 130	70	20	215	30	370	40	55.0	242
180 323 00 00	F & S Tov 36 x 130	65	8	230	15	330	30	55.0	242
180 323 01 00	F & S Tov 36 x 130	85	17	250	30	390	45	55.0	242
180 323 02 00	Stabilus T 40 x 130	65	8	230	15	330	30	44.0	244.5
180 323 03 00	Stabilus T 50 x 130	65	8	230	15	330	30	56.0	244.5
180 323 05 00	Bilstein Type 062	80	40	140	70	320	135	50.0	240

H. Test Values of Rear Shock Absorbers

Part No.	Designation	Test values in kg at n = 100 rpm						External Diameter "D" mm	Length "L" Compressed mm
		Stroke 25 mm		Stroke 50 mm		Stroke 100 mm			
		Pull	Pressure	Pull	Pressure	Pull	Pressure		
000 326 55 00	F & S Sev 26 x 130	—	—	—	—	270	35	38.4	239
120 320 38 31	F & S Tov 30 x 120	150	35	285	40	350	45	46.0	236.5
120 320 11 00	Stabilus T 40 x 120	—	—	—	—	270	35	44.0	237
121 326 00 00	F & S Tov 30 x 140	90	20	200	25	370	35	46.0	251
121 326 01 00	Stabilus T 40 x 140	80	20	220	30	380	43	44.0	254
121 326 02 00	F & S Tov 36 x 130	80	10	200	20	340	40	55.0	242
121 326 03 00	F & S Tov 36 x 130	80	20	220	30	380	43	55.0	242
121 326 04 00	F & S Tov 36 x 130	80	18	200	23	400	40	55.0	242
180 326 00 00	F & S Tov 36 x 140	80	20	220	30	420	43	55.0	252
180 326 01 00	F & S Tov 36 x 140	120	35	255	52	395	75	55.0	252
180 326 02 00	Stabilus T 50 x 130	80	20	220	30	380	43	55.0	254.5
180 326 04 00	Bilstein Type 063	65	30	175	40	400	110	50.0	247

Front Axle

Front Axle Group 33

Removal and Installation of Sub-Frame or Front Axle Support

Job No.
33-1

On Models 180 to 220 SE the removal and installation of sub-frame with front axle halves, springs and shock absorbers, front wheels, torsion bar, steering assembly, steering relay arm, steering shock absorber, center and outer tie-rods is essentially the same as described for Model 190.

On Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 220 a, 219, and 190 SL 1st version with three-point engine suspension the following procedures are not required: removal and installation of the rear rubber engine mountings on the side members of the sub-frame, and supporting the transmission for the purpose of removing the sub-frame. On Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, and 190 SL 1st version in addition to the procedures described for Model 190 the steering shock absorber must be removed and installed on the chassis base panel.

When installing the sub-frame, make sure that the rubber buffers for the sub-frame are properly seated. Rub the rubber buffers with talc before installing them.

The degree of hardness of the rubber buffers differs on the various models; they can be distinguished by their part number and their color code (see Table below):

Model	Part No.	Color code	Shore hardness	Remarks
Top rubber buffers				
180 180 a, 180 b 180 D, 180 Db 190, 190 b 190 D, 190 Db 220 a 219 220 S 220 SE	rear 180 333 01 65 front 180 333 02 65	red	45	In the case of Models 220 a, 219, 220 S, and 220 SE only for sedan without sliding roof, convertible and coupé
190 SL 220 a 219 220 S 220 SE	rear 180 333 04 65 front 180 333 03 65	white	70	In the case of Models 220 a, 219, 220 S, and 220 SE only for sedan with sliding roof
Bottom rubber buffers				
180 180 a, 180 b 180 D, 180 Db 190, 190 b 190 D, 190 Db 219 220 a 220 S 220 SE	120 333 13 65	red	57±4	In the case of Models 220 a, 219, 220 S, and 220 SE only for sedan without sliding roof, convertible and coupé
190 SL 219 220 a 220 S 220 SE	180 333 05 65	white	70	In the case of Models 220 a, 219, 220 S, and 220 SE only for sedan with sliding roof

Removal and Installation of Left or Right Front Axle Half

Job No.
33-2

On Models 180 to 220 SE the removal and installation of the front axle half is the same as described for Model 190.

Disassembly and Reassembly of Front Axle Half

Job No.
33-4

On Models 180 to 220 SE the disassembly and reassembly of the front axle half is essentially the same as described for Model 190. The following details, however, require attention:

a) Adjustment of Front Wheel Bearings

On the 1st version of Models 180, 180 D, 190 SL, and 220 a hexagon nuts were used for the adjustment of the front wheel bearings; on the 2nd version of these models the hexagon nuts which were used up to the following chassis end numbers have been replaced by clamping nuts:

Model	up to Chassis End No.
180	55 07957
180 D	55 10516
190 SL	55 00130
220 a	55 08243

On the 1st version of these cars the left wheel spindle has a left-hand thread, and the right wheel spindle has a right-hand thread. The hexagon nut is locked by means of a locking plate which engages in a groove on the wheel spindle. On the 2nd version the right and left wheel spindles have no groove and for that reason only clamping nuts should be used.

On previous cars the washer installed between locking plate and outside taper roller bearing was ground on one side and on later cars it was ground on both sides in the same way as the washer used for the clamping nut. When repairs are carried out, washers ground on one side only should either be reground on both sides or should be replaced by new washers. Washers without a nose must not be used for hexagon nuts. The locking plate for the hexagon nuts should always be replaced.

The adjustment of the front wheel bearings is the same as on Model 190 whether they are provided with hexagon nut (1st version) or with clamping nut (2nd version). On the hexagon nut version it is not possible to make an additional check by turning the ground washer after the adjustment has been made.

b) Caster Adjustment on King Pin

On all sub-frame models the caster can be adjusted within certain limits. The caster adjustment system is the same as on Model 190. On the 1st version of Models 180, 180 D, and 220 a up to the chassis end numbers listed below, the caster cannot be adjusted on the steering knuckle:

Model	up to Chassis End No
180	45 07291
180 D	45 04629
220 a	45 00143

These models have no adjusting washers for caster adjustment and have threaded bushings without grooves.

Checking and Repair of Front Axle Half

Job No. 33-5

On Models 180 to 220 SE the checking and repair procedures of the front axle halves are essentially the same as on Model 190. The following details, however, require attention:

a) Steering Knuckle Bushings

The 2nd version of the bushing pressed into the steering knuckle is 38 mm long. On the 1st versions of Models 180, 180 D, 190 SL, and 220 a, i. e. up to the chassis end numbers listed below, the bearing bushings were 32 mm long:

Model	up to Chassis End No.
180	55 10833
180 D	55 13506
190 SL	55 00473
220 a	55 11977

When repairs are carried out, the shorter bushings cannot be replaced by the longer bushings, since the seat in the bore of the steering knuckle is not sufficiently deep.

Models 180 b, 180 Db, 190 b, 190 Db, and recent cars of Models 190 SL and 220 SE Convertible and Coupé have bottom bushings 45 mm long.

b) Spacer Ring on Steering Knuckle

In the case of the 2nd version the spacer ring (2) is shrunk on the wheel spindle. On some older cars of Models 180, 180 D, and 220 a, on which the spacer ring is not shrunk on, grease may extrude between the ring and the wheel spindle and may soil the brake linings. To prevent this, rubber ring (1) Part No. 120 332 01 59 can be installed between the ring and the collar on the steering knuckle (Fig. 33-5/1).

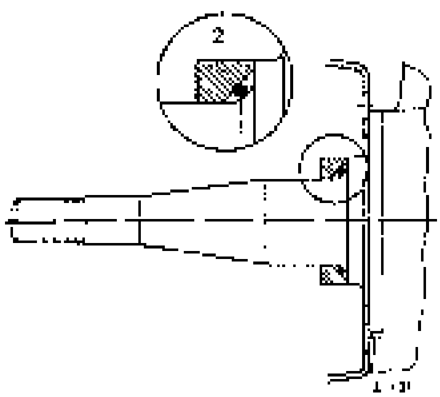


Fig. 33-5/1

1 Rubber ring
2 Spacer ring

When installing the spacer ring pay attention to the thread pattern on the circumference of the ring. On the bevelled side the spacer rings are marked

L = left side (right-hand thread) or
R = right side (left-hand thread).

On recent models the thread pattern on the circumference of the spacer ring is applied only over a length of 15 to 20 mm in order to prevent the sealing ring from making hissing noises at slow speeds (Fig. 33-5/2).

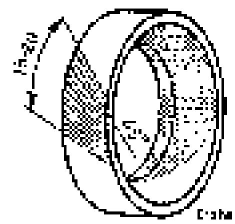


Fig. 33-5/2

When repairs are carried out install the spacer ring and then use fine emery cloth to reduce the thread pattern to the length given above of 15–20 mm on the circumference.

c) Control Arms

The upper control arms are identical on all models. In the case of the 1st version lower control arms on Models 180, 180 D, and 190 the diameter of the shock absorber throughway hole is 48 mm. These control arms were installed up to the following chassis end numbers:

Model	up to Chassis End No.
180	75 00074
180 D	75 00497
190	75 00515

In the case of the 2nd version lower control arms the shock absorber through-way hole has a diameter of 58 mm. These 2nd version control arms can only be installed in older cars of Models 180, 180 D, and 190 together with new shock absorbers.

On older cars the control arms should be checked with particular care. All control arms with slight cracks or loose cheese-head shock absorber attaching screws should always be replaced.

Removal and Installation of Tie-Rods

Job No.
33-6

On Models 180 to 220 SE the removal and installation procedures for the tie-rods are the same as on Model 190.

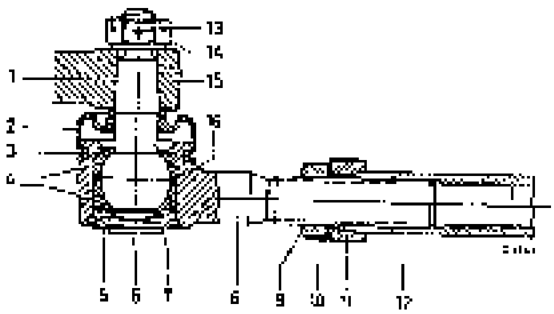
Center and Outer Tie-Rods with Self-Lubricating Ball Joints

On recent cars of Models 180 a, 180 b, 180 D, 180 Db, 190, 190 b, 190 D, 190 Db, 190 SL, 219, 220 S, and 220 SE, outer and center tie-rods with self-lubricating ball joints have been installed.

These ball joints are no longer provided with a pinion rim grease fitting. The ball studs (1) are carried in two Vulkollan bearing shells (4).

Fig. 33-6/1

1 Ball stud
2 Rubber cuff
3 Locking ring
4 Bearing shell
5 Lower cap
6 Spring retainer
7 Pressure spring
8 Ball race
9 Hexagon nut
10 Locking plate
11 Clamping ring
12 Tie-rod tube
13 Cotter pin
14 Castle nut
15 Steering knuckle arm or steering gear arm or steering relay arm
16 Spacer ring



The self-lubricating ball joints can also be installed subsequently on all sub-frame models. If this is done, all tie-rods together with the ball joints must be replaced because the new self-lubricating ball joints do not fit on the old tie-rod tubes.

If the self-lubricating ball joints are found to be defective, replace the tie-rod ends or the whole center tie-rod.

When the tie-rods are removed, the Puller 186 589 10 33 may damage the rubber cuffs (2). It is advisable, therefore, always to use new rubber cuffs (2) on the individual ball joints when the tie-rods are being reinstalled. Furthermore the space between the cuff and the joint should be filled with anti-friction bearing grease. The left-hand thread on the hexagon nut (9) is marked by grooves (Fig. 33–6/1).

Survey of Tie-Rods

Model	Tie-rod		Length mm
	with grease fittings on the ball joints Part No.	with self-lubricating ball joints Part No.	
180, 180 a, 180 b 180 D, 180 Db	120 330 06 03	120 330 09 03	457 ± 10
190, 190 b, 190 D, 190 Db, 190 SL	121 330 02 03 (left) 121 330 03 03 (right)		
220 a, 219 220 S, 220 SE	180 330 07 03 (left) 180 330 08 03 (right)	180 330 11 03	477 ± 10

Job No.
33–8

Checking of Front Axle Support

On Models 180 to 220 SE the checking procedures for the front axle support are the same as on Model 190.

Rear Axle

Rear Axle Group 35

Rear Axle - General

Job No.
35-0

The rear axles of Model 180 2nd version, 180 a, 180 b, 180 D 2nd version, 180 Db, 190 D, 190 Db, 190 SL, 220 a, 219, 220 S, and 220 SE are essentially the same as the single-jointed rear axle installed on Model 190. They differ only in the gear ratio between the drive pinion and the ring gear (see table), the brake design and the support of the rear axle suspension. The rear axle housing, the axle tubes and the rear axle shaft have the same dimensions.

Note: Models 180 and 180 D were provided with a twin-jointed rear axle up to the following Chassis End Nos.:

Model 180 up to Chassis End No. 55 12433
Model 180 D up to Chassis End No. 55 14467.

Gear Ratios and Number of Teeth

Model		Gear ratio	Number of teeth	Remarks
180 2nd version	standard	1 : 3.90	10 : 39	1st version was twin-jointed rear axle
	optional	1 : 4.10	10 : 41	
180 D 2nd version	standard	1 : 3.70	10 : 37	1st version was twin-jointed rear axle
	optional	1 : 4.10	10 : 41	
180 a, 180 b,	standard	1 : 3.90	10 : 39	
	optional	1 : 4.10	10 : 41	export version
190, 190 b		1 : 4.10	10 : 41	
190 D, 190 Db	standard	1 : 3.70	10 : 37	
	optional	1 : 4.10	10 : 41	
190 SL	1st version	1 : 3.70	10 : 37	installed as a standard part up to Chassis End No. 55 00060
	2nd version	1 : 3.89	9 : 35	installed as a standard part as from Chassis End No. 55 00061 up to Chassis End No. 55 00786
	3rd version	1 : 3.90	10 : 39	installed as a standard part as from Chassis End No. 55 00787
	optional	1 : 4.10	10 : 41	export version
220 a	1st version	1 : 4.11	9 : 37	installed as a standard part up to Chassis End No. 55 00776
	2nd version	1 : 4.10	10 : 41	installed as a standard part as from Chassis End No. 55 00777
219	1st version and optional	1 : 4.10	10 : 41	installed as a standard part up to Chassis End No. 75 00492 and as optional equipment on export cars
	2nd version	1 : 3.90	10 : 39	installed as a standard part as from Chassis End No. 75 00493
220 S, 220 SE		1 : 4.10	10 : 41	

Removal and Installation of Rear axle

Job No.
35-1

On Models 180 to 220 SE the removal and installation procedures for the single-jointed rear axle are essentially the same as on Model 190. The following points need attention:

a) Rear Axle Suspension

On Models 180 a, 180 b, 180 Db, 190, 190 b, 190 D, 190 Db, 190 SL, 219, 220 S, and 220 SE a steel bushing has been vulcanised into the upper rubber mountings for the rear axle suspension on the chassis base panel. Previous cars of Models 220 a and 180, 180 D, and 190 SL 1st version were provided with rubber mountings without steel bushings. There is a difference in the pivot diameter on the rear axle support between rubber mountings with steel bushings and those without steel bushings (see table below).

Model	Diameter of pivot on support mm	Upper rubber mounting Part No.	Remarks
180, 180 D, 190 SL 220 a	30.000 / 29.987	180 351 08 86 (without steel bushing)	1st version on Models 180, 180 D, and 190 SL
180, 180 D 190 SL, 219, 220 S, 220 SE		180 351 10 86 (with steel bushing)	2nd version on Models 180, 180 D, and 190 SL
180 a, 180 b, 180 D, 180 Db, 190, 190 b	25.980 / 25.959	121 351 01 86 (with steel bushing)	3rd version on Model 180 D
190 D, 190 Db		121 351 00 48 (with steel bushing)	

The part number is indicated at the top of the rubber mounting. The lower Rubber Ring 180 351 05 86 for the support of the rear axle is the same on all models with the exception of Models 190 D and 190 Db. On these models Rubber Ring 121 351 02 48 is installed. After installing the rear axle on Model 190 D the lower rubber ring should be loose enough to be moved by hand.

The lower rubber ring and the upper rubber mounting should be rubbed with talc before they are installed. When installing the upper rubber mounting, pay attention to the arrow at the top of the mounting and the inscription "Fahrtrichtung" (direction of travel).

b) Front Mounting of Torque Arms

On Models 180 to 220 SE the step bearings on the chassis base panel for the front mounting of the torque arms are of the same height.

On these models dimension "a" from the lower edge to the upper edge of the step bearing is 42 mm; however, on older cars of Models 180, 180 D, and 220 a, step bearings were installed with a dimension "a" = 36 mm.

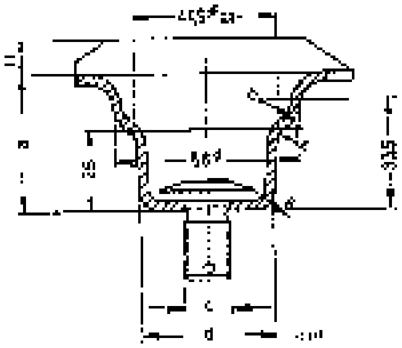


Fig. 35-1/3

Survey of Step Bearings

Version	Part No.	a	b mm	c mm	d mm	Sheet-metal gage mm
1st version	120 350 34 33	36 ± 0.5	6	M 12 × 1.5	40 ⌀ + 0.5	2.5
2nd version	180 350 01 33	42 ± 0.5	6	M 12 × 1.5	40 ⌀ + 0.5	2.5 + 0.25
3rd version	180 350 03 33	42 ± 0.5	10	M 14 × 1.5	40 ⌀ + 0.5	2.75
4th version	180 350 03 33	42 ± 0.5	10	M 14 × 1.5	41.5 ⌀ + 0.5	3

In the case of step bearings with the dimension "a" = 36 mm the metal cap (1) Part No. 180 358 0059 should be installed on the lower section of the cup in order to prevent the torque arms from striking against the chassis base panel when the springs are fully depressed. When the metal cap is installed, the torque arm is moved to a slightly lower position, so that it cannot strike against the chassis base panel. Only 30 mm cups (2) Part No. 180 352 0067 can be used together with the metal cap (fig. 35–1/4).

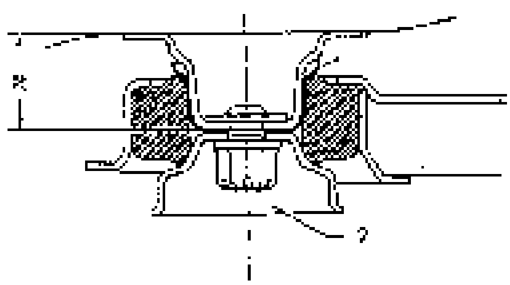


Fig. 35–1/4

1 Metal cap
2 Cup

Note: Modify the holding cradles for the step bearings on the chassis base panel gage in accordance with the present type of step bearings (4th version, see table).

When repairs are carried out, for instance when the step bearings are cracked, always replace the lower sections of the step bearings on both sides. The procedures are the same as described for Model 190, but note the following differences:

1. When the step bearing lower section 120 350 06 33 is installed, the step bearing can be replaced quickly and **without using the chassis base panel gage.**

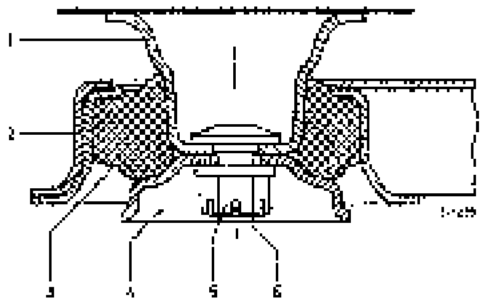
2. It is vitally important to finish and clean the welding seam very carefully in order to obtain a smooth curve from the step bearing to the welding seam. Projecting welding beads may damage the rubber mounting.

3. When installing the torque arms, use a **cup 25 mm high Part** No. 120 352 05 67 for the step **bearing** 42 mm high with thread M 12×1.5 and a cup 25 mm high Part No. 180 352 01 67 for the step bearing with thread M 14×1.5.

4. Since the rubber mountings for the front torque arm suspension are of necessity subject to wear, they must be checked very carefully and if necessary replaced when the rear axle is being removed. The rubber mountings should be replaced after a maximum of 100 000 km

New Rubber Mountings

On recent cars of Models 180 b, 180 Db, 190 b, and 190 Db rubber mountings with a lip have been installed (Fig. 35-1/5).



1 Step bearing
2 Torque arm
3 Rubber mounting
4 Cup
5 Shouldered castle nut
6 Fine-threaded screw (M 14 × 1.5)

Fig. 35–1/5

When installing the rubber mountings make sure that the lip always points upward. The lower surface is marked "unten" (this side down)

Rubber mounting Part No.	Rubber hardness ° Shore	Height mm
121 352 00 65	55 ± 3	35

Only rubber mountings of the new shape are being supplied as replacement parts.

c) Rear Axle Suspension on Models 190 D and 190 Db

In order to reduce chassis noises on the rear axle suspension on Models 190 D and 190 Db the upper rubber mountings and the lower rubber rings have a lower Shore hardness than those on the other models. In a few isolated cases knocking noises have been heard when the car is being driven away at high speed since the support of the rear axle suspension strikes against the chassis base panel. To prevent these noises on the rear axle support a rubber ring (6) Part No. 121 351 02 86 has been installed as a standard part on recent cars of Model 190 Db (see Fig. 35–1/6).

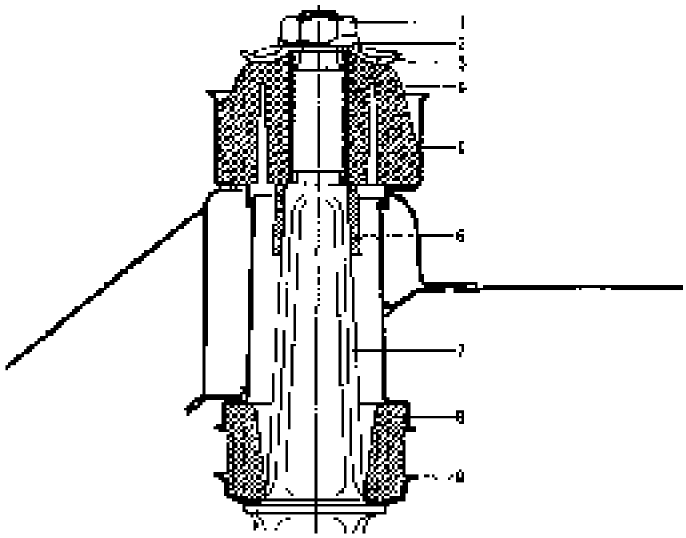


Fig. 35-1/6

1 Hexagon nut
2 Locking plate
3 Tension disk
4 Upper rubber mounting
5 Chassis base panel
6 Rubber ring
7 Support
8 Lower rubber ring
9 Cap

The rubber ring reduces the free motion torque of the support on the chassis base panel to such an extent that the knocking noise is eliminated.
The rubber ring has been installed as a standard part on Model 190 Db as from Chassis End No. 009437.

Disassembly and Reassembly of Rear Axle

Job No. 35–4

On Models 180 to 220 SE disassembly and reassembly procedures of the single-jointed rear axle are the same as described for Model 190.

Checking and Repair of Rear Axle

Job No. 35–5

On Models 180 to 220 SE checking and repair procedures of the single-jointed rear axle are the same as described for Model 190.

Note: On recent models an annular grooved bearing with a smaller radial play has been installed on the rear axle shaft.

Previous version:
Annular grooved bearing Part No. 180 981 00 25 (modified bearing 6208 C 4 DIN 625)
Radial play: 0.032–0.050 mm

New version:
Annular grooved bearing Part No. 183 981 00 25 (modified bearing 6208 C 3 DIN 625)
Radial play: 0.020–0.037 mm

When complaints are received about loud knocking noises on the rear axle, the annular grooved bearing on the right side can be replaced by a barrel roller bearing 20 208 DIN 635 when repairs on the rear axle are being carried out.

Wheels and Adjustment of Wheels

40

Wheels and Adjustment of Wheels Group 40

Wheels

Job No.
40–0

A. Disk Wheels

All cars of Models 180 to 220 SE are fitted with 13" steel disk wheels. With the exception of Model 190 SL all export models can be fitted with 15" disk wheels as an optional extra.

The disk wheels of Models 180, 180 a, 180 D, 190 D, 190 SL, 220 a, 219, 220 S, and 220 SE are provided with rim balancing slots for balancing the wheels, whereas the disk wheels on Models 180 b, 180 Db, 190 b, and 190 Db have no rim slots (see Job No. 40-2).

Disk Wheels

Model	180 180 a 180 D 190 D	180 b, 180 Db 190, 190 b 190 Db	190 SL	219	220 a 220 S 220 SE
Standard version					
Rim type	Well base rim				
Rim designation	4½ K x 13—A	4½ K x 13—B	5 K x 13—B	5 K x 13—B	5 K x 13—B
Rim version	symmetrical	asymmetrical			
Optional version					
Rim type	Well base rim				
Rim designation	4½ K x 15—A		—	4½ K x 15—A	
Rim version	symmetrical		—	symmetrical	
Test Values of Disk Wheels					
Permissible eccentricity	1.5 mm		1.0 mm	1.5 mm	
Permissible run-out	1.5 mm				
Permissible unbalance	750 cmg				

B. Tires

For general remarks on tires and tire pressures see Workshop Manual Model 190.

Model	Rim	Tire	DIN	Ply	Permissible maximum speed (km/h)	Permissible maximum load (kg)/air pressure (atm.)
Standard Tires						
180 180 a, 180 b 180 D, 180 Db 190, 190 b 190 D, 190 Db	4½ K x 13	6.40—13 Low pressure	7803	4	150	440/1.9
219	5 K x 13	6.40—13 Low pressure	7803	4	150	450/1.7
190 SL	4½ K x 13	6.40—13 Sports type	—	4	175	425/2.0
220 a 220 S 220 SE	5 K x 13	6.70—13 Sports type	—	4	175	500/2.3
Special Tires						
180 180 a, 180 b 180 D, 180 Db 190, 190 b 190 D, 190 Db 219	4½ K x 13 or 5 K x 13	6.40—13	7803	6	150	450/2.0
		6.70—13 Sports type	—	4	175	500/2.3
		6.70—13 Extr. sports type	—	6	175	475/2.1
		6.40—13	7804	4	150	500/2.5
		6.40—13 Extr. transp. type	7804	6	150	525/2.5
		6.70—13	7804	4	150	550/2.5
		6.40—13 Extr. transp. type	7804	5	150	425/3.0
	4½ K x 15	6.40—15 Low pressure	7803	4	150	450/1.7
		6.40—15 Extr. sports type	7803	6	175	485/2.2
190 SL	5 K x 13	6.40—13 Sup. Record	—	4	—	—
220 a 220 S 220 SE	5 K x 13	6.70—13 Sports type	—	4	175	500/2.3
		6.70—13 Extr. sports type	—	6	175	475/2.3
		6.70—13	7804	4	150	550/2.5
	4½ K x 15	6.40—15 Extr. sports type	—	6	175	485/2.2

Tire Pressures (only for standard types)

Tire pressure (atm.)			180 180 a, 180 b 180 D, 180 Db 190, 190 b 190 D, 190 Db	190 SL	219	220 a 220 S 220 SE
For normal driving	Cold tires — Partial load	front	1.7	1.7	1.7	1.6
		rear	1.8	1.8	1.8	1.7
	Cold tires — Full load	front	1.7	1.7	1.7	1.7
		rear	1.9	1.8	1.9	1.8
	Increases after prolonged city-driving or limited highway travel to approx.	front	1.8	1.9	1.8	1.8
		rear	2.0	2.0	2.0	2.0
	Increases after fast highway travel to approx.	front	1.9	2.0	1.9	1.9
		rear	2.1	2.1	2.1	2.1
For fast freeway travel or sports events	Cold tires	front	1.9	1.9	1.9	1.9
		rear	2.0	2.0	2.0	2.0
	Increases after fast freeway driving to approx.	front	2.1	2.3	2.2	2.3
		rear	2.3	2.4	2.4	2.4

Note: Full load = Car normally loaded (see Job No. 40-0).

Fitting of Tires

Job No. 40-1

On Models 180 to 220 SE the tires are fitted in the same way as on Model 190.

Balancing of Wheels

Job No. 40-2

Models 180, 180 a, 180 D, 190 D, 190 SL, 220 a, 219, 220 S, 220 SE

The wheels are balanced in the same way as on Model 190.

Models 180 b, 180 Db, 190 Db

The wheels are balanced in the same way as on Model 190 b.

Adjustment of Wheels

Job No. 40-3

On Models 180 to 220 SE the wheels are adjusted in the same way as on Model 190. The wheel adjustment data differ for the individual models (see table overleaf).

Wheel Adjustment Data

		180, 180 a, 180 b, 180 D, 180 Db, 190, 190 b, 190 Db	190 SL	219, 220 a, 220 S, 220 SE	Remarks
Normal load		6 x 65 + 45 kg	3 x 65 + 30 kg	6 x 65 + 45 kg	On Model 220 S Convertible and Coupe and on Model 220 SE Convertible and Coupé load 5 x 65 + 40 kg
Front axle					
Wheel bearing end play on adjustment, mechanical		0—0.005 mm			
Permissible total play, optical		0° 30'			
Permissible difference of axle positioning distance from right to left		5 mm			Measurement by Master Gage 180 589 02 23
Pivot point distance		34 ± 2 mm		30 ± 2	Measure the difference between the axes of the pivot pins for the lower control arm and the lower edge of the steering gear arm and the steering relay arm
Permissible deviation of height between steering gear arm and steering relay arm		2 mm			
Toe-in normally loaded	optical	0—2 mm			The toe-in must be measured with the wheels in their neutral position
	mechanical	0°—0° 20'			
Camber		0° up to + 1°			Camber on both sides as nearly identical as possible. Maximum permissible difference 30'. Optimal camber + 0° 20' to 0° 40' under normal load
Caster	rush condition	2° 50' — 4°	3° — 4°	2° 50' — 4°	Maximum permissible difference between right and left 30'
	normally loaded	3° 00' — 4° 10'	3° 30' — 4° 30'	3° 30' — 4° 10'	
Track angularity on 20° lock of inside wheel		approx. —2° 30'		approx. —2° 30'	At left or right lock as nearly identical as possible, maximum permissible difference 30'
Rear Axle					
Permissible divergence from center position		2 mm			Measured with Master Gage 180 589 08 21. Start from center of the connecting pin
Permissible difference of axle positioning distance from left to right		3 mm			Measure with Master Gage 180 589 08 21 from the check bore on the chassis base panel to the bores in the axle tubes
Permissible rear axle misalignment		0° 25'			
Permissible toe-in (+) or toe-out (—) under normal load	mechanical	± 2 mm			
	optical	± 0° 20'			
Permissible wheel base difference from left to right		5 mm			

Rear Wheel Camber of Cars with Standard Rear Springs

Model	Normal load kg: Rear axle load kg	left: Rear spring Part No.	left: Camber curb condition	left: Camber normally loaded	right: Rear spring Part No.	right: Camber curb condition	right: Camber normally loaded
180 180 D	$\frac{5 \times 65 + 45}{880}$	120 324 15 04	approx. + 1° 45'	— 3° up to — 4°	Values as for "left" (Twin-jointed rear axle)		
190 180 D 190	$\frac{6 \times 65 + 45}{880}$	121 324 20 04	+ 1° up to + 2°	— 3° 40' up to — 4° 40'	121 324 21 04	+ 1° 10' up to + 2° 10'	— 4° 10' up to — 5° 10'
180, 180 a, 180 b, 180 D, 180 Db, 190, 190 D, 190 Db	$\frac{6 \times 65 + 45}{880}$	105 324 00 04	+ 1° 10' up to + 2° 10'	— 3° 30' up to — 4° 30'	105 324 01 04	+ 1° 20' up to + 2° 20'	— 4° up to 5°
190 SL	$\frac{3 \times 65 + 30}{700}$	121 324 18 04	0° up to + 1°	— 2° 10' up to — 3° 10'	121 324 19 04	0° up to + 1°	— 2° 30' up to — 3° 30'
219	$\frac{6 \times 65 + 45}{900}$	105 324 00 04	+ 1° 10' up to + 2° 10'	— 3° 30' up to — 4° 30'	105 324 01 04	+ 1° 20' up to + 2° 20'	— 4° up to — 5°
220 a, 220 S 220 SE	$\frac{6 \times 65 + 45}{940}$	180 324 15 04 or 105 324 00 04	+ 1° 10' up to + 2° 10'	— 3° 30' up to — 4° 40'	180 324 10 04 or 105 324 01 04	+ 1° 20' up to + 2° 20'	— 4° up to — 5°
220 S and SE Convertible and Coupé	$\frac{5 \times 65 + 40}{925}$	180 324 15 04 or 105 324 00 04	+ 0° 30' up to + 1° 30'	— 3° 10' up to — 4° 10'	180 324 16 04 or 105 324 01 04	+ 0° 40' up to + 1° 40'	— 3° 40' up to — 4° 40'
Rear Wheel Camber of Cars with Export Rear Springs and Springs for Bad Roads							
180 D, 180 Db, 190, 190 D, 190 Db, 180, 180 a, 180 b	$\frac{6 \times 65 + 45}{880}$	180 324 25 04	+ 2° 20' up to + 3° 20'	— 0° 50' up to — 1° 50'	180 324 27 04	+ 2° 30' up to + 3° 30'	— 1° up to — 2°
219, 220 a 220 S 220 SE	$\frac{6 \times 65 + 45}{940}$	180 324 26 04	+ 2° up to + 3°	— 1° 30' up to — 2° 30'	180 324 27 04	+ 2° 10' up to + 3° 10'	— 1° 40' up to — 2° 40'
Rear Wheel Camber of Cars with Rear Springs for Police Radio Cars and Ambulances							
180, 180 a, 180 b, 180 D, 180 Db, 190, 190 D, 190 Db, 219, 220 a, 220 S	710 curb condition 1100 maximum load	121 324 12 04	+ 1° up to + 2°	— 2° 30' up to — 3° 30'	121 324 13 04	+ 1° 10' up to + 2° 10'	— 2° 50' up to — 3° 50'
Rear Wheel Camber of Cars with Rear Springs for Special-Purpose Bodies							
180, 180 a, 180 b, 180 D, 180 Db, 190, 190 Db, 190 D	600 curb condition 1250 maximum load	121 324 24 04	+ 2° 10' up to + 3° 10'	— 2° up to — 3°	121 324 24 04	+ 2° 30' up to + 3° 30'	— 2° 20' up to — 3° 20'
Rear Wheel Camber of USA Taxi Cabs							
190 D, 190 Db	570	180 324 26 04	+ 1° 10' up to + 2° 10'	–	180 324 27 04	+ 1° 20' up to + 2° 20'	—

Note: In the case of springs for police radio cars, ambulances and cars with special-purpose bodies such as light trucks etc. the rear wheel camber listed in the column "camber, curb condition" applies only in relation to this rear axle load. If the curb condition rear axle load of these cars changes as a result of modified equipment, the rear wheel camber has to be adjusted accordingly. The camber data given in the column "normally loaded" only apply to the rear axle maximum load. If on these cars the rear wheel camber is adjusted under normal load, the load must be sufficient to produce the rear axle load listed above. For details see Job No. 32-0 "Springs".

Propeller Shaft

41

Propeller Shaft Group 41

Removal and Installation of Propeller Shaft

Job No.
41-1

On Models 180 to 220 SE the removal and installation procedures for the propeller shaft are essentially the same as on Model 190. However, on Model 220 a and on older cars of Models 180, 180 D, and 190 SL the propeller shaft can only be removed toward the rear when the rear axle has been removed or it can be removed toward the front when the engine and the transmission have been removed, since on these cars the rear aperture in the propeller shaft housing at the point where the rib has been welded to the housing is smaller than on recent cars.

Disassembly and Reassembly of Propeller Shaft

Job No.
41-4

On Models 180 to 220 SE the disassembly and reassembly procedures for the propeller shaft are essentially the same as on Model 190.

The following points deserve attention:

a) Three-Way Flange on Front Propeller Shaft

The three-way flanges on the front propeller shaft have varying bolt-hole circles on the individual models (see table).

Model	Bolt-hole circle of three-way flange mm
180, 220 a	80
180 D up to Chassis End No. 65 01919	
190 SL up to Chassis End No. 65 00172	
219 up to Chassis End No. 65 00740	
180 a, 180 b, 180 Db, 190, 190 b, 190 D, 190 Db, 220 S, 220 SE	90
180 D as from Chassis End No. 65 01920	
190 SL as from Chassis End No. 65 00173	
219 as from Chassis End No. 65 00741	

When repairs are carried out on older cars of these models, a front propeller shaft with a three-way flange (90 mm bolt-hole circle) can be installed, provided that the three-way flange on the transmission is replaced at the same time.

b) Universal Joint Spider

The trunnions of the spiders on the front and rear propeller shafts have been reinforced. Furthermore both the arrangement and the design of the grease fitting have been modified in order to provide better access to the grease fitting when the universal joint is greased (see table).

Dimensions and Tolerances of Shaft Yoke, Needle Bearing Bushings, and Universal Joint Spider

		1st Version		2nd Version		3rd Version	
Installed in propeller shafts of Models		180, 180 D up to Chassis End No. 650 1919		180 D as from Chassis End No. 650 1920, 180 a, 190, 190 D, 190 SL, 220 a, 219, 220 S, 220 SE			
Type		I	II	I	II	I	II
Marking		1 white dot	2 white dots	1 white dot	2 white dots	1 white dot	2 white dots
Bore in shaft yoke		22.000 / 22.010	22.011 / 22.020	26.000 / 26.010	26.011 / 26.021	28.000 / 28.010	28.011 / 28.021
Needle bearing bushing	External diameter	22.012 / 22.002	22.023 / 22.013	26.012 / 26.002	26.023 / 26.013	28.012 / 28.002	28.023 / 28.013
	Internal diameter	16.707 / 16.720		20.107 / 20.120		21.707 / 21.720	
Trunnion ⌀ of universal joint spider		12.700 / 12.689		15.100 / 15.089		16.700 / 16.689	
Part No. of complete universal joint spider		120 410 01 31		120 410 01 31		180 410 03 31	
Arrangement and design of grease fitting		Grease fitting at an angle of 70° and screwed into end face of universal joint spider (Fig. 41-4/3)				Longer straight grease fitting, screwed in between two trunnions at an angle of 45° (Fig. 41-4/3)	

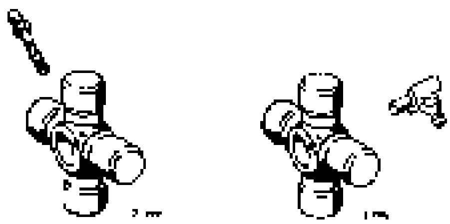


Fig. 41-4/3

Universal joint spider

3rd Version 1st and 2nd Versions

c) **Self-Lubricating Universal Joints**

A large number of cars of Models 180 a, 180 D, 190 D, 190 SL, 219, and 220 S and all cars of Models 180 b, 180 Db, 190 b, and 190 Db are fitted with propeller shafts with self-lubricating universal joints.

When these universal joints are installed, they are provided with a special lubricating compound sufficient to lubricate the spider trunnions for the whole of their service life. For this reason the joints require no maintenance. The grease fitting bore in the spider has been closed with a grub screw.

The fact that cars have no grease fittings on the universal joints of their propeller shaft proves that they have been provided with self-lubricating universal joints. Propeller shafts with standard universal joints cannot be subsequently converted to self-lubricating units by lubricating them with the special compound mentioned above since the ordinary spider seals are not suitable for permanent lubrication. The rubber sealing rings on self-lubricating universal joint have a higher sealing pressure which makes any lubricant leaks impossible.

d) Propeller Shafts as Replacement Parts

For reasons of standardization the reinforced universal joint spider Part No. 180 410 03 31 has also been installed in propeller shafts supplied as replacement parts. When front propeller shafts Part No. 180 410 16 01 (with 80 mm bolt-hole circle on the three-way flange) and with reinforced universal joint are installed on older cars of Models 190 SL and 220 a, it is no longer possible to lubricate the universal joint with a standard lubricator since the cut-out in the chassis base panel is too small. For this reason the universal joint on these cars must be lubricated by hand with Special Grease Gun 000 583 18 18 which has a curved mouth-piece.

e) Survey of Propeller Shafts / Date: December 31, 1959

Model	Total propeller shaft Part No.	Front propeller shaft Part No.	Rear propeller shaft Part No.	Three-way flange bolt-hole circle	Model
180 180 D	120 410 25 03	120 410 38 01	120 410 40 05	80	For cars with twin-jointed and single-jointed rear axle, on Model 180 D 1st version (up to Chassis End No. 65 015 15)
180 D	120 410 27 03	120 410 14 01	120 410 41 02	90	2nd Version (as from Chassis End No. 65 015 16)
180 a 190, 190 D 219	121 410 13 03	180 410 14 01	121 410 23 02	90	On Model 219 2nd Version (as from Chassis End No. 65 007 41)
190 SL	121 410 17 03	180 410 16 01	121 410 24 02	80	1st Version (up to Chassis End No. 65 001 72)
190 SL	121 410 14 03	180 410 14 01	121 410 24 02	90	2nd Version (as from Chassis End No. 65 001 73)
220 a	180 410 14 03	180 410 16 01	180 410 23 02	80	
219	105 410 32 03	180 410 16 01	121 410 23 02	80	1st Version (up to Chassis End No. 65 007 40)
220 S, 220 SE	180 410 11 03	180 410 14 01	180 410 23 02	90	
220 S, 220 SE Convertible and Coupe	180 410 12 03	180 410 14 01	180 410 24 02	90	
219	121 410 18 03	180 410 17 01	121 410 23 02	90	For cars with hydraulic automatic clutch

Model	Total propeller shaft Part No.	Front propeller shaft Part No.	Rear propeller shaft Part No.	Three-way flange bolt-hole circle	Remarks
220 S, 220 SE	180 410 15 03	180 410 17 01	180 410 23 02	90	For cars with hydraulic-automatic clutch
220 S, 220 SE Convertible and Coupé	180 410 17 03	190 410 37 01	180 410 24 02	90	For cars with hydraulic-automatic clutch
180 Db	120 410 29 03	190 410 38 01	120 410 42 02	90	With self-lubricating universal joints
180 a, 190 b, 190 Db	121 410 19 03	180 410 13 01	121 410 25 02	90	

f) Repair of Self-Lubricating Universal Joints

The procedures necessary to repair the self-lubricating universal joints are the same as for those with grease fittings, but the following details require attention:

In order to safeguard the service life of the self-lubricating universal joints, the lubricating canals in the universal joint spider must be completely filled with the prescribed special lubricant. On a self-lubricating universal joint the sealing between universal joint spider and needle bearing bushings is of particular importance since the lubricant cannot be replenished. For this reason the sealing rings between universal joint spider and needle bearing bushings are installed with a much greater bearing pressure than the sealing rings of universal joints with grease fittings. It goes without saying that self-lubricating universal joints should not be lubricated with ordinary grease or roller bearing grease, but only with the specified compound. The complete universal joint spiders are supplied fully lubricated and it is imperative that they should be fitted in such a way that no lubricant can be lost.

If the lubricant has to be replenished for some reason and if the prescribed special lubricant (EXD 1310 of Mobil OIL AG) is not available, a similar compound can be made to meet emergencies. This compound should consist of 75% by volume of roller bearing grease and 25% by volume of hypoid transmission oil SAE 90. The ingredients should be mixed thoroughly.

Brakes

Brakes Group 42

Brake System

Job No.
42-0

Description of Brake System

The brake system is essentially the same as on Model 190, all deviations are listed below.

I. Models 180, 180 a, 180 D, and 190 D

On these models the brake shoes are 50 mm wide. Adjustment eccentrics for adjusting the brake shoes are provided on the brake anchor plate. The brake drums are of grey-cast iron without radial fins.

II. Models 180 b, 180 Db, and 190 Db

On the front axle the brake shoes are 65 mm wide, and on the rear axle they are 50 mm wide. The brake system is provided with eccentric adjustment. The front wheel brake has grey-cast iron drums with radial fins, the rear wheel brake has grey-cast iron drums without radial fins.

The anchor pins for the front axle brake shoe suspension are no longer attached to the brake anchor plate but to the wheel brake cylinder. As a result better contact is achieved between the brake shoes and the contact plate of the brake anchor plate.

III. Models 219, 220 a, 220 S, 220 SE and 190 SL 1st version

The cars of these models are provided with brake shoes 65 mm wide and with automatic adjustment. All cars provided with ATE Power Brake as standard equipment have Alfin front brake drums and grey-cast iron rear brake drums with radial fins.

IV. 190 SL 2nd Version

In the case of the 2nd version of the front wheel brake the brake shoes are no longer attached to the brake anchor plate, but to the wheel brake cylinder as in the case of Models 180 b, 180 D, and 190 Db.

V. ATE Power Brake

Models 190 SL, 220 a, 220 S, and 220 SE are provided with ATE Power Brakes as standard equipment, with the exception of a few older cars of Models 190 SL and 220 a. The ATE Power Brake can be installed subsequently on these cars and can also be installed as optional equipment on all models with the exception of the diesel engine models.

VI. Hand Brake

The arrangement of the hand brake is the same on all models

Job No.
42-1

Bleeding and Flushing-Out of Brake System

On Models 180 to 220 SE the bleeding and flushing out procedures for the brake system are the same as on Model 190.

Job No.
42-2

Checking of Brake System

On Models 180 to 220 SE the checking procedures for the brake system are the same as on Model 190.

Removal and Installation of Brake Master Cylinder

Job No.
42-3

A. General

The brake master cylinders on the various models differ in the cylinder diameter (see table below) and the brake line connections.

On recent models the brake master cylinder is provided with a front bleed screw. Furthermore, on models with ATE Power Brake the brake light switch is installed on the ATE Power Brake and not on the brake master cylinder. On recent cars the fluid reservoir is made of transparent plastic.

Model		Brake master cylinder Ø in.	Brake master cylinder Ø mm	Remarks
180 180 a 180 b 180 D 180 Db 190 D 190 Db	without ATE Power Brake	1"	25.4	
190 SL 220 a 219	with ATE Power Brake T 50	1 1/16"	26.96	Model 220 a as from Chassis End No. 55 13000, Model 190 SL as from Chassis End No. 65 01957 have ATE Power Brake T 50 as standard equipment
220 S	with ATE Power Brake T 50	1 1/16"	26.98	Brake master cylinder installed as standard equipment on Model 220 S up to Chassis End No. 85 19002, on Model 220 SE up to Chassis End No. 85 00217
220 S 220 SE	with ATE Power Brake T 50/12			
220 S 220 SE	with ATE Power Brake T 50/12	1 1/16"	26.57	Brake master cylinder installed as standard equipment on Model 220 S as from Chassis End No. 85 19003, on Model 220 SE as from Chassis End No. 85 00218

B. Removal and Installation

On Models 180 to 220 SE the removal and installation procedures for the brake master cylinder are the same as on Model 190. On Models 220 a, 219, 220 S, and 220 SE make sure that new copper sealing rings are used for the hollow screw when the annular nipple is screwed to the brake master cylinder.

C. Brake Master Cylinder with Fluid Reservoir Attached

Models 180, 180 D, and 220 a

Installed in the following models:

Model	up to Chassis End No
180	45 17433
180 D	45 12617
220 a	45 01933

This brake master cylinder is attached to the bracket by means of a hexagon nut and a lock washer. A brake master cylinder with separate fluid reservoir can only be installed subsequently if a new bracket is welded to the chassis base panel and if the stay rod, the compensating spring, and the return spring for the clutch actuating mechanism are replaced.

Disassembly and Reassembly of Brake Master Cylinder

Job No.
42-4

Dimensions and Tolerances

Brake master cylinder Nominal diameter	Permissible housing bore mm	Piston diameter mm
1 inch	25.400 / 25.502	25.335 / 25.252
1 1/16 inches	26.980 / 27.082	26.915 / 26.832
1 1/8 inches	28.570 / 28.672	28.505 / 28.422

Pressure Spring in Brake Master Cylinder

Brake master cylinder Nominal diameter	Pressure spring Part No.	Spring length	
		Free length mm	installed under a load of 3.2 kg mm
1 inch	000 421 31 93	73	57
1 1/16 inches	000 431 41 93	72.5	56.5
1 1/8 inches			

Removal and Installation of Front Wheel Brake Cylinders

Job No.
42-5

A. General

The front wheel brake cylinders on the various models differ in the cylinder diameter (see table).

Model	Brake cylinder diameter in.	Brake cylinder diameter mm	Remarks
180 a 180 D	1"	25.4	1st version
180 a 180 D 190 D 220 a	1 1/16"	26.98	On Models 180 a and 180 D 2nd version, on Model 220 a 1st version
180 b, 180 Db 190 190 Db 190 SL 219 220 a 220 S 220 SE	1 1/8"	28.57	On Model 220 a 2nd version

B. Removal and Installation

I. Models 180, 180 a, 180 D, and 190 D

To remove and install the wheel brake cylinder remove the brake shoes (see Job No. 42-8, Section A). Further removal procedures for the wheel brake cylinder are the same as on Model 190.

II. Models 180 b, 180 Db, and 190 Db 1st Version

Removal:

1. Remove the brake shoes (see Job No. 42-8, Section A).

2. Unscrew the hollow screws from the wheel brake cylinders and remove the brake lines from the wheel brake cylinders, paying attention to the rubber pad between the brake lines and the brake anchor plate.

3. Unscrew the three hexagon screws (3) and remove the wheel brake cylinder (4) (Fig. 42-5/1).

Installation:

4. Install the wheel brake cylinder (4) in the brake anchor plate (1) and attach by means of the three fixing screws (3). Use new lock

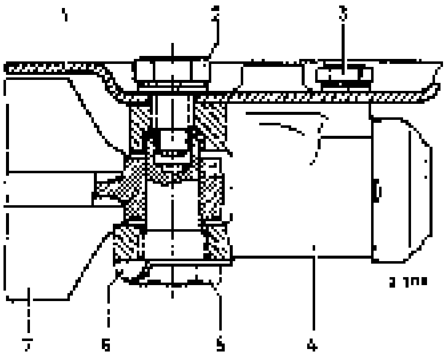


Fig. 42-5/1

1 Brake anchor plate
2 Stop screw
3 Hexagon screw
4 Wheel brake cylinder
5 Anchor pin
6 Locking plate
7 Brake shoe

washers and make sure that the fixing screws are tightened evenly (Fig. 42-5/1).

5. Attach the brake lines between the two wheel brake cylinders by means of the hollow screws using new copper gaskets. Insert the rubber pad between the brake lines and the brake anchor plate.

Note: Tighten the hollow screws carefully in order to avoid distorting the brake lines.

6. Install the brake shoes (see Job No. 42-8, Section A).

7. Bleed the brake system.

III. Models 180 b, 180 Db, 190 Db, and 190 SL 2nd Version

On these models the anchor pin (5) stop is located in the wheel brake cylinder.

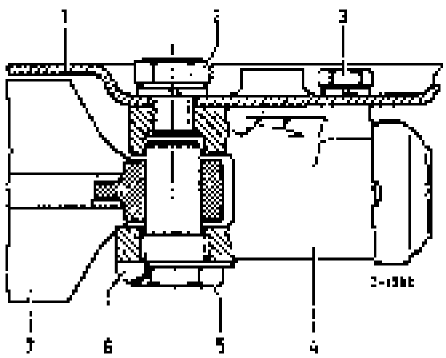


Fig. 42-5/2

1 Brake anchor plate
2 Hexagon screw
3 Hexagon screw
4 Wheel brake cylinder
5 Anchor pin
6 Locking plate
7 Brake shoe

IV. Models 220 a, 219, 220 S, 220 SE, and 190 SL 1st Version

Removal and installation procedures for the wheel brake cylinder are the same as described for Model 190.

Removal and Installation of Rear Wheel Brake Cylinder

Job No.
42-6

A. General

Model	Rear wheel brake cylinder ⌀ in inches	Rear wheel brake cylinder ⌀ in mm	Remarks
180, 180 a, 190 D, 190, 190 SL, 219, 220 a, 220 S	1"	25.4	1st version, except Model 220 a
180, 180 a, 180 b, 180 D, 180 Db, 190, 190 b, 190 D, 190 Db, 190 SL, 219, 220 S, 220 SE	15/16"	23.81	2nd version, except Models 180 b, 180 Db, 190 b, 190 D, 190 Db, and 220 SE

Note: When repairs are carried out the 1" wheel brake cylinders can be replaced by the 15/16" wheel brake cylinders.

B. Removal and Installation

I. Models 190 SL, 219, 220 a, 220 S, and 220 SE

The removal and installation procedures for the rear wheel brake cylinders are the same as described for Model 190.

II. Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, and 190 Db

The removal and installation procedures for the rear wheel brake cylinders are essentially the same as on Model 190, but in addition the return springs of the brake shoes must be detached and the brake shoes must be forced outward.

C. Wheel Brake Cylinders with Spring-Loaded Pins

On Models 190 SL, 219, 220 S, and 220 SE rear wheel brake cylinders with spring-loaded pins have been installed as from the following Chassis End Nos (Fig. 42-6/1):

Model	as from Chassis End No.
190 SL	85 00741
219	85 01607
220 S	85 02964
220 SE	65 00001

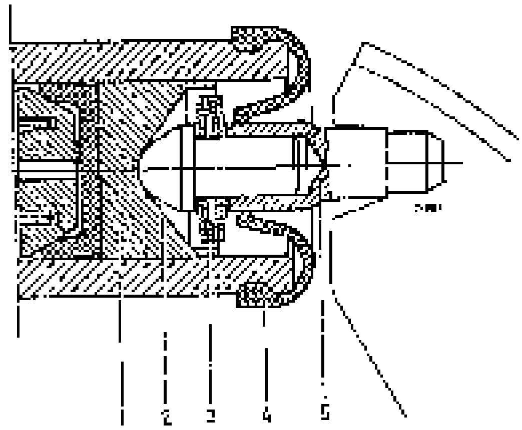


Fig. 42-6/1

1 Piston
2 Seal
3 Cup spring
4 Protective cap
5 Guide pin

When complaints are received about brake grabbing, the spring-loaded pins can be subsequently installed on older cars of Models 190 SL, 219, and 220 S (see Section D).

D. Subsequent Installation of Spring-Loaded Pins

For subsequent installation the spring-loaded pins are supplied together with the appropriate brake cylinder pistons "Wa" ∅ with Part No. 180 420 00 74. If older cars are fitted with wheel brake cylinders with a piston diameter of 1", the pistons must be re-machined as shown in Fig. 42-6/2.

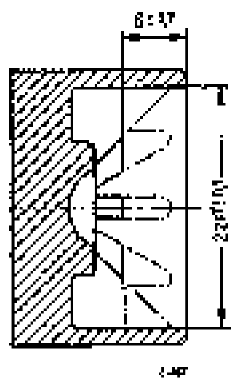


Fig. 42-6/2

Installation Hints

a) When installing the spring-loaded pins, pay attention to the required number and the correct positioning of the cup springs. Mount 4 cup springs on each spring-loaded pin in such a way that one pair of cup springs is supported by the other pair, so that the desired spring action is obtained (see Fig. 42-6/1).

Note: In order to reduce pedal travel, recent cars are fitted with 15 mm cup springs in place of the 1st version 20 mm diameter springs.

b) After installing the spring-loaded pins, depress the brake pedal several times with the car stationary. Then take the car on the road to warm up the brakes, so that the brake shoes are adjusted properly and unnecessary pedal travel is prevented. As a result of the resilient spring-loaded pins, pedal travel is automatically somewhat increased. In order to ensure that this increase remains within normal limits particular attention should be paid too proper and satisfactory wear pattern of the brake linings. Furthermore the whole brake system must be properly bled and the automatic adjustment must have proper clearance.

c) Installation of spring-loaded pins does not automatically prevent brake grabbing if this should be due to other causes; in such cases check the brake system in order to trace the fault, in particular check the rear axle suspension, the uniform efficacy of the shock absorbers, check the brake drums for out-of-roundness, for eccentricity, and for variation in wall thickness.

Job No.
42-7

Disassembly and Reassembly of Wheel Brake Cylinders

On Models 180 to 220 SE the disassembly and reassembly procedures for the front and rear wheel brake cylinders are the same as on Model 190.

When reassembling wheel brake cylinders with spring-loaded pins, pay particular attention to the correct position of the cup springs (see Job No. 42-6, Section D).

Dimensions and Tolerances

Wheel brake cylinder Rated diameter	Housing bore mm	Piston diameter mm	Permissible piston clearance mm
15/16"	$\frac{23.810}{23.912}$	$\frac{23.745}{23.662}$	$\frac{0.065}{0.250}$
1 inch	$\frac{25.400}{25.502}$	$\frac{25.335}{25.252}$	
1 1/16"	$\frac{26.980}{27.082}$	$\frac{26.915}{26.832}$	
1 1/8"	$\frac{28.570}{28.672}$	$\frac{28.505}{28.422}$	

Removal and Installation of Front Brake Shoes

Job No.
42-8

A. Removal and Installation

I. Models 219, 220 a, 220 S, 220 SE, and 190 SL 1st Version

The removal and installation procedures for the front brake shoes are the same as on Model 190.

II. Models 180, 180 a, 180 D, and 190 D

The removal and installation procedures for the front brake shoes are essentially the same as on Model 190, but the section on the automatic adjustment of the brake shoes does not apply since the brakes are provided with mechanical adjustment (Fig. 42-8/1).

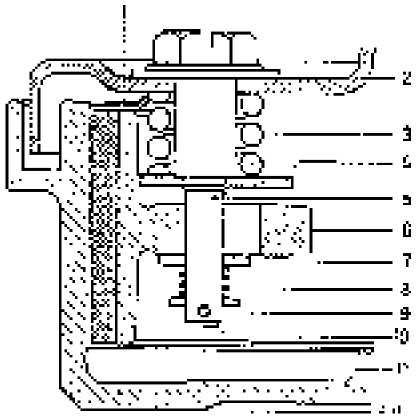


Fig. 42-8/1

1 Contact plate
2 Brake anchor plate
3 Pressure spring
4 Adjustment eccentric
5 Adjustment bolt
6 Brake shoe
7 Washer for brake shoe guide
8 Pressure spring
9 Washer
10 Cotter pin
11 Brake drum

III. Models 180 b, 180 Db, and 190 Db 1st Version

Removal:

1. Jack up the car and remove the brake drum

2. Detach the two return springs by means of Brake Spring Pliers 000 589 01 37.

Note: Put a suitable pad under the brake spring pliers to prevent damage to the brake lining.

3. Loosen the hexagon screw (9) and remove the washer (8), the spring (7), and the washer (6) (Fig. 42-8/2).

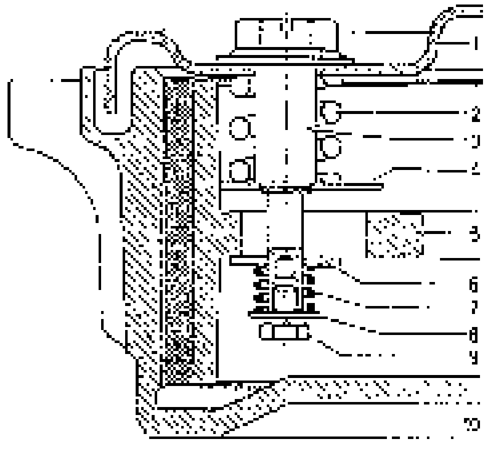


Fig. 42-8/2

1 Brake anchor plate
2 Pressure spring
3 Adjustment bolt
4 Eccentric
5 Brake shoe
6 Washer
7 Pressure spring
8 Washer
9 Hexagon screw
10 Brake drum

4. Unscrew the stop screw (2) (Fig. 42-8/3).

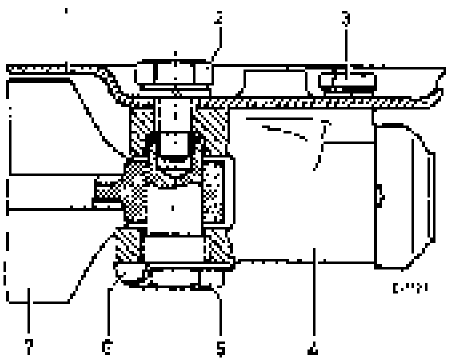


Fig. 42-8/3

1 Brake anchor plate
2 Stop screw
3 Hexagon screw
4 Wheel brake cylinder
5 Anchor pin
6 Locking plate
7 Brake shoe

5. Bend the locking plate (6) upward and screw the anchor pin (5) from the eye of the wheel brake cylinder (4) (Fig. 42-8/3).

6. Remove the brake shoes.

7. Follow the same procedure in removing the second brake shoe.

8. Remove the retaining pins from the wheel brake cylinders.

9. Thoroughly clean the brake shoes and the brake anchor plate with compressed air.

Installation:

10. Press the retaining pin into the wheel brake cylinder and install the brake shoe in the brake anchor plate.

11. Place the locking plate (6) over the anchor pin (5) and screw in the anchor pin (Fig. 42-8/3).

12. Secure the anchor pin with the locking plate.

13. Screw in and tighten the stop screw (2) (Fig. 42-8/3).

14. First place in position the large washer (6), the pressure spring (7), and then the small washer (8) and screw in the hexagon screw (9) until it is positioned against the adjustment bolt (3) (see Fig. 42-8/2).

Note: The purpose of the pressure spring (8) is to press the brake shoe against the contact plate of the brake anchor plate.

15. Attach the return springs.

16. Install the brake drum and the wheel.

17. Adjust the brakes (see Job No. 42-20, Section A).

18. Jack down the car.

IV. Models 180 b, 180 Db, and 190 Db 2nd Version

The stop screw need not be removed since the anchor pin (5) stop is located in the wheel brake cylinder (4) (Fig. 42-8/4).

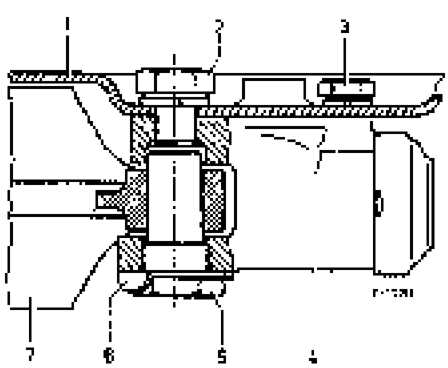


Fig. 42-8/4

1 Brake anchor plate
2 Hexagon screw
3 Hexagon screw
4 Wheel brake cylinder
5 Anchor pin
6 Locking plate
7 Brake shoe

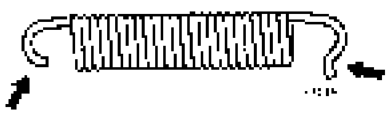
V. 190 SL 2nd Version

In this version the brake shoes are attached to the wheel brake cylinder (For removal and installation of brake shoes see Job No. 42-8, Section A, III and Workshop Manual for Model 190).

B. Return Springs for Brake Shoes

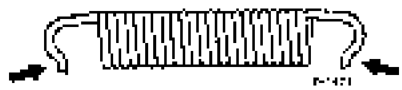
Various types of return springs have been installed on the individual models (see Table).

Model	Part No.	Spring length free length mm	Spring length under normal load mm	Load kg	Spring steel wire Ø mm	Remarks
180 180 D 180 a 190 190 D 190 SL 220 a 219 220 S	120 993 08 10 (a standard eye and an open eye Fig. 42-8/2)	95.5	114	36.5	2.5	On Models 190, 219, 220 S, and 190 SL 1st version
180 a 180 Db 190 190 b 190 Db 190 SL 219 220 S 220 SE	190 993 25 10 (both eyes open Fig. 42-8/2)	84.0	114	28.9	2.5	On Models 190, 219, 220 S, and 190 SL 2nd version



Return spring
Part No. 120 993 08 10

Fig. 42-8/2



Return spring
Part No. 190 993 25 10

Note: a) When installing the brake shoes make sure that return springs of the same elastic force are mounted.

b) Use only 2nd version springs on cars of Models 220 S and 220 SE with ATE Power Brake T 50/12.

C. Bolt for Automatic Brake Shoe Adjustment

(see Job No. 42-10).

Job No.
42-9

Removal and Installation of Rear Brake Shoes

A. Removal and Installation

I. Models 190 SL, 219, 220 a, 220 S, and 220 SE

The removal and installation procedures for the rear brake shoes are the same as on Model 190.

Note: On recent cars the reinforcing plate of the brake anchor plate or the collar bushing for the automatic adjustment attachment is no longer installed (see Fig. 42-9/1 Workshop Manual Model 190).

II. Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, and 190 Db

The removal and installation procedures for the rear brake shoes are essentially the same as on Model 190, but the automatic adjustment for the brake shoes need not be removed since the brakes are provided with a mechanical adjustment (see Fig. 42-8/1).

B. Return Springs for Brake Shoes

Various types of return springs have been installed on the individual models (see Table).

Model	Part No.	Spring length: free length mm	Spring length: under norm. load mm	Load kg	Spring steel wire ⌀ mm	Remarks
180 180 a 180 b 180 D 180 Db 190 D 190 Db	120 993 20 10	134	160	30	2.4	
190 190 SL 219 220 a 220 S	180 993 11 10 left 180 993 12 10 right	118.5	166.5	30.5	2.4	1st and 3rd versions except Model 220 a
190 190 SL 219 220 S 220 SE	180 993 23 10 left	126.5	166.5	13.0	2.0	2nd version except Model 220 SE
	180 993 24 10 right	107.0		18.1		

Note: When installing the brake shoes make sure that return springs of the same elastic force are mounted.

C. Bolt for Automatic Brake Shoe Adjustment

(see Job No. 42-10)

Disassembly and Reassembly of Automatic Adjustment

Job No.
42-10

A. Disassembly and Reassembly

On Models 190 SL, 219, 220 a, 220 S, and 220 SE the disassembly and reassembly procedures for the automatic brake shoe adjustment are the same as on Model 190.

B. Bolt for Automatic Brake Shoe Adjustment

For reasons of standardization and in order to enlarge the clearance of the brake shoes recent cars of Models 190 SL, 219, 220 S, and 220 SL have been provided **both on the front axle and on the rear axle** with bolts of equal diameter for the automatic brake shoe adjustment. As a result there is a uniform brake shoe clearance on the front axle and on the rear axle of **1.0** mm.

The bolts providing a clearance of 1.0 mm can be identified by the shoulder on the hexagon head (Fig. 42-10/2). (On previous cars bolts on the front axle provided a brake shoe clearance of 0.8 mm and on the rear axle of 1.0 mm)

Before this change was made bolts giving a clearance of 1.3 mm were installed on the leading brake shoes of the rear axle. These bolts can be identified by a groove on the hexagon head (Fig. 42-10/1).

The adjusting sleeves in the brake shoes have the same internal diameter on all models.

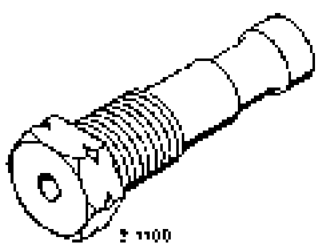


Fig. 42-10/1

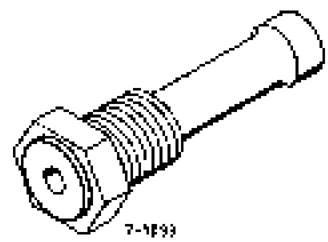


Fig. 42-10/2

Dimensions and Tolerances of Automatic Adjustment in mm

Brake shoe	Version	Bolt Part No.	Bolt Diameter	Adjusting sleeve Internal Ø	Adjusting sleeve Length	Clearance between bolt and adjusting sleeve
Front Axle						
leading	1st	180 421 02 71	11.200 / 11.173	12.000 / 12.070	36	0.800—0.885
leading	2nd	180 421 05 71	11.000 / 10.973			1.000—1.085
Rear Axle						
leading and trailing	1st	180 423 02 71	11.000 / 10.973	12.000 / 12.070	30	1.000—1.085
leading	2nd	180 423 03 71	10.700 / 10.673			1.300—1.385
leading		180 423 02 71	11.000 / 10.973			1.000—1.085
leading and trailing	3rd	180 421 06 71	11.000 / 10.973			1.000—1.085

Note: The front axle has 4 leading brake shoes, the rear axle has 2 front leading brake shoes and 2 rear trailing brake shoes.

Replacement and Conditioning of Brake Linings

Job No.
42-11

A. Replacement of Brake Linings

Since for all models the brake linings are bonded to the shoes by a special process in our works, the brake linings can only be replaced by replacing the brake shoes.

Under certain circumstances the brake linings can be riveted to the brake shoes. The procedures are the same as described for Model 190, but please note that in the case of the 50 mm wide brake shoe the mean hole distance is 32 mm instead of 41 mm and the lateral hole distance is 9 mm instead of 12 mm (see Fig. 42-11/1 in Workshop Manual 190).

B. Conditioning of Brake Linings

a) General

A satisfactory wear pattern is of the utmost importance to prevent the car from pulling to one side and to ensure fully effective braking. A satisfactory wear pattern can be obtained by wearing the brake in with the help of sand-blasted or knurled brake drums or by conditioning the brake linings by means of Brake Lining Miller 000 589 03 66.

It is particularly important to obtain a satisfactory wear pattern by the methods described above if new brake shoes have been installed, when complaints are received about uneven brake action or pulling of the car to one side and if glazed spots or signs of overheating are found on the brake linings.

b) Conditioning of Brake Linings with Sand-Blasted Drums

The brake drums can be sand-blasted by means of a sand-blasting apparatus using quartz sand or medium-grain blasting sand. It is advisable to use a special set of sand-blasted brake drums for wearing in the brakes; this set should be used exclusively for this purpose. It goes without saying that the internal diameter of these brake drums should correspond to the prescribed standard.

After installing the sand-blasted brake drums the brake should be worn in by carefully braking several times on a trial run of at least 10 km. After the trial run remove the brake drums, thoroughly clean the brakes with compressed air, and check the wear pattern. Reinstall the brake drums of the car.

If special drums for wearing in are not available, the drums of the car itself can also be used for the purpose. In this case sand-blasting must be done carefully and with a very small grain in order to ensure that there is no roughness on the braking area after the brakes have been worn in.

c) Conditioning of Brake Linings with the Brake Lining Miller

When brake linings are conditioned by means of the Brake Lining Miller 000 589 03 66 or 000 589 07 66, it is advisable to mill the brake linings down to a diameter 0.5–0.6 mm smaller than the brake drum diameter and not as was described in the Workshop Manual Model 190 to a diameter 1.5 mm smaller. With this new procedure a satisfactory wear pattern will be obtained after a short mileage.

Before milling, re-adjust the brake shoes with mechanical adjustment by moving the adjustment eccentric on the brake anchor plates and adjust the brake shoes with automatic adjustment by means of the pressure screws on the clamps. It is not permissible to back out the adjusting screw of the miller and to turn it in again. Make sure that the brake shoe adjustment is not excessive since the miller will not work accurately when too much stock is removed.

When milling used brake linings it is advisable to remove glazed spots on the lining surface with a file before starting operations. Do not continue milling once the surface of the brake linings is perfectly smooth all round

I. Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, and 190 Db

1. The brake shoes with adjustment eccentrics on the brake anchor plate should be pushed outward until the brake linings contact the brake drum. Then turn the adjustment eccentric back until the brake drum moves freely.

Note: If the brake shoes are being adjusted with the wheels removed from the vehicle, the brake drums must be fixed by means of two wheel nuts.

2. Remove the brake drum and install the brake lining miller with three wheel nuts.

Note: The Cutter 000 589 32 51 or 120 589 00 51 (10 mm ⌀, 60 mm long) must be Fixed in such a way that it does not touch the brake anchor plate.

3. After loosening the locking nut, adjust the miller by means of the adjusting screw in such a way that the cutter just touches the highest spot on the brake linings. In this position **turn the adjusting screw in ¼ turn.** Tighten the locking nut without turning the adjusting screw.

4. Then move the miller over the brake linings in the opposite direction to the rotation of the cutter.

5. If the brake shoes have to be milled several times, turn them outward by means of the adjustment eccentrics on the brake anchor plate.

II. Models 190 SL, 219, 220 a, 220 S, and 220 SE

The brake lining miller is used in the same way as on Model 190. Only the following differences require attention.

Adjustment of Brake Lining Miller

When the cutter has been set in such a way that it just touches the highest spot of the brake shoes in their released position, the adjusting screw of the miller should be adjusted as follows:

On brake shoes with a **clearance of 0.8 mm back out the adjusting screw ¼ turn,**
on brake shoes with a **clearance of 1.0 mm back out the adjusting screw ⅓ turn.**

Note: In the case of the intermediate version where the clearance of the brake shoes on the rear axle is 1.3 mm for the leading shoe and 1.0 mm for the trailing shoe proceed from the trailing shoe and **back out** the adjusting screw of the brake lining miller ⅓ **turn.**

Reconditioning of Brake Drums

Job No.
42-12

On Models 180 to 220 SE the reconditioning procedures for the brake drums are the same as on Model 190.

Brake Lines

Job No.
42-13

The details about brake lines given in the Workshop Manual Model 190 also apply to Models 180 to 220 SE.

Particular importance should be attached to careful and regular checking of the brake lines (every 48 000 km or every two years). Heavily corroded brake lines should always be replaced and only galvanized lines should be used as replacement parts.

The protective rails for the brake lines are no longer installed. On older cars the protective rails can be removed, provided that the protective plate for the pedal system is installed, if the cars should be provided with it as a protection against chipping by stones.

Part numbers of the protective plate for the pedal system:

Models 180, 180 a, 180 D, 190 D, 190 SL	120 524 11 33
Models 220 a, 219, 220 S, and 220 SE	180 524 02 33

Removal and Installation of ATE Power Brake

Job No.
42-14

A. General

Models 190 SL, 220 a, 220 S, and 220 SE have ATE Power Brakes as standard equipment with the exception of a few older cars of Models 190 SL and 220 a. Models 180 a, 180 b, and 219 can be equipped with a power brake as an optional extra.

On Models 180 a, 180 b, 219 and on older cars of Models 190 SL and 220 a the ATE Power Brake can also be installed subsequently. The power brake differs for the individual models (see table).

Model	Designation of power brake	Remarks
180 a, 180 b 190, 190 b 219	ATE T 50	Installed as optional equipment
190 SL	ATE T 50	Up to Chassis End No. 6501956 installed as optional extra, as from Chassis End No. 6501957 installed as standard equipment.
220 a	ATE T 50	Up to Chassis End No. 5512999 installed as optional extra, as from Chassis End No. 5513000 installed as standard equipment.
220 S	ATE T 50	Installed as standard equipment up to Chassis End No. 7511920
	ATE T 50/12	Installed as standard equipment as from Chassis End No. 7511921
220 SE	ATE T 50/12	Installed as standard equipment

The two ATE Power Brakes T 50 and T 50/12 differ in length and diameter of the cylinders and pistons (see table).

Power brake mode	Overall length mm	Vacuum power cylinder		Hydraulic slave cylinder		Control valve piston	
		in. ⌀	mm ⌀	in. ⌀	mm ⌀	in. ⌀	mm ⌀
ATE T 50	222	6¾	171.5	1	25.4	5/16	7.94
ATE T 50/12	292	6¾	171.5	11/16	17.46	3/8	9.52

B. Vacuum Cup in ATE Power Brake

Previous models of ATE Power Brakes T 50 and T 50/12 were equipped with a leather vacuum cup. On recent power brakes plastic vacuum cups have been installed. **For these plastic cups oil lubrication is no longer required.** For this reason power brakes with plastic cups are not equipped with a screw plug on the vacuum power cylinder.
During a transition period a certain number of power brakes with plastic cups had the screw plugs screwed into the vacuum power cylinder from the inside.

C. Testing of ATE Power Brakes

The test values for the individual power brakes are listed in the table below.

Power Brake	Beginning of braking power assistance at control pressure kg/cm²	Vacuum kg/cm²	Hydraulic control pressure of brake master cylinder kg/cm²	Hydraulic servo pressure of power brake kg/cm²	Braking power multiplication factor
ATE T 50	3.5	0.4	25	47	approx. 2
		0.6	29	55	
		0.8	33	61	
ATE T 50/12	3.2	0.4	13.4	41.5	approx. 3.5
		0.8	18.8	64.5	
		0.6	24	87	

The various tests should be made in accordance with the details given in the ATE Power Brake T 50 servicing instructions published by the firm of Teves.

Power brakes without a screw plug on the vacuum power cylinder have a screw plug for connecting a vacuum tester on the control valve tube connection on the front part of the power brake.

D. Removal and Installation

I. Models 180 a, 180 b, 219, 220 a, 220 S, and 220 SE

The arrangement and the removal and installation procedures for the ATE Power Brake are the same as on Model 190.

II. Model 190 SL

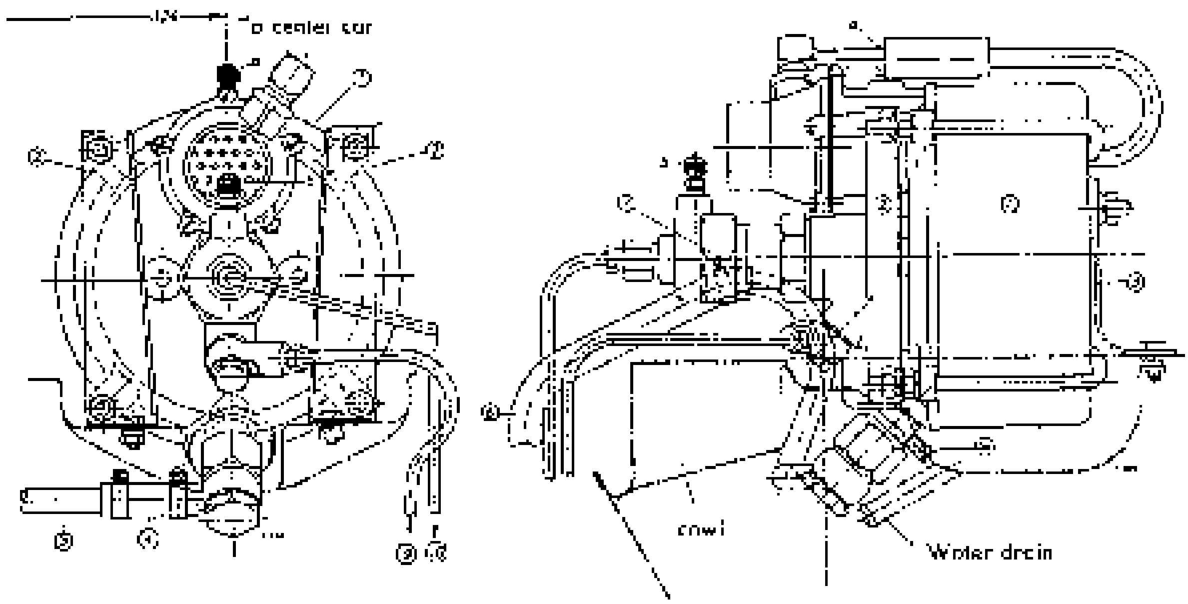


Fig. 42-14/1

1 ATE Power Brake
2 Front bracket
3 Rear bracket
4 Connecting hose
5 Vacuum line
5a Rubber grummet
6 Connecting hose with supporting spring
7 Hose clip
9 Brake line between brake master cylinder and power brake
10 Brake line between power brake and distributor union
a Upper bleed screw
b Lower bleed screw

Removal:

1. Unscrew the hollow screw of the annular nipple for the vacuum line (5) working from the interior of the car. Detach the hose clip at the annular nipple and remove the nipple from the connecting hose (4) (Fig. 42-14/1).

2. Unscrew the check valve from the power brake, paying attention to the copper sealing ring.

3. Disconnect the cables of the stop light switch at the annular nipple and disconnect the brake line (10) (Fig. 42-14/1).

Note: On the 1st version the stop light switch is screwed into the brake master cylinder and not into the annular nipple of the power brake, so that it is not necessary to disconnect the cables.

4. Disconnect the brake line (9) on the power brake. Unscrew the hexagon nuts fixing the power brake to the front brackets (2) from the interior of the car and remove together with lock washers and washers (see Fig. 42-14/1).

5. Unscrew the hexagon nut, attaching the power brake to the rear bracket (3) and remove together with lock washer and washer.

6. Remove the power brake upward and unscrew the two front brackets (2) from the power brake (see Fig. 42-14/1).

Installation:

7. Screw the two front brackets to the power brake.

8. Install the power brake and screw in the check valve with a new copper sealing ring.

9. Tighten the nuts on the two hexagon screws on the front brackets and the hexagon nut on the rear bracket after having made sure that all lock washers and washers have been installed.

10. Tighten the check valve, making sure that the rubber grommet is properly seated.

    Slide the annular nipple onto the connecting hose of the vacuum line and screw in and tighten the hollow screw, using new copper sealing rings. Tighten the hose clip on the connecting hose.

Note: When tightening the hollow screw hold the check valve steady with an SW 32 wrench.

11. Connect the two brake lines and connect the cables to the stop light switch.

12. Bleed the brake system as usual and check the hydraulic part and the vacuum system for leaks.

Subsequent Installation of ATE Power Brake T 50

Job No.
42-15

I. Models 180 a, 180 b, and 219

The ATE Power Brake T 50 is installed in the same way as on Model 190.

On Model 219 an annular nipple for connecting the brake lines is screwed into the brake master cylinder, whereas on Models 180 a, 180 b, and 190 a distributor union is fixed to the chassis base panel. The location of the annular nipple on the brake master cylinder is the same as on Models 220 a, 220 S, and 220 SE.

II. Model 220 a

The procedures for the subsequent installation of ATE Power Brake T 50 are essentially the same as for Model 190. The following paragraphs contain details deviating from this basic procedure.

1. Attachment of Bracket for the Power Brake

On older cars there are no threaded bores in the cowl for the brackets of the power brake. On these cars the bracket for the ATE Power Brake should be attached to the threaded bore for attaching the bracket for the fuse box. Then mark and drill the three holes for the riveting nuts. Please note that in the front the bracket is flush with the cowl. The lateral check dimension from center car to center power brake is 145 mm as on Model 190. Use a special appliance to fix the three riveting nuts M 6 in the holes or weld them. Before welding the nuts, remove the inside cowl panel below the instrument panel.

2. Vacuum Connection on Intake Manifold

Replace any intake manifolds which have no eye for the threaded union by a new intake manifold with threaded union. In the case of intake manifolds with eye but without thread cut a thread M 14 x 1.5 at right angles to the eye face. When screwing in the threaded union, coat the thread with Starryte Sealing Compound.

3. Brake Master Cylinder

Replace the brake master cylinder with 1" cylinder diameter by a new brake master cylinder with 1 1/16" cylinder diameter.

On cars which have a brake master cylinder with fluid reservoir attached (up to Chassis End No. 45 01933) also replace the brake master cylinder bracket welded to the chassis base panel (for details see Job No. 42-3)

Screw on annular nipple for connecting the brake lines to the brake master cylinder. The location of the nipple is the same as on Models 220 S and 220 SE (see Job No. 42-3).

4. Brake Drums

On the front axle replace the grey-cast iron brake drums by new Alfin brake drums, using brake drums Part No. 121 420 01 05 up to Chassis End No. 55 09258 (diameter of brake anchor plate 258 mm) and brake drums Part No. 121 420 00 05 as from Chassis End No. 55 09259 (diameter of brake anchor plate 256 mm).

5. Bolt for Automatic Brake Shoe Adjustment

On cars up to Chassis End No. 55 02005 equipped with the 1st version of the automatic brake shoe adjustment the bolts screwed into the brake anchor plates must be replaced.

Part No. of bolts for front axle: 180 421 01 71

Part No. of bolts for rear axle: 180 423 01 71

III. Model 190 SL

The procedures for the subsequent installation of an ATE Power Brake are essentially the same as described in Job No. 42-14. The following paragraphs contain details deviating from this basic procedure.

1. Attachment of ATE Power Brake to the Cowl

The holes for attaching the brackets of the power brake and the through-way holes for the vacuum line have already been drilled into the cowl and are closed by rubber plugs. When installing the power brake, clear the holes in the cowl and install suitable rubber grommets in the two through-way holes.

2. Vacuum Line

Attach the vacuum line to the cowl from the interior of the car by means of two pipe clips 1 x 12 DIN 72571.

3. Vacuum Connection on Intake Manifold

Turn out the screw plug of the compensating canal on the rear intake manifold and screw in the threaded union for the vacuum line coating the thread with Starryte Sealing Compound.

4. Brake Master Cylinder

Replace the brake master cylinder with 1" cylinder diameter by a new brake master cylinder with 15/16" cylinder diameter.

Attach a distributor union to the chassis base panel for connecting the brake lines. The necessary threaded bolt Part No. 121 435 00 74 should be electrically welded to the chassis base panel as shown in Fig. 42-15/1.

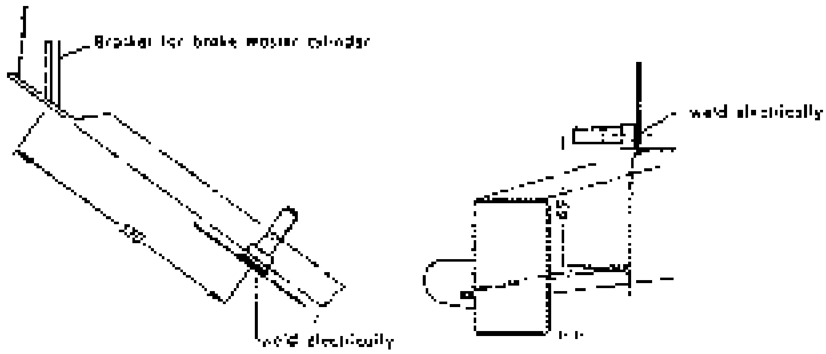


Fig. 42–15/1

The threaded bolt is a standard part as from Chassis End No. 55 00101.

When connecting the brake lines to the distributor union, connect the line to the right front wheel with the additional line Part No. 121 420 04 26 by means of a coupling.

Trouble Shooting Hints for the Brake System

Job No.
42–16

On Models 180 to 220 SE the same trouble shooting hints apply as on Model 190.

Job No.
42–18

Ratchet and Brake Lever of Pistol-Grip Hand Brake

A. Removal and Installation of Hand Brake Ratchet

I. Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 220 a, 219, 220 S, and 220 SE

The arrangement of the pistol-grip hand brake and the removal and installation procedures for the ratchet are the same as on Model 190.

II. Model 190 SL

Also on this model the pistol-grip hand brake is arranged on the left side below the steering column. The guide tube of the ratchet is not attached to the steering column jacket but to the cowl (by two hexagon screws at the top and by the pulley bearing (21) below), and the front brake cable is carried by the brake cable pulley (17) (Fig. 42–18/1).

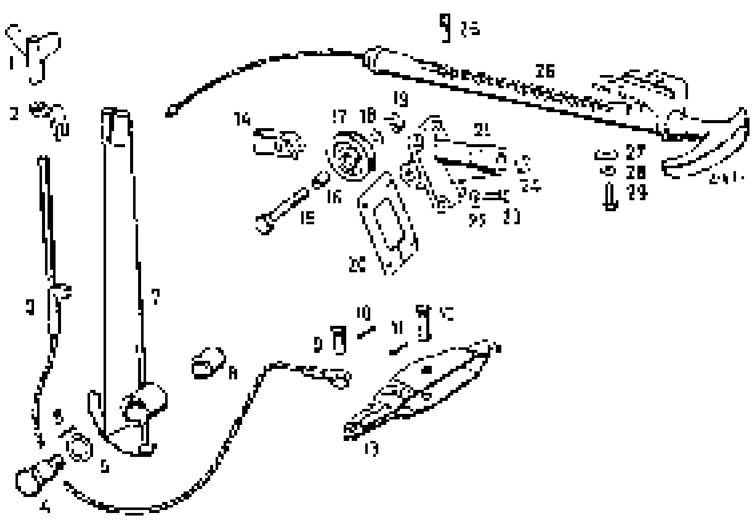


Fig. 42–18/1

1 Wing nut
2 Bracket
3 Center brake cable
4 Anchor pin
5 Cotter pin
6 Washer
7 Brake pedal
8 Bushing
9 Bolt
10 Cotter pin
11 Cotter pin
12 Bolt
13 Equalizer
14 Guide plate
15 Hexagon screw
16 Spacer sleeve
17 Brake cable pulley
18 Spring washer
19 Hexagon nut
20 Pad
21 Pulley bearing
22 Spring washer
23 Hexagon screw
24 Spring washer
25 Guide pin
26 Pistol-grip hand brake, complete
27 Washer
28 Lock washer
29 Hexagon screw

The removal procedures for the ratchet are essentially the same as on Model 190, but in addition the brake cable pulley (17) must be removed. To do this loosen and remove the hexagon nut (19) together with spring washer (18) and pull out the hexagon screw (15). Remove the pulley (17) together with spacer sleeve (16) and guide plate (14).

When reinstalling the ratchet make sure that the guide plate (14) is properly seated on the pulley (17) (Fig. 42–18/1).

B. Removal and Installation of Hand Brake Lever

On Models 180 to 220 SE the arrangement and the removal and installation procedures for the brake lever are the same as on Model 190.

Center and Rear Brake Cable

Job No.
42–19

On Models 180 to 220 SE the removal and installation procedures for center and rear brake cable are the same as on Model 190.

Adjustment of Brakes

Job No.
42–20

A. Brakes with Mechanical Adjustment

1. After jacking up the car check whether all wheels turn freely.

Note: If a wheel is difficult to turn, determine the cause (seized up brake shoes, wheel brake cylinder or hand brake cable).

2. On each wheel turn the adjustment bolt (eccentric) outward until the brake shoes contact the brake drums, i. e. until considerable resistance is felt when turning the wheel.

Note: The brake shoes should only be adjusted when the brake drums are cold.

3. Carefully back out the adjustment bolt (eccentric) until the wheel turns freely.

4. Depress the brake pedal and check whether the wheels turn freely when the pedal is released.

5. After a trial run check again whether the brake shoes are properly released.

B. Adjustment of Hand Brake

The adjustment procedure for the hand brake is the same as on Model 190.

Steering

46

Steering Assembly

Job No.
46–0

A. DB Re-Circulating Ball Steering Type LO (Previous Version)

Model 180 up to Chassis End No. 45 11768

Model 180 D up to Chassis End No. 45 07593

Like the 1st version of the standard re-circulating ball steering this version of the re-circulating ball steering has a gear ratio of 1 : 19.4. However, the construction of the steering differs from that of the standard re-circulating ball steering in the following details:

1. The steering worm is carried in angular contact bearings.
2. The cables for the horn and the flash direction signals are wound round the steering tube and emerge from the steering column jacket at the bearing assembly of the steering wheel gear shift mechanism.
3. The diameter of the serrated part of the steering worm is 15.4 mm.
4. The diameter of the bearing surfaces of the steering shaft was changed from 25.4 mm to 28.5 mm and later to 30.0 mm as on the standard re-circulating ball steering.
5. The set screw for the steering shaft has an M 24×1.5 thread (Fig. 46–0/1 and Table).

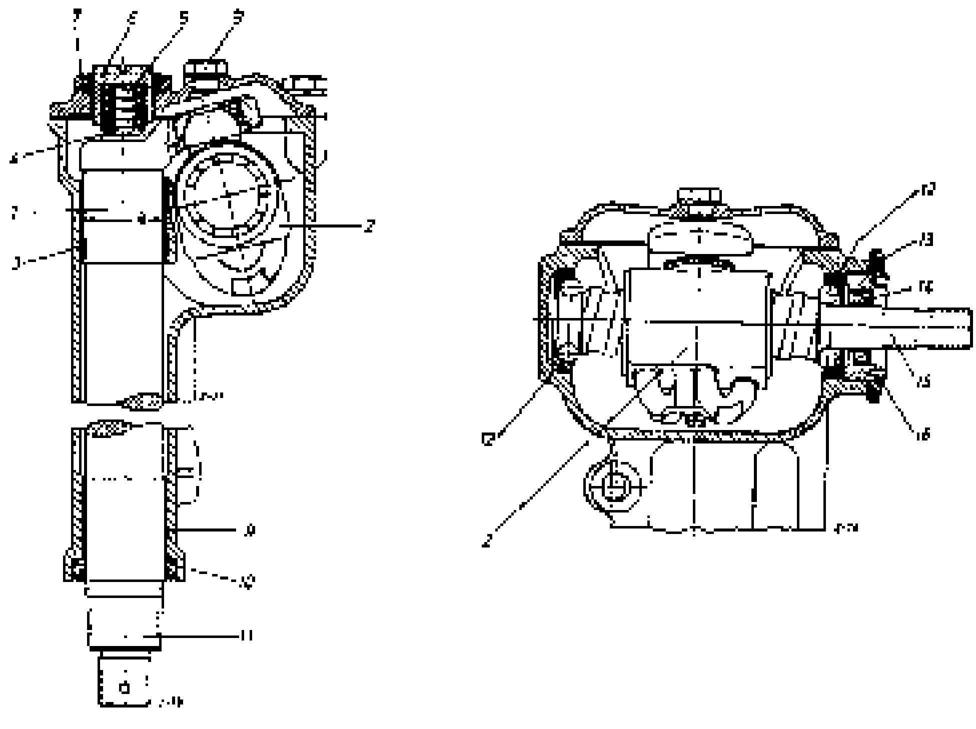


Fig. 46–0/1

DB Re-Circulating Ball Steering (Previous Version)

a Steering shaft diameter
1 Steering shaft
2 Steering nut
3 Upper bearing bushing
4 Pressure sleeve
5 Pressure spring
6 Set screw
7 Hexagon nut
8 Screw plug
9 Lower bearing bushing
10 Sealing ring
11 Serrations for steering gear arm
12 Angular contact bearing
13 Hexagon nut
14 Sealing ring
15 Steering worm
16 Adjusting ring

Model	Steering Assembly Part. No.	Version	Steering Shaft Mounting Ø "c"	Remarks
180	120 460 11 01	1st	25.4 mm	Installed up to Chassis End No. 35 00220
180	120 460 16 01	2nd	28.5 mm	Installed from Chassis End No. 35 00221 to 35 00964
180 180 D	120 460 14 01	3rd	30.0 mm	Installed on Model 180 from Chassis End No. 35 00965 to 45 11768, on Model 180 D up to Chassis End No. 45 07993

Gear Ratios of DB Re-Circulating Ball Steering Type LO (Previous Version)

Model	Steering Assembly Part. No.	Steering Assembly Steering Gear Ratio	Steering Gear Arm Part No.	Steering Gear Arm Length in mm	Overall Gear Ratio
180	120 460 11 01 120 460 16 01 120 460 14 01	1 : 19.4	120 463 02 01 120 463 05 01	152	1 : 15.3
180 D	120 460 14 01	1 : 19.4	120 463 03 01	140	1 : 16.6

Note: The gear ratio data are given with reference to the steering shaft in the dead center position. On lock the gear ratio is slightly smaller.

It is possible subsequently to replace the previous version of the re-circulating ball steering by the standard re-circulating ball steering provided that the steering tube, the steering coupling and the cable harness are replaced. In addition the steering assembly must have a steering gear arm Part No. 120 463 05 01 and a steering relay arm Part No. 120 460 10 19.

B. DB Re-Circulating Ball Steering Type LO

On Models 180 to 220 SE the DB standard re-circulating ball steering type LO is the same as on Model 190. On Models 180, 180 D, 190 SL and 220 a two different versions of the standard re-circulating ball steering were installed:

The DB standard re-circulating ball steering type LO 1st version Part No. 120 460 24 01 with a gear ratio of 1 : 19.4 was installed in the following cars:

Model 180 from Chassis End No. 45 11769 to 55 16274
Model 180 D from Chassis End No. 45 07994 to 55 19025
Model 190 SL up to Chassis End No. 55 01501
Model 220 a up to Chassis End No. 55 18013

The DB standard re-circulating ball steering type LO 2nd version Part No. 120 460 31 01 with a gear ratio of 1 : 23.4 was installed in the following cars:

Model 180	from Chassis End No. 55 16275
Model 180 D	from Chassis End No. 55 19026
Model 190 SL	from Chassis End No. 55 01502
Model 220 a	from Chassis End No. 55 18014

The two versions of the standard re-circulating ball steering differ not only in the gear ratio but also in the steering shaft, the steering shaft arm being inclined upward on the 1st version and being horizontal on the 2nd version. In addition the arm is longer on the 2nd version so that in the dead center position the steering nut is no longer inclined inward but slightly outward. The tilting action of the steering nut which takes place when the steering is turned is considerably less and the axial movement of the steering shaft is reduced to a minimum. The steering housing cover is also different on the two versions.

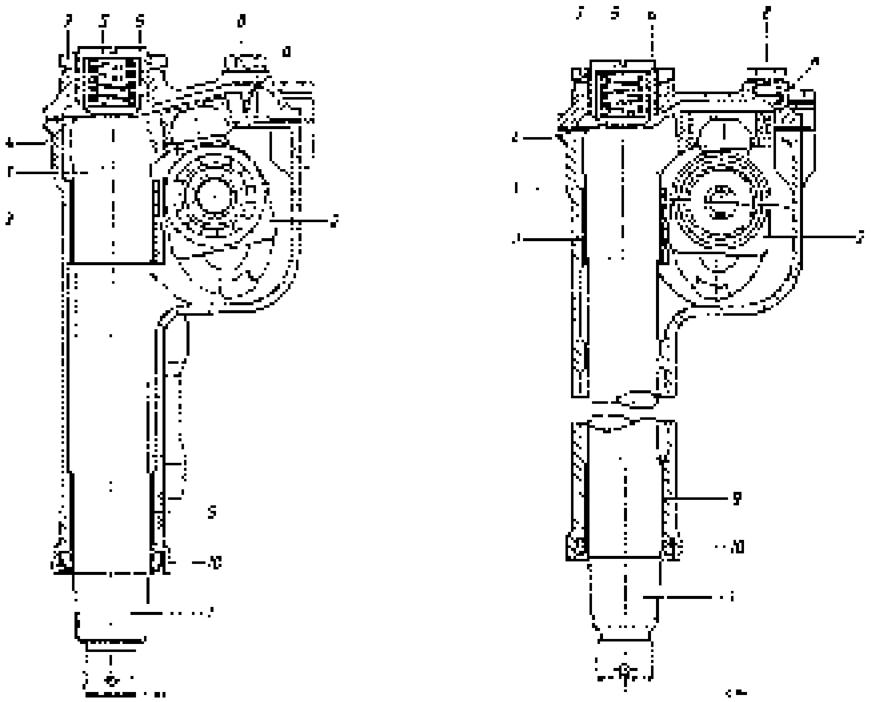


Fig. 46-02

DB Standard Re-Circulating Ball Steering Type LO

1st Version	2nd Version
a Mid-position center of steering shaft arm	5 Pressure spring
1 Steering shaft	6 Set screw
2 Steering nut	7 Hexagon nut
3 Upper bearing bushing	8 Screw plug
4 Pressure sleeve	9 Lower bearing bushing
	10 Sealing ring

On Models 180, 180 D, 190 SL, and 220 a, the 1st version can be subsequently replaced by the 2nd version steering. When this is being done the following details require attention:

a) If 140 mm steering gear arm and steering relay arm are installed on Model 180 D, these two arms must be replaced by arms 152 mm long when the 2nd version standard re-circulating ball steering is installed (see Table Page 46-11).

b) On Model 190 SL the steering gear arm and steering relay arm of the 1st version can be used or can be replaced by the 2nd version. It is not permissible, however, **to install a 2nd version steering gear arm together with a 1st version steering relay arm or vice versa** on any car.

On cars with four-point engine suspension only 2nd version steering gear arms and steering relay arms should be installed. The same applies when the engine suspension is changed from the three-point to the four-point system, in which case also the center tie-rod and the steering shock absorber must be replaced (see Table Page 46–1 1).

Gear Ratios of Standard Re-Circulating Ball Steering

Model	Steering assembly		Steering gear arm		Overall gear ratio
	Part No.	Steering gear ratio	Part No.	Length in mm	
150	120 460 24 01	1 : 19.4	120 463 05 01	152	1 : 15.3
	120 460 31 01	1 : 23.4			1 : 18.5
180 D	120 460 24 01	1 : 19.4	120 463 08 01	140	1 : 16.6
			120 463 05 01	152	1 : 15.3
	120 460 31 01	1 : 23.4	120 463 05 01	152	1 : 18.5
180 a 190 190 D	120 460 31 01	1 : 23.4	120 463 05 01	152	1 : 18.5
190 SL	120 460 24 01	1 : 19.4	121 463 01 09	170	1 : 13.7
			120 463 05 01	152	1 : 15.3
	120 460 31 01	1 : 23.4	121 463 21 01	170	1 : 16.5
			120 463 05 01	152	1 : 18.5
220 a	120 460 24 01	1 : 19.4	180 463 03 01	135	1 : 17.2
	120 460 31 01	1 : 23.4			1 : 20.8
215 220 S 220 SE	120 460 31 01	1 : 23.4	180 463 03 01	135	1 : 20.8

Note: The gear ratio data are given with reference to the steering shaft in the dead center position. On lock the gear ratio is slightly smaller.

Steering Assembly Group 46

Removal and Installation of Steering

Job No.
46-1

A. DB Re-Circulating Ball Steering Type LO (Previous Version)

On Models 180 and 180 D the removal and installation procedures for the steering are essentially the same as on Model 190 but note the installation instructions for the steering tube in Job No. 46-7

B. DB Standard Re-Circulating Ball Steering Type LO

I. Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 220 a, 219, 220 S, and 220 SE

The removal and installation procedures for the steering are the same as for Model 190. On six cylinder cars the steering shock absorber on the steering gear arm must be unscrewed and screwed on again.

II. Model 190 SL

The removal and installation procedures for the steering are the same as for Model 190.
The steering coupling is not provided with a jointing disk but takes the form of a universal joint.

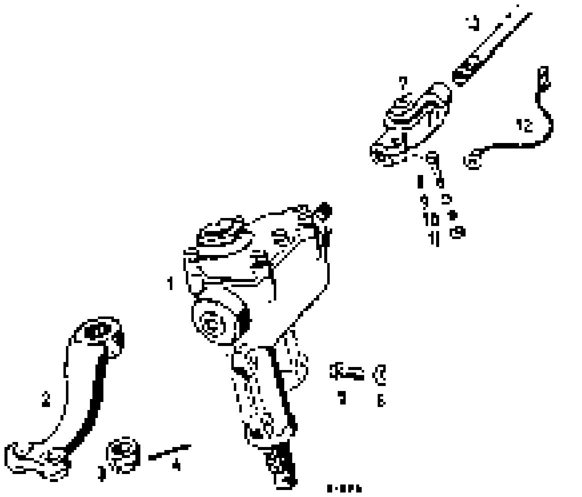


Fig. 46-1/1

1 Steering
2 Steering gear arm
3 Castle nut
4 Cotter pin
5 Hexagon screw
6 Lock washer
7 Universal joint
8 Hexagon screw
9 Washer
10 Lock washer
11 Hexagon nut
12 Ground connection
13 Steering tube

Furthermore the steering tube is not secured by a grub screw on the annular grooved bearing at the top of the steering column jacket.

Job No.
46-2

Removal and Installation of Steering Wheel

I. Models 180, 180 a, 180 D, 190 D, 190 SL, 220 a, 219, 220 S, and 220 SE

The removal and installation procedures for the steering wheel are the same as for Model 190.

II. Models 180 b, 180 Db, and 190 Db

The removal and installation procedures for the steering wheel are the same as for Model 190 b.

Job No.
46-3

Checking of Play in Steering Assembly Units

On Models 180 to 220 SE the checking procedures for the play in the steering assembly units are the same as for Model 190.

Disassembly and Reassembly of Steering

Job No.
46-4

A. DB Re-Circulating Ball Steering Type LO (Previous Version)

On Models 180 and 180 D disassembly and reassembly of the re-circulating ball steering are essentially the same as on Model 190.

B. DB Standard Re-Circulating Ball Steering Type LO

On Models 180 to 220 SE disassembly and reassembly of the standard re-circulating ball steering are the same as on Model 190.

The component parts of the standard re-circulating ball steering are shown in Fig. 46-4/1.

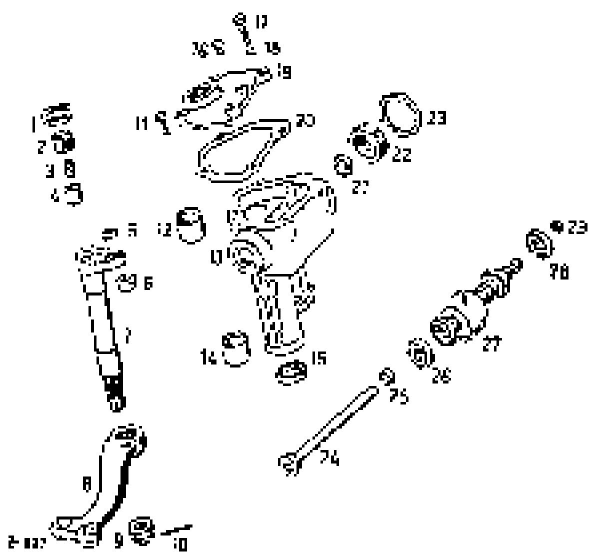


Fig. 46-4/1

1 Hexagon nut
2 Set screw
3 Pressure spring
4 Pressure sleeve
5 Snap ring
6 Ball cup
7 Steering shaft
8 Steering gear arm
9 Castle nut
10 Cotter pin
11 Hexagon screw
12 Upper bearing bushing (30 mm long)
13 Steering housing
14 Lower bearing bushing (33 mm long)
15 Sealing ring for steering shaft
16 Screw plug
17 Hexagon screw
18 Lock washer
19 Steering housing cover
20 Gasket
21 Sealing ring for steering worm
22 Adjusting ring
23 Hexagon nut
24 Cable guide tube
25 Lower sealing ring for cable guide tube
26 Lower taper-roller bearing
27 Steering worm with steering nut (assembly)
28 Upper taper-roller bearing
29 Upper sealing ring for cable guide tube

Job No.
46-5

Checking and Repairing of Steering Assembly

A. DB Re-Circulating Ball Steering Type LO (Previous Version)

On Models 180 and 180 D the checking and repair procedures for the previous version of the re-circulating ball steering are essentially the same as on Model 190. The dimensions and tolerances of individual components are different, however.

a) Steering Worm and Steering Nut

As in the case of the standard re-circulating ball steering there are 67 ± 2 balls in the ball races of the steering nut.

b) Angular Contact Bearing

Contrary to the annular ball bearings on the standard re-circulating ball steering the angular contact bearings for the steering worm have no internal race and the balls run in a race-way on the steering worm.

Dimensions and Tolerances of Steering Worm Bearing in mm

Angular contact bearing			Steering housing
consisting of	Ball race External ⌀	Width	Base bore diameter
Ball race Part No. 120 462 04 27 Ball retainer Part No. 000 981 04 64	39.700 / 39.659	7.5	43.000 / 43.025

c) Steering Shaft

The original diameter of 25.4 mm of the bearing surfaces of the steering shaft was changed to 28.5 mm and later to 30.0 mm as on the standard re-circulating ball steering (see Section d).

d) Steering Housing

The base bore for the bearing bushings in the steering housing varies in accordance with the type of steering shaft installed.

Dimensions and Tolerances of Steering Shaft Mounting in mm

Steering shaft version	Steering shaft Bearing surfaces	Upper and lower bearing bushing: Internal Rough-turning dimension	Upper and lower bearing bushing: Internal Finished dimension	Upper and lower bearing bushing: External	Steering housing base bore
1st	25.380 / 25.359	25.2 / 25.3	25.400 / 25.421	27.549 / 27.535	27.500 / 27.525
2nd	28.480 / 28.459	28.0 / 28.1	28.500 / 28.521	30.548 / 30.535	30.500 / 30.525
3rd	29.993 / 29.980	29.5 / 29.6	30.000 / 30.013	32.059 / 32.040	32.000 / 32.025

e) Pressure Block Assembly

Dimensions and Tolerances of Pressure Block Assembly in mm

Pressure Spring

Connection mm	Wire gage mm	Free length mm	Length under load mm	kg
19.0 ± 0.1	3.5	$18.0 \pm {}^{0.1}_{0.3}$	16.0	$60 - {}^{10}_{5}$

Pressure Sleeve

External	Internal	Length
17.139 / 17.128	13.1 / 13.2	19.5

Set Screw

External	Internal	Tightening of set screw
Thread M 24 x 1.5	17.2 / 17.3	In dead center position screw in till light and then back out 2-4 mm, measured at the circumference of the set screw

B. DB Standard Re-Circulating Ball Steering Type LO

On Models 180 to 220 SE the checking and repair procedures for the standard re-circulating ball steering are the same as on Model 190. The dimensions and tolerances are also the same. In addition the following points require attention:

New Mounting of Steering Shaft

On recent cars of Models 180 a, 180 b, 180 D, 180 Db, 190, 190 b, 190 D, 190 Db, 190 SL, 219, 220 S, and 220 SE a longer upper bearing bushing has been installed for the steering shaft in the steering housing (see Table).

<table>
<tr><th>Bearing bushing</th><th>Version</th><th>Part No.</th><th>Length in mm</th></tr>
<tr><td>top and bottom</td><td>1st</td><td>120 462 05 50</td><td>30.0</td></tr>
<tr><td>top</td><td rowspan="2">2nd</td><td>120 462 06 50</td><td>37.0</td></tr>
<tr><td>bottom</td><td>120 462 05 50</td><td>30.0</td></tr>
</table>

The steering housing with the longer upper bearing bushing has the Part No. 186 460 13 02.

The steering shaft has also been modified at the upper bearing surface and has the Part No. 186 460 03 11 (Fig. 46-5/1).

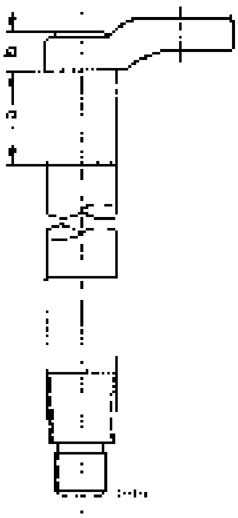


Fig. 46-5/1

<table>
<tr><th>Steering shaft Part No.</th><th>Length "a" mm</th><th>Shoulder "b" mm</th></tr>
<tr><td>120 460 03 11</td><td rowspan="3">35</td><td rowspan="3">19</td></tr>
<tr><td>186 460 01 11</td></tr>
<tr><td>186 460 02 11</td></tr>
<tr><td>186 460 03 11</td><td>39</td><td>15</td></tr>
</table>

The steering shafts Part No. 186 460 01 11 and 120 460 03 11 had ball cups with shoulder whereas on the recent versions the ball cup is secured by a snap ring.

When repairs are carried out, the steering shafts 186 460 02 11 and 01 11 can be replaced by the steering shaft 186 460 03 11 even on 1st version steering housings with the 30 mm long bearing bushings.

However, it is not possible to install the steering shafts 180 460 02 11 and 01 11 into the 2nd version steering housing with the longer upper bearing bushing.

Removal and Installation of Sealing Rings in the Steering

Job No.
46-6

On Models 180 to 220 SE the removal and installation procedures for the sealing rings in the steering are the same as on Model 190.

Removal and Installation of Steering Tube

Job No.
46-7

A. General

I. Models 180 and 180 D with DB Re-Circulating Ball Steering Type LO (Previous Version)

On these cars the cables for the horn and the flash direction signals are not carried through the steering tube and the steering worm but are wound round the steering tube and emerge from the steering column jacket at the bearing assembly of the gear shift mechanism. On the first cars the cables were wound directly on the steering tube in 20–21 turns; later the steering tube was provided with a fabric hose and the cables were wound in 19 turns.

II. Models 180, 180 a, 180 D, 190 D, 220 a, 219, 220 S, and 220 SE, with DB Standard Re-Circulating Ball Steering Type LO

On these models the arrangement of the steering tube and its mounting in the steering column jacket are the same as on Model 190.

However, the length of the steering tube differs on the individual models. A 50 mm longer steering tube is available as an optional extra for all models listed above.

III. Model 190 SL

The steering tube is mounted in the steering column jacket in the same way as on Model 190, but it is not secured by a grub screw on the annular grooved bearing. The steering coupling is not provided with a jointing disk but takes the form of a universal joint. On recent cars the steering tubes are fitted with a lock ring for the steering lock. Steering tubes 40 mm longer are available as an optional extra.

IV. Models 180 b, 180 Db, and 190 Db

The arrangement of the steering tube and its mounting in the steering column jacket are the same as on Model 190.

B. Removal and Installation

I. Models 180 and 180 D with DB Re-Circulating Ball Steering Type LO (Previous Version)

Removal:

1. Disconnect the ground cable from the negative terminal of the battery.
2. Disconnect the cables for the flash direction signals and for the horn from the cable connector on the wheel arch panel.
3. Unscrew the cable clip on the bearing assembly of the steering wheel shift system.
4. Unscrew the upper clamping screw of the steering coupling.
5. Unscrew the grub screw at the top of the steering column jacket.

6. Set the steering lock to the "garage" position and take out the ignition key.

7. Loosen the two hexagon nuts on the tightening strap for the steering column jacket and pull out the tightening strap.

8. Pull out the steering tube together with the steering wheel and the cable harness, at the same time exerting a downward pressure on the steering column jacket.

Installation:

9. Insert a wire through the aperture for the cable harness in the rubber plate of the bearing assembly, pull the wire upward in the steering column jacket taking care not to damage the felt.

10. Attach the cables on the steering tube to the wire pulled through the steering column jacket. Carefully insert the steering tube and pull the cables through the aperture in the bearing assembly by means of the wire.

Note: a) When the steering tube is installed the cables must be tightly wound round the spindle. On steering tubes without fabric hose there are 20–21 turns but on the steering tube with fabric hose there are only 19 turns.

Only steering tubes with fabric hose are supplied as replacement parts.

b) When installing a new steering tube remove the tape on the bottom cable turn before inserting the tube in the steering column jacket.

11. Pull the cables through the rubber plate on the bearing assembly of the steering wheel shift system until they project about 440–450 mm. The insulating tube of the cable harness should not project into the steering column jacket by more than 15–20 mm (Fig. 46-7/1).

12. Install the tightening strap on the steering column jacket and tighten the two hexagon nuts.

13. Wind the cables onto the steering tube by turning the steering wheel toward the left while an assistant holds the cables at the cable opening A on the bearing assembly (Fig. 46-7/1).

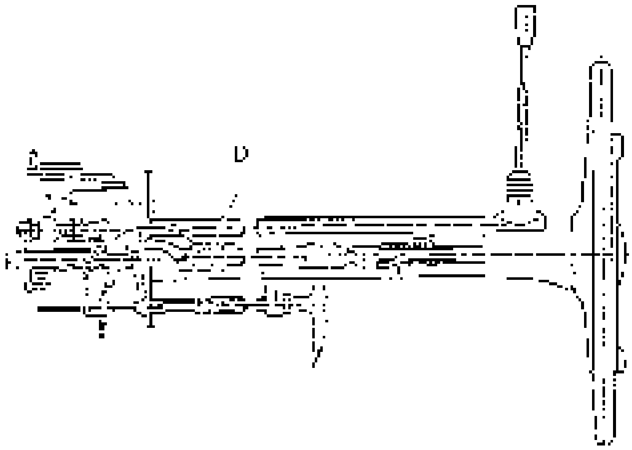


Fig. 46-7/1

A Cable opening on the bearing assembly
B Cable opening on the steering tube
C Lock out of steering lock
D Number of cable turns:
20–21 turns on steering tube without fabric hose
19 turns on steering tube with fabric hose

14. Starting from this position loosen the turns of the cables by turning the steering wheel about three turns toward the right. In this position of the steering tube press the tube into the serrations of the steering coupling after having made sure that the steering wheel is in the dead center position.

Note: When the steering tube is installed, the front wheel must be in the straight fore and aft position, the steering and the steering wheel must be in the dead center position.

Use Center Position Check Screw 186 589 00 23 to check the dead center position of the steering. If the dead center position of the steering does not correspond to the straight fore and aft position of the front wheels, the adjustment of the front wheels must be corrected by adjusting the tie-rods (for details see Job No. 40–0).

15. Turn the steering wheel hard over to the left and to the right in order to check whether the steering tube is correctly installed. At the same time make sure that on left lock the cables are not under tensile stress at the cable opening A on the bearing assembly by means of the cable clip (see Fig. 46-7/1).

16. Place the upper clamping screw in the steering coupling and tighten the hexagon nut.

Only specified clamping screws may be used for the steering coupling.

The clamping screws should be so tightened that the steering coupling is seated firmly on the steering worm and on the steering tube. Excessive tightening should be avoided in order to prevent the screws from being strained and from snapping.

17. Screw in the grub screw for the steering tube in the top of the steering column jacket.

18. Connect the cables for the flash direction signals and the horn to the cable connector on the wheel arch assembly.

19. Connect the ground cable to the negative terminal of the battery. Check whether the horn and the flash direction signals are working properly.

II. Models 180, 180 a, 180 D, 190 D, 220 a, 219, 220 S, and 220 SE with DB Re-Circulating Ball Steering Type LO

The removal and installation procedures for the steering tube are the same as on Model 190; the following details, however, require attention:

Upper Beam Flash Signal Switch Attached Directly to the Steering Column Jacket

Since on recent cars of Models 190, 190 D, 190 SL, 219, 220 S, and 220 SE the upper beam flash signal switch has been attached directly to the steering column jacket and since the switch projects into the steering column jacket, it is necessary to loosen the two Phillips head screws for the switch before removing or installing the steering tube and to pull the switch slightly back before the steering tube is removed. The same applies to export cars provided with a flash signal switch with automatic return mechanism.

III. Model 190 SL

The removal and installation procedures for the steering tube and the steering column jacket are described in Job No. 46–8.

IV. Models 180 b, 180 Db, and 190 Db

The removal and installation procedures for the steering tube are the same as on Model 190.

Removal and Installation of Steering Column Bracket and Lock

Job No.
46–8

I. Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, and 219

The removal and installation procedures for the steering column bracket and lock are the same as on Model 190.

II. Models 220 a, 220 S, and 220 SE

Removal:

1. Disconnect the ground cable at the negative terminal of the battery.

2. Remove the instrument cluster (see Job No. 54–11).

3. Set the steering lock to the "garage" position and take out the ignition key.

4. Remove the cable cover in the left glove compartment and unscrew the cover plate on the steering column below the instrument panel.

5. Loosen the two hexagon nuts on the tightening strap for the steering column jacket and remove together with washers. Pull out the tightening strap, taking care not to damage the mounting plate for the control knobs.

6. Unscrew the pull switch for the roof light (1), the rotary light switch (2) and pull switch for the instrument lighting (3) and pull them out of the mounting plate without disconnecting the cables (see Fig. 46-8/1).

7. Unscrew the choke control knob (8) with escutcheon (Fig. 46-8/1).

Note: a) On Model 220 SE there is no choke control knob (8). The arrangement of the other control knobs on the mounting plate is as shown in Fig. 46–8/1.

b) On Model 220 a and the 1st version of Model 220 S the ignition control knob (10) (octane number compensator) is to the right of the choke control knob. The pull switch for the demisting blower is arranged to the left of the charging light (Fig. 46–8/2).

Fig. 46–8/1

1 Pull switch for roof light
2 Rotary light switch
3 Pull switch for instrument lighting
4 Pull knob for return mechanism of trip recorder
5 Charging light
6 Steering lock
7 Starter push-button switch
8 Choke control knob
9 Pull switch for demisting blower
10 [illegible]
11 Green pilot light for demisting blower
12 Red pilot light for flash direction signal
13 Fuel reserve indicator
14 Trip recorder
15 Cumulative mileage counter
16 Oil pressure gage
17 Cooling water thermometer
18 White parking pilot light
19 Blue upper beam pilot light
20 Speedometer

c) It is necessary to disconnect the ignition control cable from the distributor before the mounting plate can be removed (see Job No. 30–8).

Fig. 46-B/2

1 Pull switch for roof light
2 Rotary light switch
3 Pull switch for instrument lighting
4 Pull knob for return mechanism of trip recorder
5 Pull knob for demisting blower
6 Charging light
7 Steering lock
8 Starter push button switch
9 Choke control knob
10 Ignition control knob [illegible]
11 Green pilot light for demisting blower
12 Red pilot light for flash direction signal
13 Fuel reserve indicator
14 Trip recorder
15 Cumulative mileage counter
16 Oil pressure gauge
17 Cooling water thermometer
18 White starter pilot light
19 Blue upper beam pilot light
20 Speedometer

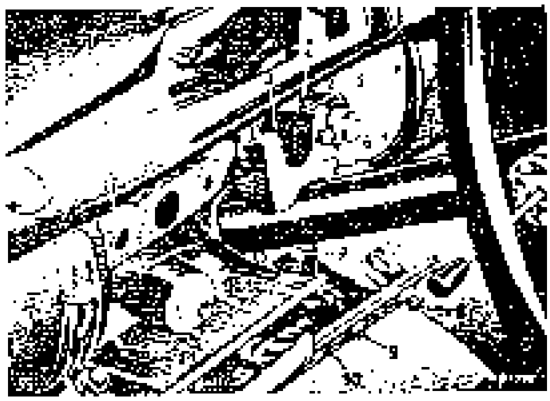


Fig. 46-B/3

1 Bracket for mounting plate
2 Aperture for instrument cluster of instrument panel
3 Contact cap of steering lock
4 Stud screw
5 Shim
6 Steering column bracket and lock
7 Wing nut for set screw
8 Pull switch for demisting blower
9 Starter push-button switch
10 Mounting plate for control knobs
11 Pull switch for instrument lighting
12 Rotary light switch
13 Pull switch for roof light

8. Loosen the hexagon nuts of the two set screws on the right hand side which fix the mounting plate for the control knobs to the lower part of the cowl and remove the nuts together with the spring washers. Then pull out the mounting plate.

9. Working from the aperture of the instrument cluster loosen the two hexagon nuts for the steering column bracket and remove together with washers and crimped washers (see Fig. 46-B/3).

10. Press the steering column slightly down and pull out the steering column bracket together with the lock (6) (Fig. 46-B/3).

Note: If shims were installed between the steering column bracket and the cowl, remove the shims from the stud screws.

11. Unscrew the contact cap (3) from the steering lock and disconnect the cables (see Fig. 46-B/3).

Installation:

12. Connect the cables to the contact plate of the steering lock. Pay attention to the color coding:

Connect the red cable (lead number 57) to terminal 30, the black cable (lead number 10) and the black/red cable (lead number 24) to terminal 15,

the blue cable (lead number 72) to terminal 61 (see Job No. 15-21).

13. Install the steering column bracket with lock, the washer and crimped washers and finger-tighten the two hexagon nuts (see Fig. 46-B/3)

Note: During installation the steering lock must be in the "garage" position.
If necessary shims can be installed between the steering column bracket and the cowl as required (see Fig. 46-B/3).

14. Insert the choke cable in the mounting plate for the control knobs and screw on the escutcheon and the knob.

15. Install the mounting plate. Make sure that the two set screws on the right side of the mounting plate are adjusted to the correct height. After adjusting the set screws tighten the wing nuts (7). Screw the hexagon nuts and the spring washers onto the set screws and tighten (see Fig. 46-8/3).

16. Screw on the pull switch for the roof light (1), the rotary light switch (2) and the pull switch for the instrument panel lighting (3) (see Fig. 46-8/2).

17. Attach the tightening strap for the steering column bracket and screw on finger-tight.

18. Align the steering column and finally tighten the two hexagon nuts for the attachment of the steering column bracket.

19. As a check of the steering lock turn the key to the position "Halt" (stop) and take it out.

In this position the lock bolt must engage in the steering tube when the steering wheel is turned and thus lock the steering.

Position of the Steering Lock:

Key in position "Halt" (stop): ignition switched off, steering locked. The ignition key can be taken out.

Key in position "Garage": ignition switched off, steering free. The ignition key can be taken out.

Key in position "Fahrt" (drive): ignition switched on, steering free. The ignition key cannot be taken out.

20. Install the instrument cluster (see Job No. 54-19).

21. Install the cable cover in the left glove compartment and screw the cover plate to the steering column below the instrument panel.

22. Connect the ground cable to the negative terminal of the battery. Check whether the horns and the flash direction signals work properly.

23. On cars of Models 220 a and 220 S with ignition control cable connect the cable to the distributor (see Job No. 30-8).

III. Model 190 SL

Removal:

Note: Cars of Model 190 SL as from Chassis End No. 85 01846 are provided with a steering lock as a standard part.

1. Disconnect the ground cable at the negative terminal of the battery.

2. Disconnect the cables for the flash direction signals and for the horn from the cable connector on the wheel arch panel.

3. Unscrew the upper beam flash signal switch from the steering column jacket.

In the case of the 1st version switch loosen the tightening strap, remove the switch but do not disconnect the cables. In the case of the 2nd version switch which is fastened directly to the steering column jacket, unscrew the two Phillips head screws and disconnect the cables. Remove the switch and pull the cable harness out of the steering column jacket.

Note: For the flash direction signal switch with automatic return mechanism (on export cars) the procedures are the same as for the 2nd version upper beam flash signal switch.

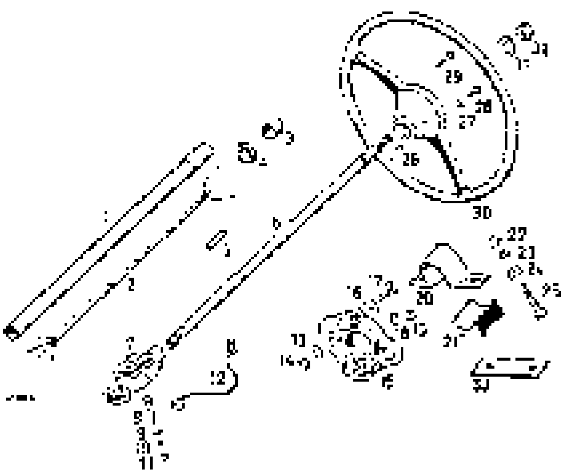


Fig. 46-8/4

1 Steering column jacket
2 Cable harness for steering tube
3 Needle bearing
4 Rubber ring for cable at steering column jacket
5 Rubber sleeve for cable attachment
6 Steering tube
7 Universal joint
8 Hexagon screw
9 Washer
10 Lock washer
11 Hexagon nut
12 Ground cable
13 Washer
14 Hexagon nut
15 Support for steering column holder
16 Washer
17 Hexagon screw
18 Washer
19 Hexagon nut
20 Retaining clamp for steering column jacket
21 Rubber support for steering column jacket
22 Hexagon nut
23 Lock washer
24 Washer
25 Hexagon screw
26 Key
27 Spring washer
28 Cylinder screw
29 Cylinder screw
30 Steering wheel
31 Locking plate
32 Hexagon nut
33 Shim

4. Loosen the upper clamping screw of the universal joint on the steering tube and remove.

5. Set the steering lock to the "garage" position so that the lock bolt does not engage in the steering tube; then take out the ignition key.

6. On Convertibles fold back the roof and on Coupés remove the roof.

7. Pull out the steering tube giving due attention to the cable harness. If necessary loosen the steering tube by tapping the upper shank of the universal joint lightly with a hammer. Do not apply force to the steering wheel.

8. Loosen the two hexagon screws (25) for the retaining clamp (20) at the top of the cross strut in the cowl and remove the clamp together with the rubber support (21) and the shims (33) (Fig. 46-8/4).

9. Loosen the hexagon screw fixing the steering lock to the steering column jacket. Unscrew the grub screw at the bottom of the steering lock.

10. Working from the engine compartment side loosen the two hexagon nuts (19) at the bottom of the steering column jacket support. If necessary also loosen the two hexagon screw (17) attaching the support to the cowl. Pull the steering column jacket out toward the rear and remove the steering lock (see Fig. 46-8/4).

Note: Before pulling out the steering column jacket mark it in relation to the support. If necessary the rubber ring (4) for the attachment of the upper beam flash signal switch cable harness must be removed from the steering column jacket together with the tightening strap attachment.

11. Remove the contact cap from the steering lock, disconnect the cable and remove the steering lock.

Installation:

12. Connect the cables to the contact plate of the steering lock and pay attention to the color coding of the cables:

Connect the red cable (lead number 57) to terminal 30,
the black cable (lead number 10)
and
the black/red cable (lead number 24) to terminal 15,
the blue cable (lead number 72) to terminal 61 (see Job No. 15-21).

13. Insert the steering column jacket into the aperture of the instrument panel, install the steering lock and fully insert the steering column jacket. Fix the steering lock in the slot in the steering column jacket by means of the grub screw at the lower side of the lock but do not clamp the steering lock in position.

14. Clamp the steering column jacket to the support on the cowl noting the position marked during removal and making sure that the steering lock is correctly positioned.

15. Insert the steering tube into the steering column jacket and pull the cable harness through the cable guide tube of the steering. When doing this the steering lock must be in the "garage" position.

16. With the front wheels in the fore and aft position and the steering wheel and steering assembly in the dead center position press the steering tube onto the serrated part of the universal joint.

Note: Use Center Position Check Screw 186 589 00 23 to check the dead center position of the steering. If the dead center position of the steering does not correspond to the straight fore and aft position of the front wheels, the adjustment of the front wheels must be corrected by adjusting the tie-rods (see Job No. 40–3).

17. Install the upper clamping screw on the universal joint and tighten.

Note: Only specified clamping screws (hexagon screws) may be used for attaching the universal joint to the steering tube and to the steering worm.

These screws should be tightened until the steering coupling is seated firmly on the steering worm and on the steering tube. Excessive tightening should be avoided in order to prevent the screws from being strained and from snapping.

18. Detach the steering column jacket again from the support on the cowl and move it to obtain a distance of 2–2.5 mm between the steering column jacket and the steering wheel hub.

19. Slightly tighten the two hexagon screws at the bottom of the support and if necessary the two hexagon screws for attaching the support to the cowl.

20. Slide the rubber support (21) with shims (33) onto the cross strut under the steering column jacket and install the clamp. Install the two hexagon screws (25) from below and tighten. Also tighten the clamping screw of the steering lock (see Fig. 46–8/4).

Note:

a) The height of the steering column jacket can be adjusted from above by inserting or removing shims between the cross strut and the rubber support.

b) The steering lock can be moved in the longitudinal direction of the steering column jacket inside the slot for the grub screw. The cylinder of the steering lock must be positioned in the center of the aperture in the instrument panel and should project about 1–2 mm.

21. Now tighten the screws and nuts on the support making sure that the steering tube is positioned in the center of the steering column jacket. If necessary loosen the support and move it to center the steering tube.

22. To check the steering lock turn the ignition key to the position "Halt" (stop) and take it out. In this position, when the steering wheel is turned, the lock bolt must engage in the steering tube, thus locking the steering.

Positions of the Steering Lock:

Key in position "Halt" (stop) - ignition switched off, steering locked. The ignition key can be taken out.

Key in position "garage" - ignition switched off, steering free. The ignition key can be taken out.

Key in position "Fahrt" (drive): ignition switched on, steering free. The ignition key cannot be taken out.

23. Connect the cables for the flash direction signals and for the horn to the cable connector on the front wheel arch (front left). Pay attention to the color coding. The color coding of the cables of the steering tube harness must correspond to the color coding of the main cable harness.

24. Attach the upper beam flash signal switch to the steering column jacket. In the case of the 1st version switch clamp the switch to the steering column jacket with the tightening strap. In the case of the 2nd version switch pass the cable through the steering column jacket and connect it to the flash signal switch. Then screw the switch to the steering column jacket.

25. Connect the ground cable to the negative terminal of the battery and check whether the horns and the flash direction signals are working properly.

Subsequent Installation of a Steering Lock on Model 190 SL

a) Modification of the Steering Column Jacket

When a steering lock is installed subsequently, the steering column jacket need not be replaced, since it can be modified for the installation of the steering lock. To do this mark and file the two slots on the steering column jacket as shown in picture 3 in Fig. 46–6/5, making sure that the two slots are arranged at the correct distance from one another and at an angle of 90°.

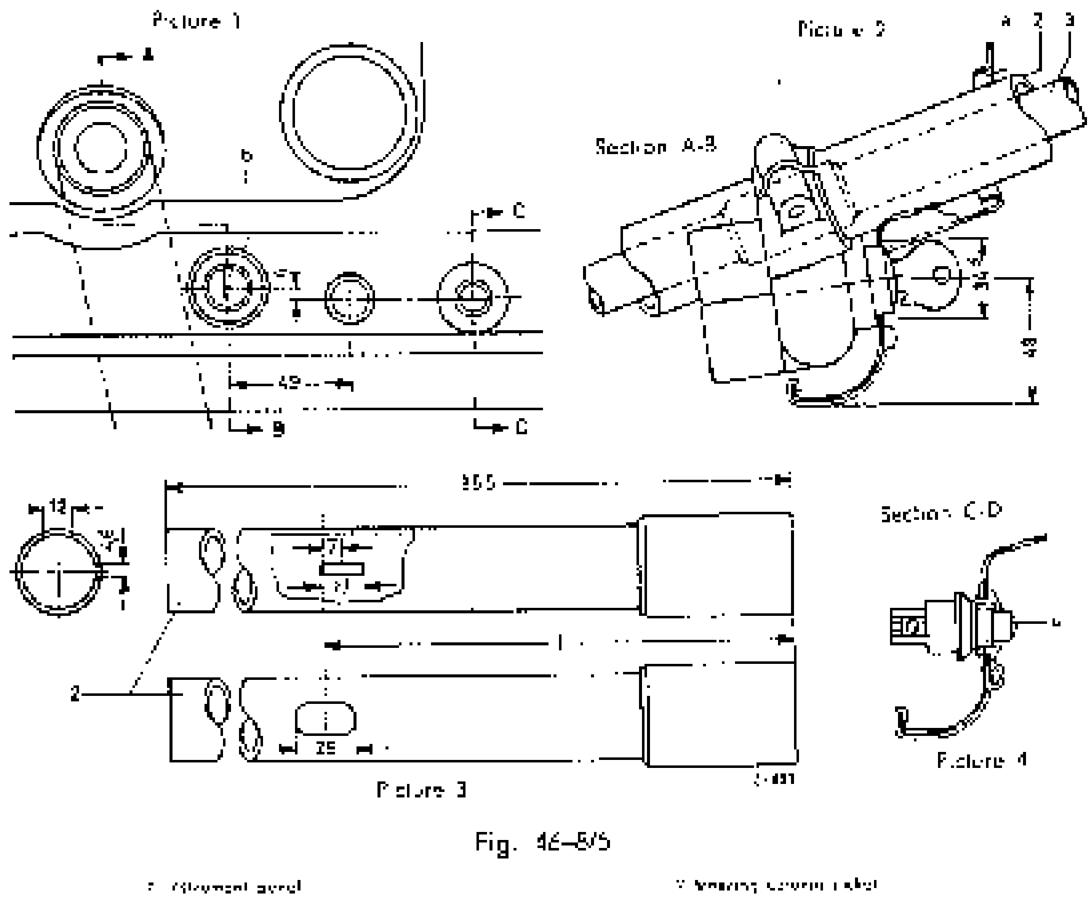


Fig. 46–6/5

[illegible]
[illegible]
Steering lock

[illegible]
Steering tube
[illegible]

b) **Aperture for Steering Lock in Instrument Panel**

After having mounted the steering column jacket on the steering tube, cut out the circular opening (b) (approx. 34 mm Ø) on the instrument panel to take the cylinder of the steering lock. To do this loosen the hexagon screw on the steering lock and back out the grub screw slightly so that the steering lock can be moved on the steering column jacket. When filing the opening check the steering lock for position several times (Fig. 46–8/5).

c) **Starter Switch**

Remove the starter switch and replace it by the push-button switch (4) Part No. 000 545 27 08 (see Fig. 46–8/5).

d) **Cables and Leads**

1. Replace the soldering sleeves on the cable ends at the starter switch by cable terminals 4.3 x 0.8 and Hellermann rubber grommets after having shortened the insulating tube by 80 mm.
2. Connect the lead from the starter (terminal 50) to the push-button switch.
3. Connect the new lead Part No. 121 540 16 38 from the steering lock (terminal 15–24) to the push-button switch.
4. Connect the lead from fuse No. 2 to the steering lock (terminal 15-24).
5. Connect the lead from the rotary light switch (terminal 30) to the steering lock (terminal 30).

Note: The charging light is not removed from the instrument panel.

e) **Parts Required for Subsequent Installation of Steering Lock on Model 190 SL**

Number	Designation	Nº de pieza
1	Steering tube with lock ring (overall length 1135 mm) Standard version	121 460 09 09
1	Steering tube with lock ring (overall length 1175 mm) Special version	121 460 14 09
1	Steering lock for steering column jacket with 38 mm tube diameter on left-hand drive models	000 462 07 30
1	Steering lock for steering column jacket with 34 mm tube diameter on left-hand drive models	000 462 06 30
1	Steering lock for steering column jacket with 34 mm tube diameter on right-hand drive models	000 462 09 30
1	Steering column jacket with 38 mm tube diameter	121 460 34 16
1	Steering column jacket with 34 mm tube diameter	121 460 37 16
1	Steering column jacket with 34 mm tube diameter for longer steering tube	121 460 42 16
1	Starter push-button switch	000 545 27 08
1	Escutcheon for push-button switch	121 545 00 72
1	Washer for push-button switch	135 990 42 40
1	Washer for push-button switch	121 990 24 40
3	Spade terminal 4 x 8 N 261	
3	Rubber grommet	000 997 01 81
1	Electric lead B 2.5 DIN 72 551 from steering lock to starter push-button switch	121 540 16 38
3	Hexagon screw M 8 x 40 DIN 931 — 8 G	
1	Lock washer B 8 DIN 127	
1	Hexagon nut M 8 DIN 934 — 5 S	

Job No.
46-9

Survey of Center Tie-Rods

A. General

On Models 180 to 220 SE the center tie-rods differ in length and in the type of bracket for attaching the steering shock absorber (see Fig. 46-9/1 and Table).

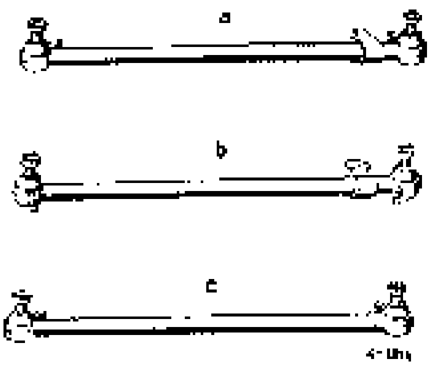


Fig. 46-9/1

a) Version with straight bracket
b) Version with curved bracket
c) Version without bracket

Survey of Center Tie-Rods

Model	Center tie-rod with grease nipples on ball joints Part No.	Center tie-rod with self-lubricating ball joints Part No.	Length mm	Remarks
180, 180 D, 180 Db	120 460 11 05	120 460 14 05	286±1	Bracket for steering shock absorber straight
180 a, 180 b, 190 D, 190 Db	121 460 07 05	120 460 13 05		
190, 190 a	121 460 09 05	121 460 15 05		Bracket for steering shock absorber curved
190 SL	121 460 02 05	120 460 13 05		(1st version) Bracket for steering shock absorber straight. Installed up to Chassis End No. 5501501
	121 460 09 05	121 460 15 05		(2nd version) Bracket for steering shock absorber curved. Installed as from Chassis End No. 5501502
219, 220 a, 220 S, 220 SE	121 460 07 05	180 460 13 05	326±1	Without bracket for steering shock absorber

Note: The length of the center tie-rod is measured from center ball stud to center ball stud.

Center Tie-Rods with Self-Lubricating Ball Joints

On Models 180 a, 180 b, 180 D, 180 Da, 190, 190 b, 190 D, 190 Db, 190 SL, 219, 220 S, and 220 SE the tie-rods are now installed with self-lubricating ball bearings. For details see Job No. 33-6.

B. Removal and Installation

On Models 180 to 220 SE the removal and installation procedures for the center tie-rod are the same as on Model 190 but on the six-cylinder models it is not necessary to remove and attach the steering shock absorber.

Removal and Installation of Steering Shock Absorber

Job No.
46–10

A. General

The Models 180, 180 a, 180 D, 190 D, 190 SL, 220 a, 219, and 220 SE are equipped with different steering shock absorbers (see Tables below). Apart from the standard steering shock absorbers special export type steering shock absorbers are available for countries where excessive dust conditions prevail; they are provided with a rubber sleeve as a protection against the penetration of dust and sand.

Standard Version

Model	Steering shock absorber Part No.	Designation	Length mm (Shock absorber compressed)	Remarks
180 180 a, 180 b 180 D, 180 Db 190 D, 190 Db	000 463 07 32	Stabilus StoZ 20 x 150/12	268±1.5	For center tie-rod with straight bracket
190, 190 b	000 463 15 32	Stabilus T 20 x 135/3	253±1.5	For center tie-rod with curved bracket
190 SL	000 463 07 32	Stabilus StoZ 20 x 150/12	268±1.5	(1st version) For center tie rod with straight bracket
	000 463 15 32	Stabilus T 20 x 135/3	253±1.5	(2nd version) For center tie-rod with curved bracket
219 220 a 220 S 220 SE	000 460 00 66	Stabilus T 20 x 125/3	251^{+2}_{-1}	Steering shock absorber with ball pin

Special Export Version

Model	Steering shock absorber Part No.	Designation	Length mm (Shock absorber compressed)	Remarks
180 180 a, 180 b 180 D, 180 Db 190 D, 190 Db	000 460 03 66	StoZ T 20 x 150/15	268±1.5	For center tie-rod with straight bracket
190, 190 b	000 460 04 66	T 20 x 135/5	253±1.5	For center tie-rod with curved bracket
190 SL	000 460 03 66	StdZ T 20 x 150/15	268±1.5	(1st version) For center tie-rod with straight bracket
	000 460 04 66	T 20 x 135/5	253±1.5	(2nd version) For center tie-rod with curved bracket
219 220 a 220 S 220 SE	000 460 05 66	T 20 x 125/7	251^{+2}_{-1}	Steering shock absorber with ball pin

B. Removal and Installation

I. Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, and 190 SL

The removal and installation procedures for the steering shock absorber are the same as on Model 190; on cars with three-point engine suspension the support bolt for the steering shock absorber is attached to the chassis base panel and not to the front axle support.

II. Models 220 a, 219, 220 S and 220 SE

On these models the steering shock absorber is not attached to the center tie-rod as on Model 190 but is connected to the steering gear arm by a ball pin (Fig. 46–10/1).

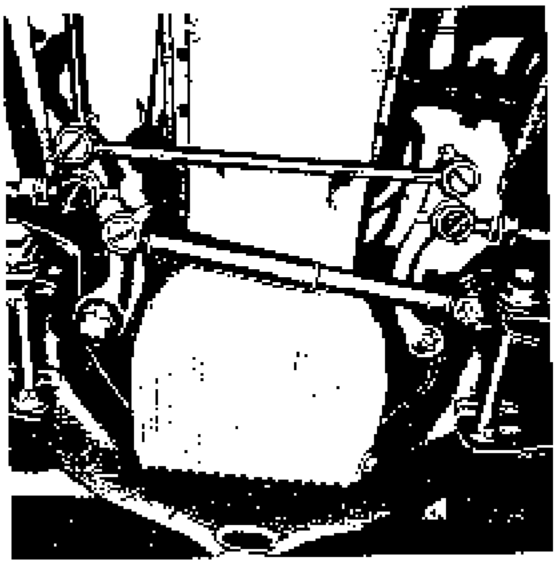


Fig. 46-10/1

When removing the steering shock absorber pull out the cotter pin, unscrew the castle nut and press off the ball pin from the steering gear arm with Fixture 136 589 10 33.

When installing the ball pin keep the cone free from oil and grease! Further procedures are the same as for Model 190.

Removal and Installation of Steering Relay Arm and Pivot Bearing

Job No.
46-11

A. General

The steering relay arms on Models 180 to 220 SE differ in length (see Table).

Model	Steering relay arm		Remarks
	Part No.	Length mm	
180, 180 a, 180 b, 180 Db, 190, 190 b, 190 D, 190 Db	120 460 10 19	152	
180 D	120 460 12 19	141	Installed in cars with steering Part No. 120 460 14 01 and Part No. 120 460 24 01
	120 460 10 19	152	Installed in cars with steering Part No. 120 460 24 01 and Part No. 120 460 31 01
190 SL	121 460 20 19	170	Installed in cars with steering Part No. 120 460 31 01; but only with three-point engine suspension
	120 460 10 19	152	Installed in cars with steering Part No. 120 460 24 01 and Part No. 120 460 31 01; with three-point and four-point engine suspension
219, 220 a, 220 S, 220 SE	180 460 02 19	125	

B. Removal and Installation

On Models 180 to 220 SE the removal and installation procedures for the steering relay arm and the pivot bearing are the same as on Model 190.

C. Checking and Repair

On Models 180 to 220 SE the procedures as well as the dimensions and tolerances for the checking and repairing of the steering relay arm and the pivot bearing are the same as on Model 190.

Removal and Installation of Steering Gear Arm

Job No.
46–12

A. General

On Models 180 to 220 SE the steering gear arms differ in the length "a", the height "c" and the offset "b". The length "a" is measured from the fulcrum of the steering gear arm on the steering shaft to the fulcrum of the ball pin of the tie-rod on the steering gear arm (see Fig. 46-12/1 and Table).

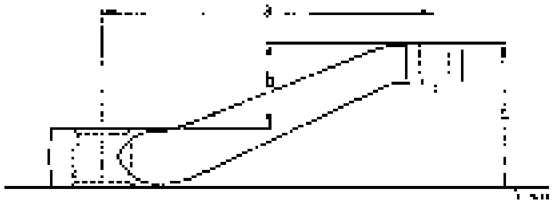


Fig. 46–12/1

Model	Steering gear arm Part No.	Length "a" mm	Offset "b" mm	Height "c" mm	Remarks
180	120 463 02 01	152	47±0.3	64±0.5	(1st version) For steering Part No. 120 460 11 01 and Part No. 120 460 18 01
	120 463 05 01	152	39±0.3	64±0.5	(2nd version) For steering Part No. 120 460 14 01, Part No. 120 460 24 01, and Part No. 120 460 31 01
180 D	120 463 08 01	140	32±0.5	57±0.5	(1st version) For steering Part No. 120 460 14 01 and Part No. 120 460 24 01
	120 463 05 01	152	39±0.3	64±0.5	(2nd version) For steering Part No. 120 460 24 01 and Part No. 120 460 31 01
180 a, 180 b, 180 Db, 190, 190 b, 190 D, 190 Db	120 463 05 01	152	39±0.5	64±0.5	
190 SL	121 463 01 31	170	50±0.3	75±0.5	(1st version) For steering Part No. 120 460 24 01 and Part No. 120 460 31 01 but only for cars with three-point engine suspension
	120 463 05 31	152	39±0.3	64±0.5	(2nd version) For steering Part No. 120 460 24 01 and Part No. 120 460 31 01; for cars with three-point and four-point engine suspension
219, 220 a, 220 S, 220 SE	180 463 03 01	135	30±0.3	55±0.5	

Note: The steering gear arm Part No. 120 463 02 01 installed on Model 180 for steering assemblies Part No. 120 460 11 01 and Part No. 120 460 18 01 (steering shaft diameters 25.4 and 28.5 mm) has smaller serrations than the steering gear arm for steering assemblies with a steering shaft diameter of 30.0 mm

B. Removal and Installation

On Models 180 to 220 SE the removal and installation procedures for the steering gear arm are the same as on Model 190 but on six-cylinder engines the steering shock absorber must be removed and attached to the steering gear arm (see Job No. 46-10).

Job No.
46–13

Removal and Installation of Steering Coupling

I. Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 220 a, 219, 220 S, and 220 SE

The removal and installation procedures for the steering coupling jointing disk are the same as for Model 190.

II. Model 190 SL

The steering coupling is not provided with a jointing disk but takes the form of a universal joint.

Removal:

1. Remove the steering tube (see Job No. 46-8).
2. Unscrew the lower clamping screw of the universal joint and pull the universal joint off the steering worm.

Installation:

3. Press the universal joint onto the steering worm serrations and fix in position by means of the clamping screw.
4. Install the steering tube (see Job No. 46-8).

Note: In case of repairs the complete universal joint must be replaced.

Fuel System

47

Fuel System Group 47

Removal and Installation of Fuel Tank

Job No.
47-1

A. General

On Models 180 to 220 SE the fuel level in the tank is indicated on the fuel gage. Models 180, 180 a, 190 a, 180 D, 180 Db, 190 D, 190 Db, 219, and 220 SE are not fitted with a reserve fuel line. When the fuel level in the tank is down to 5 to 6 liters, the red warning light lights up on the fuel gage. Models 190 SL, 220 a, and 220 S are fitted with a reserve fuel line and a fuel change-over cock.

B. Removal and Installation

On Models 180 to 220 SE the removal and installation procedures for the fuel tank are essentially the same as on Model 190.

To check the fuel gage fill up with fuel slowly after the installation of the fuel tank and on cars without reserve fuel line get a second mechanic to watch the red warning light on the fuel gage in the instrument cluster. The warning light must go out after 5 to 6 liters have been put in the tank.

Fuel Gage Graduation

Model	Reserve	¼ full	½ full	¾ full	full
190, 190 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 219	5—6 ltr.	14 ltr.	28 ltr.	42 ltr.	56 ltr.
190 SL, 220 a, 220 S	5—6 ltr.	16 ltr.	32 ltr.	48 ltr.	64 ltr.
220 SE	5—6 ltr.	15 ltr.	30 ltr.	45 ltr.	60 ltr.

During removal and installation the following details require attention on the models listed below:

I. Models 180 D, 180 Db, 190 D, and 190 Db

Disconnect and connect the fuel return line on the tank. The connection for this line is marked by the letter "R" stamped on the fuel tank.

II. Models 220 a and 220 S

Disconnect and connect the reserve fuel line on the fuel tank. On cars of Model 220 S with built-in scavenging device also disconnect and connect the fuel return line on the filler neck.

III. Model 190 SL

Disconnect and connect the reserve fuel line. The fuel tank is ventilated by the one-turn cap (16) (Fig. 47-1/1). On this model the vent line is not required.

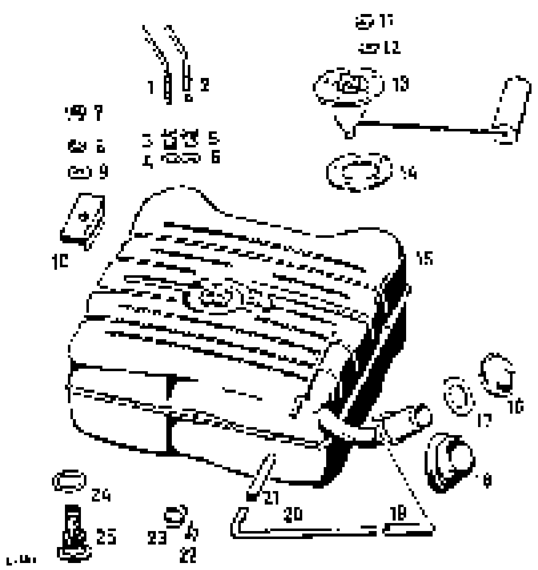


Fig. 47–1/1

1 Fuel line
2 Reserve fuel line
3 Adapter
4 Sealing ring
5 Adapter
6 Sealing ring
7 Hexagon nut
8 Lock washer
9 Washer
10 Reinforcement plate
11 Hexagon nut
12 Spring washer
13 Fuel level indicator
14 Gasket
15 Fuel tank
16 One-turn cap
17 Sealing ring
18 Cuff
19 Rubber hose
20 Breathing line
21 Rubber hose
22 Hose clamp
23 Hose strap
24 Sealing ring
25 Screw plug with washer

When complaints are received about fuel leakage through the fuel tank filler cap two vent lines (2) and (3) can be subsequently installed in the fuel tank (1). These lines, which are connected to the vent tube, provide pressure compensation if over-pressure should occur in the fuel tank. The vent tube is attached to the right wheel arch pan in the trunk compartment and runs into the open. The ventilated filler cap of the fuel tank must be replaced by a non-ventilated cap (Fig. 47–1/2).

1. Empty and remove the fuel tank.

2. Drill a 5 mm ⌀ hole into both the front and rear second corrugation at a distance a = 170 mm from the left side of the fuel tank (Fig. 47-1/2).

Note: **Observe the safety regulations when soldering.**

4. Solder the vent lines (2) and (3) to the corrugations and lay them along the breathing line (4) (Fig. 47-1/2).

Note: Solder the vent lines to the breathing line in such a way that they are flush with the highest point of the breathing line.

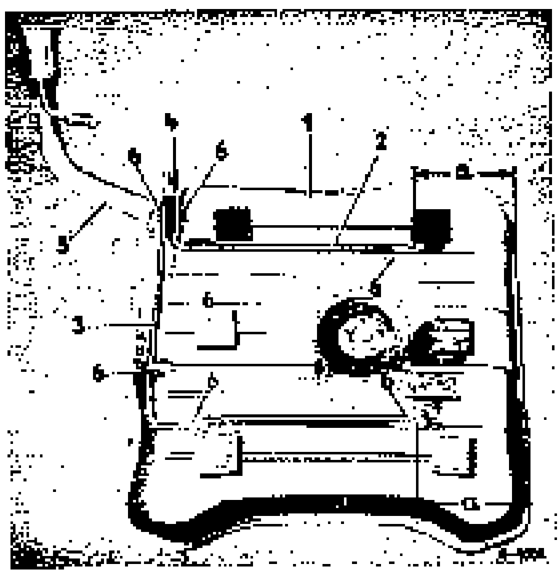


Fig. 47-1/2

1 Fuel tank
2 Vent line
3 Vent line
4 Breathing line
5 Filler neck
6 Soldering points

5. Saw off the two vent lines (2) and (3) flush with the pipe socket at the breathing line (4) (Fig. 47-1/2)

6. Install the fuel tank

7. Attach the breathing line (4) to the fuel tank (1) and the filler neck (5) (Fig. 47-1/5).

8. The vent lines (1) and the vent tube (2) must be made in a workshop as shown in Fig. 47-1/3.

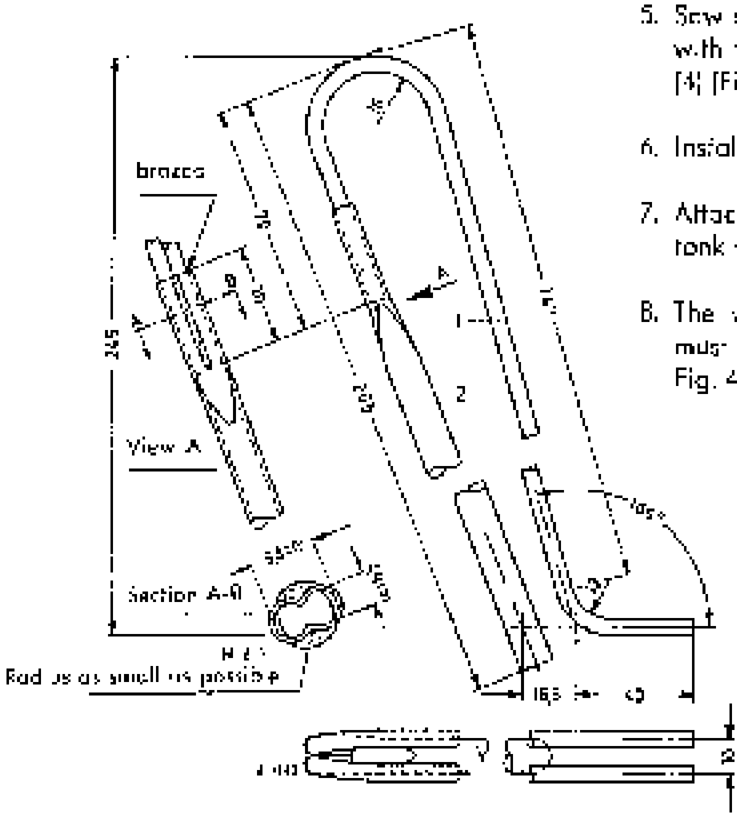


Fig. 47-1/3

1 Bundy pipe 4.75 x 0.75
approx. 255 mm extended length
2 Bundy pipe 10 x 0.75

9. Install the vent tube (12) on the right wheel arch pan in the trunk compartment. To do this drill a 14 mm ⌀ hole and two 9 mm ⌀ holes into the floor panel of the trunk compartment and fit suitable rubber grommets (16) and (17) in the bores. Now install the vent tube so that the tube projects approx. 5–10 mm beyond the rubber grommet and then fix it to the wheel arch by means of a pipe clip (15) (Fig. 47-1/4).

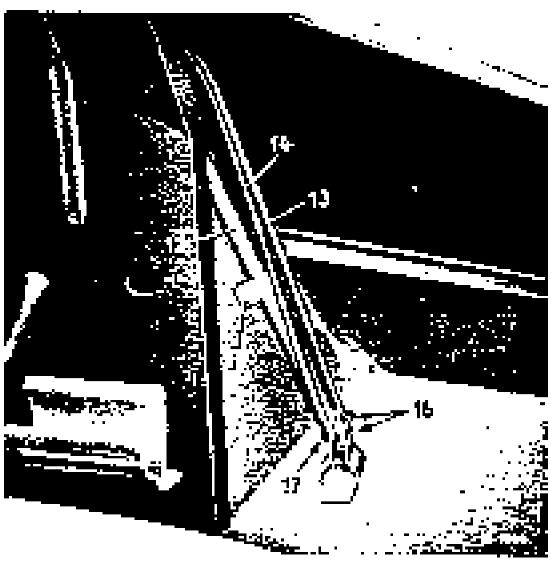


Fig. 47-1/4

12 Vent tube
13 Vent line
14 Vent line
15 Pipe clip
16 Rubber grommet
17 Rubber grommet

10. Bend the connecting pipes (7) and (8) and fit them to the vent lines of the fuel tank and to the vent lines of the vent tube (Fig. 47-1/5).

11. Connect the connecting pipes (7) and (8) to the vent lines of the fuel tank and to the vent lines of the vent tube and attach the hose clips (Fig. 47-1/5)

Note: Only fuel-resistant synthetic-rubber hoses with vulcanized fabric cover should be used as connecting hose.

12. Replace the filler cap of the fuel tank by a non-ventilated cap.

Note: The non-ventilated filler cap for the fuel tank is marked on the bottom with the words **OHNE LUFTUNG** (non-ventilated). **This cap must only be used for fuel tanks equipped with ventilating lines.**

Fig. 47-1/5

1 Fuel tank
4 Breathing line
5 Filler neck
7 Connecting pipe
8 Connecting pipe
9 Rubber hose
12 Double pipe clip
11 Pipe holder

IV. Model 220 SE

The suction line connection on the fuel tank is on the left side (seen in the direction of travel). The fuel feed pump located under the left spare wheel trough is connected by a hose to the fuel tank

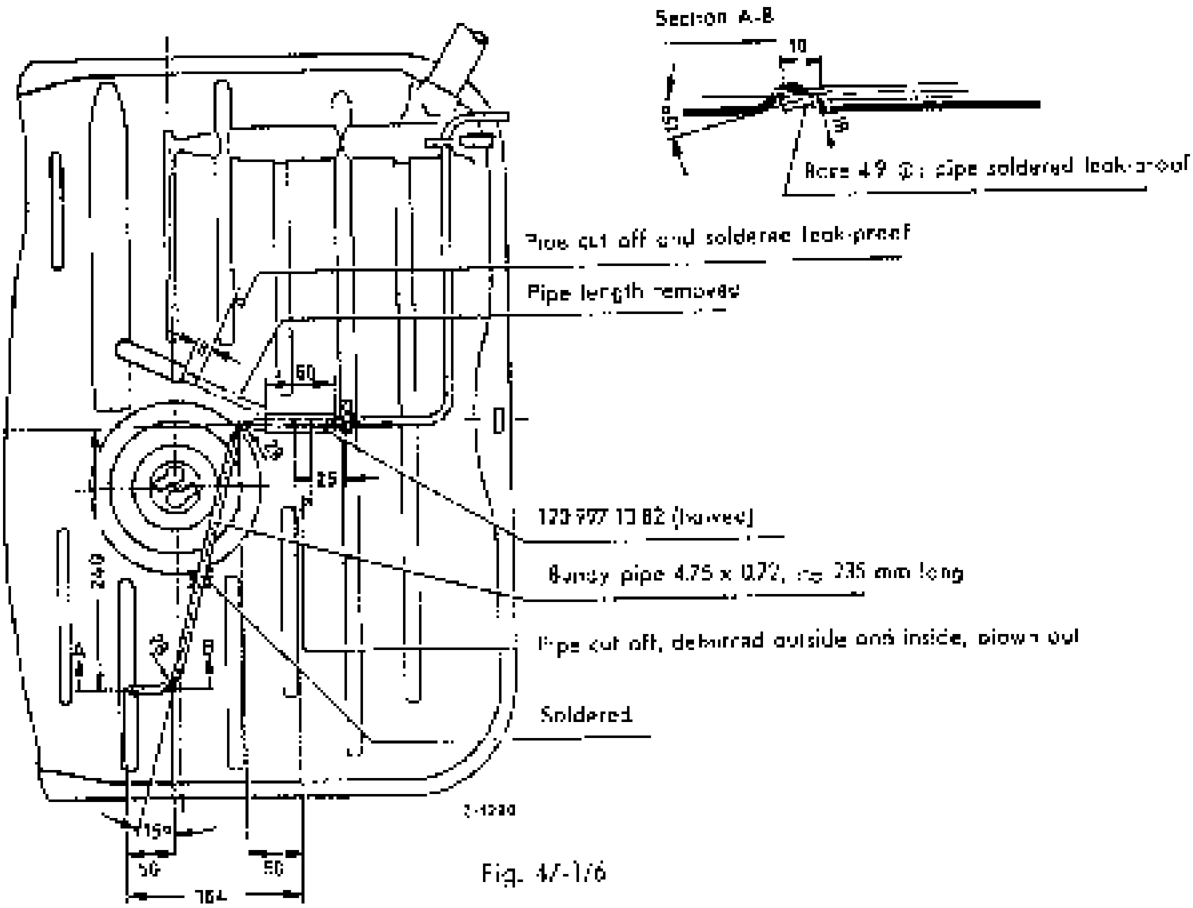


Fig. 47-1/6

suction line. The fuel return line between the injection pump and the fuel tank is screwed down at the same place as the return line on Diesel engine cars.

On recent cars of Model 220 SE Cabriolet and Coupé the fuel tank vent line is located on the left side of the fuel tank. If complaints are received about fuel leakage from the vent line on older cars of Models 180 to 220 SE (except 190 SL) the vent line can be subsequently installed as shown in Fig. 47-1/6.

C. Screw Plug for Fuel Tank

I. Models 180 to 220 S

The screw plug is provided with a screen jacket filter. When the screw plug is screwed into the fuel tank, the ring presses against a bracket in the fuel tank and prevents unfiltered fuel from flowing into the suction line.

II. Model 220 SE

1st Version

A sealing ring (7) has been installed in the screw plug (4) in the upper part of the screen jacket (6). When the screw plug is screwed in, the lip of the sealing ring is pushed over the fuel suction line (1) and provides a seal against the screen (Fig. 47-1/7).

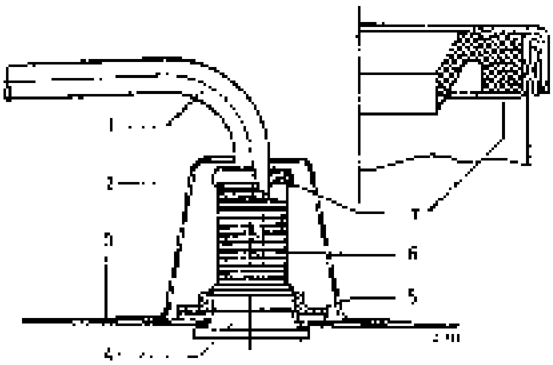


Fig. 47-1/7

1 Fuel suction line
2 Bracket in fuel tank
3 Fuel tank
4 Screw plug
5 Flange
6 Screen jacket
7 Sealing ring

2nd Version

Because of the low suction head of the fuel feed pump the fuel suction line in the fuel tank was lowered.

For this reason a small number of cars have a screw plug without screen jacket in the fuel tank and have a filter soldered to the fuel suction line which is parallel to the fuel tank bottom. On this version the filter (screen jacket) cannot be cleaned. If the filter should be clogged by impurities in the fuel or in the tank, the fuel tank must be replaced by a new tank with a 3rd version screw plug.

3rd Version

The screw plug (4) is provided with a screen jacket (6). The screen jacket is covered at the top by a lid (7). The fuel suction line (1) is soldered to the threaded socket (5). The screw plug (4) must be screwed through the lower and upper threads of the threaded socket (5).

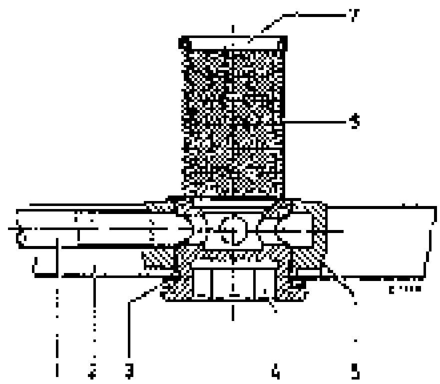


Fig. 47-1/8

1 Fuel suction line
2 Fuel tank
3 Sealing ring
4 Screw plug
5 Threaded socket
6 Screen jacket
7 Lid

Removal and Installation of Fuel Level Indicator

Job No.
47-2

On Models 180 to 220 SE the removal and installation procedures for the fuel level indicator are the same as on Model 190. Please note that the fuel level indicator should only be installed with the fuel-resistant sealing compound Terosan LB 1020/1 since all other sealing compounds are soluble in gasoline.

Note: On Models 190 SL, 220 a, and 220 S with reserve fuel line (without warning light) the fuel level indicator has only one electrical connection. On recent cars the float of the fuel level indicator has been made rattle-proof when the tank is completely full or completely empty.

Testing of Fuel Level Indicator

Job No.
47-3

Remove the fuel level indicator (see Job No. 47-2).

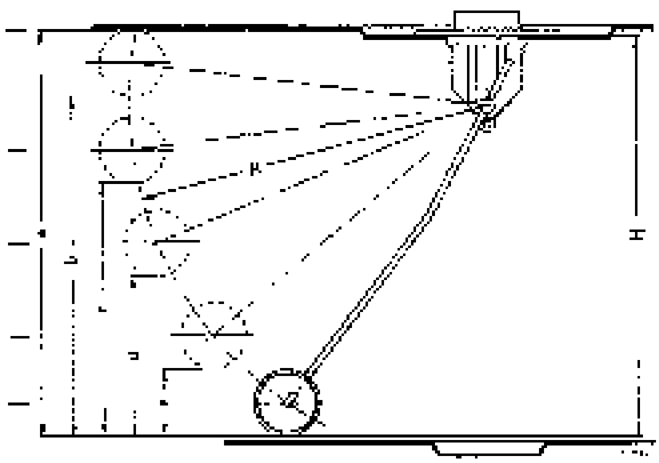


Fig. 47-3/1

Testing *Procedure*:

1. With the float lever swinging freely check the distance "H" from the lower edge of the float to the flange of the fuel level indicator. This distance should be on Models:

180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Da, 219	(56 liters tank capacity) = 172 mm
190 SL, 220 a, and 220 S	(64 liters tank capacity) = 194 mm
220 SE	(60 liters tank capacity) = 179 mm

2. Check the length "R" of the fuel level indicator from center fulcrum to center float. It should measure on Models:

180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 219	R = 151 ± 2 mm
190 SL, 220 a, and 220 S	R = 175 ± 2 mm
220 SE	R = 159 ± 2 mm

3. Connect the fuel level indicator to a fuel gage via a battery. As an expedient, the fuel level indicator, which has been removed from the vehicle, can be reconnected to the cable shear of the tail light wiring harness and the function of the fuel level indicator can be checked in the individual float positions on the fuel gage of the instrument cluster.

	Float raised by mm			Level indicated by fuel gage	Tank contents liters			Test readings ohms		
	180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 219	190 SL, 220 a, 220 S	220 SE		180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 219	190 SL, 220 a, 220 S	220 SE	180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 219	190 SL, 220 a, 220 S	220 SE
Distance "a"	145	167	178	completely full	56	54	65	180+10	180+10	180+10
Distance "b"	114	123	141	¾ full	42	40	45	157±5	147±5	143±5
Distance "c"	73	79	101	½ full	28	32	30	109±3	103±3	103±3
Distance "d"	33	33	59	¼ full	14	16	15	60±3	54±3	54±3

Note: The fuel level indicator with the additional connection for the red warning light must be checked for contact transmission to the warning light. To do this let the float lever swing freely. With the float lever in this position the warning light must light up after a switch-on lag of 4–7 minutes. The delay in the lighting-up of the warning light is caused by two bi-metal springs built into the fuel gage. This delay is necessary in order to prevent the light from constantly flickering on and off when the reserve fuel level is reached, as a result of the movement of the gasoline when the car is in motion. Raise the float by 5–7 mm (this corresponds to 5–6 liters of reserve fuel) on Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 219, and by 33–35 mm (this corresponds to 5.5 liters of reserve fuel) on Model 220 SE; in this position the warning light must no longer light up.

Job No.
47-4

Hints for Fault Tracing at Fuel Gage

The hints for tracing faults at the fuel gage on Models 180 to 220 SE correspond to those described for Model 190.

Job No.
47-5

Checking and Repair of Fuel Tank

On Models 180 to 220 SE the checking and repair procedures are the same as on Model 190.

Removal, Cleaning, and Installation of Fuel Pass Filter

Job No.
47-6

A. General

Different fuel pass filters have been installed in the individual models (see Table):

Model	Filter element	Connection thread	Remarks
180, 180 a, 180 D, 190, 219	Wire mesh	outer	On Models 180 D, 180 a, 190, and 219 1st version
180 a, 180 D, 180 Db, 190 D, 190 Db, 190, 190 b, 219	Wire mesh	inner	On Models 180 D, 180 a, 190, and 219 2nd version
180 a, 180 b, 190, 190 b, 219	Micronic	inner	On Models 180 a, 190, and 219 3rd version
220 a, 190 SL, 220 S	Wire mesh	outer	On Models 190 SL and 220 S 1st version with reserve fuel change-over cock
190 SL, 220 S	Wire mesh	inner	2nd version with reserve fuel change-over cock
190 SL, 220 S	Micronic	inner	3rd version with reserve fuel change-over cock

Note: Model 220 SE is equipped with a fine fuel filter. For checking procedures see Workshop Manual Passenger Car Models as from August 1959, Job No. 00-15, Section C.

B. Removal, Cleaning, and Installation of Fuel Pass Filter with Wire Mesh

The procedures are the same as for Model 190.

C. Removal, Replacement, and Installation of Fuel Pass Filter with Micronic Element

The micronic element must be replaced every 48 000 km.

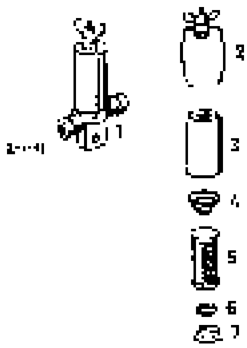


Fig. 47-6/1

1 Fuel pass filter
2 Clamp
3 Filter cup
4 Spring
5 Filter element
6 Sealing ring
7 Sealing ring

D. Fuel Pass Filter with Change-Over Cock

When the filter is removed and installed both the reserve fuel line (2) and the actuating rod (15) on the pass filter must be removed and installed (Fig. 47-6/2).

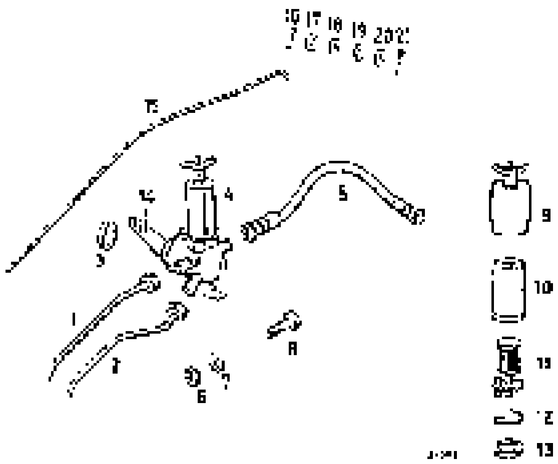


Fig. 47-6/2

1 Fuel line
2 Reserve fuel line
3 Seal
4 Fuel pass filter with change-over cock
5 Flexible hose
6 Hexagon nut
7 Lock washer
8 Hexagon screw
9 Wire clamp with wing nut and como seal
10 Filter cup
11 Filter element
12 Snap ring
13 Seal
14 Lever
15 Actuating rod
16 Cotter pin
17 Washer
18 Spring washer
19 Spring washer
20 Washer
21 Cotter pin

Job No.
47-8

Checking of Fuel Feed Pump on Model 220 SE

See Workshop Manual Passenger Car Models as from August 1959, Job No. 00-15, Section C.

Removal and Installation of Fuel Feed Pump on Model 220 SE

Job No.
47-9

The fuel feed pump (10) is located under the left spare wheel trough (6) and is covered by a protective case (9). Before removing the fuel feed pump empty the fuel tank; this is necessary because of the low position of the fuel feed hose (8) from the tank to the fuel feed pump

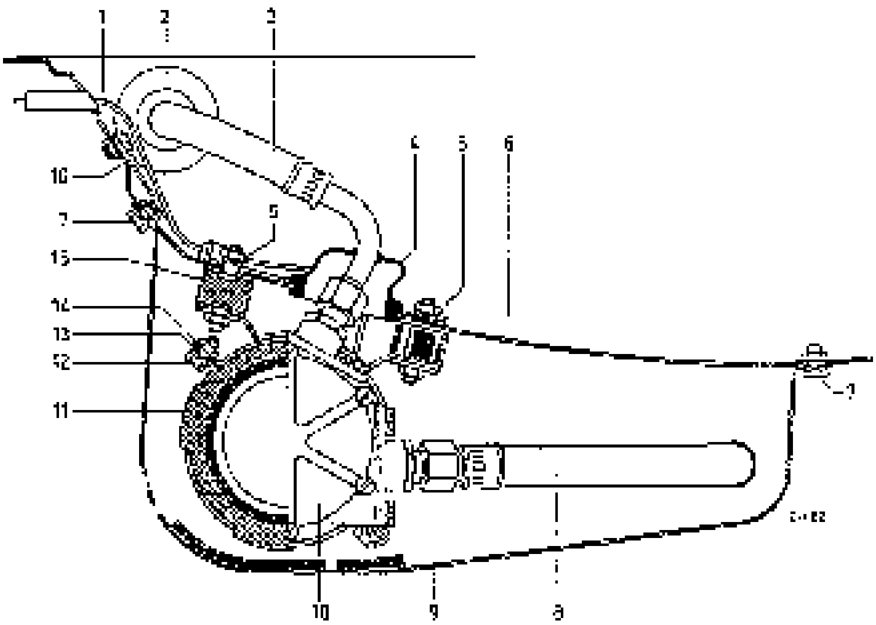


Fig. 47-9/1

1 Electric cable
2 Rubber grommet
3 Fuel pressure hose
4 Rubber cuff
5 Hexagon nut
6 Spare wheel trough
7 Hexagon screw
8 Fuel feed hose
9 Protective case
10 Fuel feed pump
11 Rubber molding
12 Hexagon screw
13 Fixing clip
14 Fixing clip
15 Bonded rubber buffer
16 Ground cable

Removal:

1. Unscrew the four hexagon screws (7) fastening the protective case (9) to the spare wheel trough (6) and remove the protective case.

2. Unscrew the fuel feed hose (8) from the threaded union of the fuel feed pump holding the threaded union on the pump steady.

3. While holding the threaded union on the pump steady unscrew the fuel pressure hose (3).

4. Disconnect the two electric cables (1) and (16) from the fuel feed pump

5. Remove the cover in the left spare wheel trough and unscrew the two hexagon nuts (5) attaching the feed pump to the spare wheel trough. When doing this have a second mechanic hold the fuel feed pump steady.

6. If the fuel feed pump has to be replaced, unscrew the two hexagon screws (12) on the fixing clips (13) and (14) and remove the top and bottom fixing clip.

7. Remove the rubber molding (11) from the retaining plates of the fuel feed pump.

8. Test the bonded rubber buffers (15) and the rubber molding.

Installation:

9. Installation is the reverse of the removal procedure. Give attention to the following details:

   Attach the fuel feed pump to the fixing clips (13) and (14) and to the spare wheel trough in such a way that the threaded union for the fuel feed line is horizontal. Connect the brown cable (16) to terminal 31.

10. After installing the fuel feed pump check all hose connections for leakage.

Exhaust System

49

Exhaust System Group 49

Removal and Installation of Exhaust System

Job No.
49-1

On Models 180 to 220 SE the removal and installation procedures for the exhaust system are essentially the same as on Model 190.

The following details require attention:

I. Models 180 a, 180 b, 180 D, 180 Db, 190 D, and 190 Db

These models are not equipped with a pre-silencer.

Note: Model 180 D 1st version was equipped with a pre-silencer.

II. Models 220 a, 219, 220 S, and 220 SE

These models are equipped with two exhaust manifolds.

Cooling System

Cooling System - Group 50

Cooling Water Circulation

Job No.
50-0

On Models 180 to 220 SE the cooling system is essentially the same as on Model 190. Note the following differences on the individual models:

I. Models 180, 180 D, and 180 Db

The engines of these models are not equipped with a water drain cock on the crankcase.

II. Model 190 SL

The thermostat is installed in the cooling water drain outlet. To provide preheating of the fuel-air mixture the intake pipe has been attached to the cooling water circulation system.

III. Model 220 SE

The heat feeler of the injection pump is installed in the cooling water circulation system.

Capacity of the Cooling System with Heat Exchangers in Liters

180, 180 a, 180 b	180 D, 180 Db	190 D, 190 Dc	190 SL	220 a, 219 220 S, 220 SE
9	8.5	9.3	10	11.2

Job No.
50-1

Removal and Installation of Radiator

On Models 180 to 220 SE the removal and installation procedures for the radiator are essentially the same as on Model 190.

The following details need attention:

a) General

The minimum distance between fan and radiator must always be maintained. If difficulties should arise, re-ream the fixing holes for the radiator on the chassis base panel or on the stiffening plate.

b) Radiator Cap

The radiator caps are marked by a number which is stamped on the cap: pay attention to this number when replacing the cap or the plate valve. For Models 180 a, 180 b, 190 D, 190 Db, 190 SL, 220 a, 219, 220 S, and 220 SE use a radiator cap with the code number 100 (opening pressure 1 atm) and for Models 180, 180 D, and 180 Db use a cap with the code number 40 (opening pressure 0.4 atm).

On both versions the vacuum valve opens at 0.1 atm.

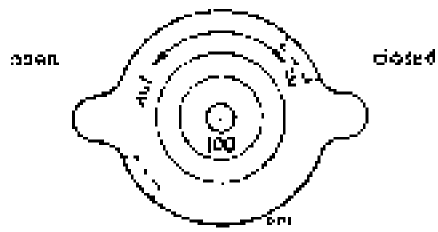


Fig. 50-1/1

c) Model 190 SL

When removing or installing the radiator take care not to damage the fuel overflow line. Before the cooling water is topped up, move the two control levers for the heating system in the center of the instrument panel to the right; this opens the regulating valves on the heat exchanger to the full.

Cleaning of Cooling System

Job No. 50-2

On Models 180 to 220 SE the degreasing, scaling, and cleaning procedures for the cooling system are the same as on Model 190.

Anti-Freeze Solutions

Job No. 50-3

Only the commercial branded anti-freeze preparations should be used for the radiator. Details about suitable anti-freezes, the required mixing ratio for the individual models, and the corrosion inhibitors which can be mixed with the anti-freeze solution are contained in the latest brochure on fuels, coolants, and lubricants.

Checking and Adjustment of Fan Belt Tension

Job No.
50-5

I. Models 180 a, 180 b, 190 D, 190 Db, 190 SL, 220 a, 219, 220 S, and 220 SE

The checking and adjustment procedures are the same as on Model 190.

II. Models 180, 180 D, and 180 Db (Fan Belt for Water Pump and Generator)

Checking:

1. The fan belt has the specified tension if moderate thumb pressure applied at the center point between the water pump and the generator pulleys depresses the belt from its straight position a distance of 6–10 mm.

Note: When checking the fan belt tension the condition of the pulleys should also be examined.
Badly worn pulleys should be replaced since otherwise the fan belt rests on the base of the pulley and cannot transmit power.

Adjustment:

2. In order to adjust or re-tension the fan belt slightly slacken the fixing screws (4) and (7) on the generator bracket under the generator, the clamping screw (2) and the hexagon nut (3) (Fig. 50–5/1).

3. Now move the generator until a correct belt tension has been achieved.

4. Tighten the fixing screws (4) and (7), the hexagon screw (2) and the hexagon nut (3) (Fig. 50–5/1).

Note: If the fan belt has to be replaced, unscrew the nut of the hexagon screw (1) and remove the screw. Slacken the fixing screws (4) and (7), the clamping screw (2) and the hexagon nut (3) (see Fig. 50–5/1), so that the generator can be moved toward the engine far enough for the belt to be easily removed and put on.

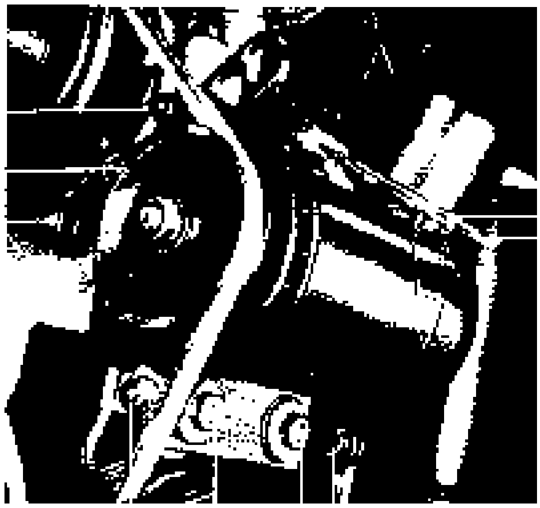


Fig 50–5/1

1 Hexagon screw
2 Hexagon screw (clamping screw)
3 Hexagon nut
4 Front fixing screw
5 Hexagon nut
6 Hexagon nut
7 Rear fixing screw
8 Terminal 61
9 Terminal 51

The fan belt must not be forced off or on with the aid of a screw driver as this may cause damage to the pulley and the belt.

III. Models 180, 180 D, and 180 Db (Fan Belt)

Checking:

(see Section II, Para 1).

Adjustment:

1. Unscrew the two hexagon screws attaching the fan mounting (3) to the support (2).

2. Loosen the lock nut of the adjusting screw (1) and turn the screw in and out until the correct belt tension is obtained.

Note: The fan belt should not be given excessive tension since this would put a strain on the annular grooved bearing in the pulley and may produce whining noises of the fan.

3. Tighten the fixing screws and the lock nut of the adjusting screw.

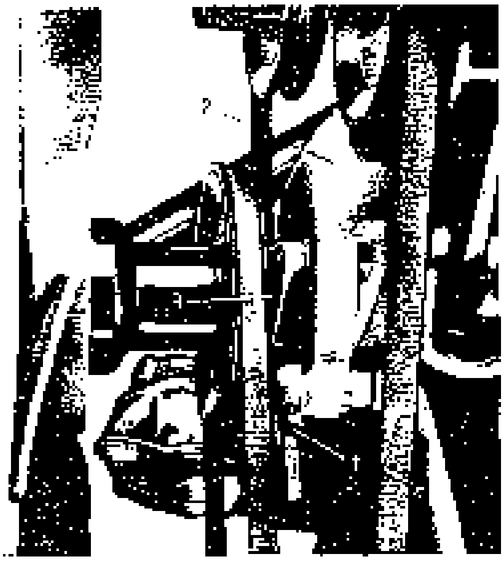


Fig. 50–5/2

1 Adjusting screw
2 Support
3 Fan mounting

Cooling Water Thermostat

Job No.
50 6

A. Steam-Pressure Thermostat

Model 180 and Model 180 D 1st Version

In the case of steam pressure thermostats the valve plate is forced open by the alcohol-filled metal bellows in the direction of flow of the cooling water. The opening phase therefore is dependend on the pressure obtaining in the cooling system, that is to say the steam-pressure thermostat is pressure-sensitive.

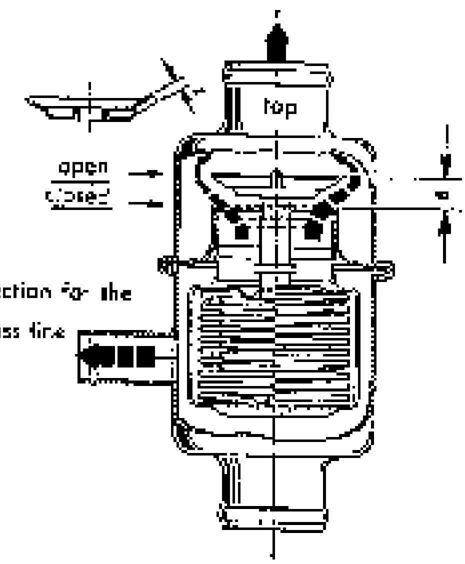


Fig. 50-6/1

Steam Pressure Thermostat

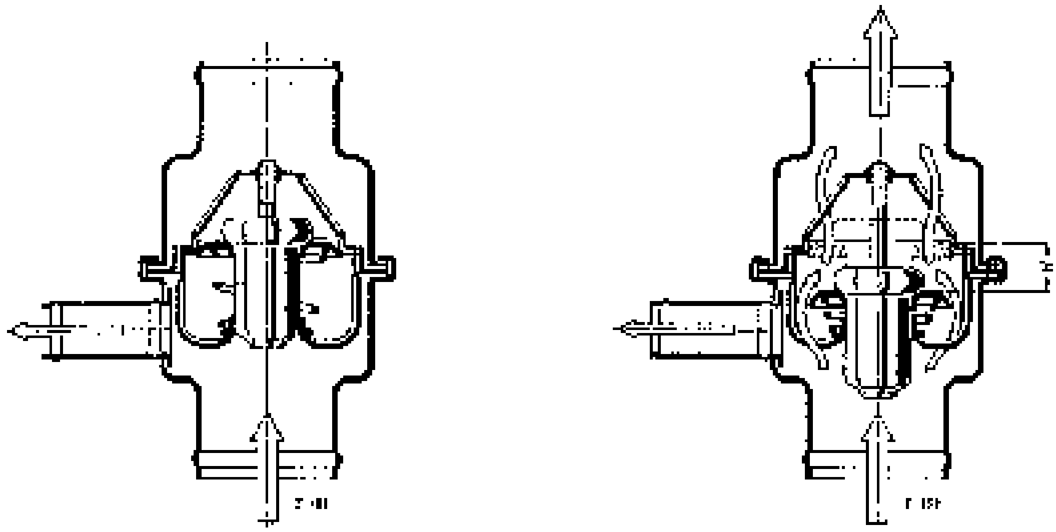
Only wax thermostats are supplied as replacement parts (see Section B). For testing instructions see Section D.

B. Wax Thermostats

a) Wax Thermostats without By-Pass Control

Models 180 (in case of replacement), 180 a, 180 D, 190 SL (thermostat element only), 220 a, 219, 220 S

The wax thermostat is independent of the pressure in the cooling water system, that is to say it is not pressure-sensitive. The thermostat element has a diaphragm (5) which is located between the wax-like mass (4) and the pin (1) soldered to the housing (Fig. 50-6/2).



closed

open
h = working stroke 8—9 mm

Fig. 50-6/2

Wax thermostat without by-pass control

When the cooling water warms up the wax-like mass (4) expands, which causes the diaphragm to bear upon the soldered pin (1) and the valve opens in the direction opposite to that of the flow of the cooling water. As the temperature of the cooling water drops, the valve is closed by the pressure spring situated between the valve plate and the thermostat guide plate. The by-pass line is open whether the valve is open or closed (see Fig. 50-6/2).

b) Wax Thermostat with By-Pass Control

Models 180 Db, 180 b, 190 D, 190 Db, 220 SE

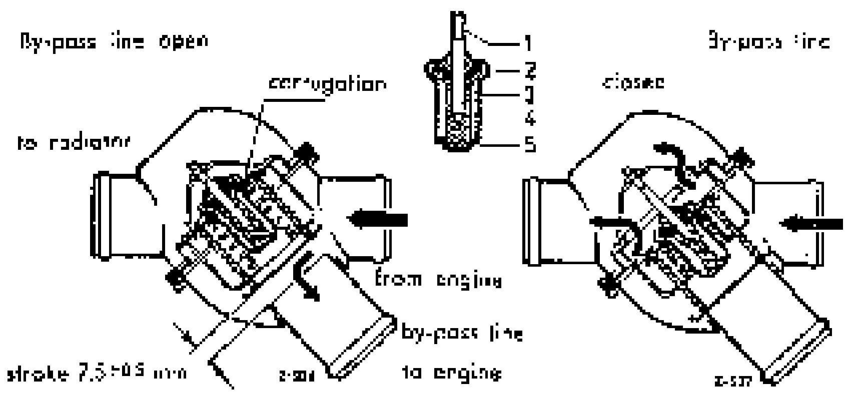


Fig. 50-6/3

Wax thermostat with by-pass control

1 Pressure pin
2 Cover disk
3 Housing
4 Wax
5 Rubber diaphragm

The element of the wax thermostat with by-pass control works and is designed on the same principle as that of the wax thermostat without by-pass control. The only difference is that the diameter of the connecting branch for the by-pass line has the same size as the diameter of the two connecting branches for the cooling water hoses from the engine to the radiator and this by-pass line is opened and closed by the valve (by-pass control).

When the valve is closed, the cooling water circulation from the engine to the radiator is interrupted. The whole amount of cooling water is returned to the engine via the completely open by-pass line.

When the valve is fully opened, the by-pass line is completely closed and the cooling water inlet to the radiator is completely open.

In the various intermediate positions of the valve the cooling water flows both to the radiator and via the by-pass line to the engine.

As a result the same amount of cooling water flows through the thermostat independent of its varying operating positions and the cooling water in the cylinder crankcase and the cylinder head is heated rapidly and at a uniform rate.

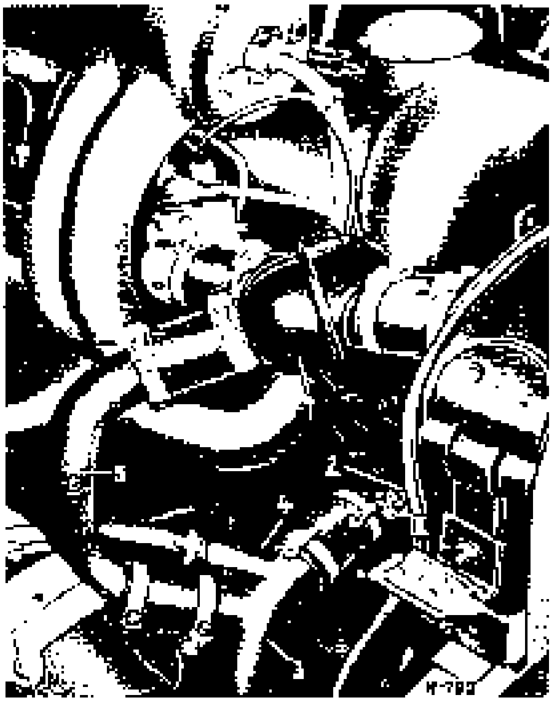


Fig. 50-6/4

Wax thermostat with by-pass control
(Fig. shows Model 220 SE)

1 Thermostat
2 Connection to fuel feeder on injection pump
3 Cooling water line from radiator to engine
4 Heater connection
5 By-pass line

C. Subsequent Installation of a Wax Thermostat with By-Pass Control

I. Model 180 D

The cooling water line from the radiator to the engine (3) must be replaced by the cooling water line Part No. 636 200 12 53 (see Fig. 50-6/4). When this line is installed, the diameter of the pipe socket of the line is 20 mm. The thermostat is connected to the cooling water system by two hoses and the new by-pass line (5) Part No. 635 501 00 24 which has to be installed.

II. Model 180 a

The arrangement of the wax thermostat with by-pass control (1) and the by-pass line (5) is shown in Fig. 50-6/4. The subsequent installation requires the cooling water line (3) Part No. 121 500 14 91 from the radiator to the engine with a diameter of the connection for the by-pass line of 32 mm and the by-pass line (5) Part No. 121 500 15 91.

D. Survey of Thermostats and Testing Instructions

Testing instructions for the thermostat are essentially the same as described for Model 190. When testing the wax thermostat with by-pass control the by-pass line must be closed when the amount of flow is being checked.

Model	Part No.	Type	Opens at °C	Working stroke of valve in mm	Working stroke of valve at C°	Flow when closed liters/mm	Diameter of connection branch from engine to radiator in mm	Diameter of connection branch for by-pass line in mm
180 180 D (1st vers.)	181 203 00 75 181 203 04 75	Steam-pressure thermostat	71—74 77—80 1)	8	80—81 87—88			13
180 D (2nd vers.)	000 203 97 75 optional 000 203 98 75	Wax thermostat without by-pass control		8—9			28	
180 Db	001 203 19 75 optional 001 203 20 75	Wax thermostat with by-pass control		7.5—8				28
220 a, 219, 220 S 180 (in case of replacement) 180 a 190 (1st version)	000 203 65 75 optional 000 203 75 75	Wax thermostat without by-pass control	76—79		91—94	0.7—1.2	32	13
190 SL	000 203 64 75	Wax thermostat element (in cooling water outlet connection)		8—9			—	—
180 b 190 b 190 D and 190 Db, 220 SE (1st version)	001 203 08 75 optional 001 203 23 75	Wax thermostat with by-pass control		7.5—8			32	32
220 SE (2nd vers.)	001 203 21 75		74—76		94			

1) water drinking

E. Removal and Installation of Thermostat

I. Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 220 a, 219, 220 S, and 220 SE

The removal and installation procedures are the same as for Model 190.

II. Model 190 SL

Removal:

1. Drain off part of the cooling water, collecting additives if present.

2. Unfasten the hose clamp on the cooling water outlet connection and remove the hose.

3. Unscrew the four hexagon socket screws fastening the cover of the outlet connection and remove the cover, the gaskets, and the thermostat element.

4. Check the thermostat.

5. If the element has to be replaced, please note that on cars with Engine End No. up to 45 01 020 the cooling water outlet connection has to be replaced as well. This is necessary because the new cooling water outlet connection increases the range of the thermostat.

Installation:

Installation is the reverse of the removal procedure. The thermostat element must be installed in the outlet connection in such a way that the vent corrugation is situated at the top. Replace the gaskets between the outlet connection, the thermostat element and the cover.

Fig. 50-6/5

Cooling water outlet connection

1st version 2nd version

Electrical System

15/54/82

Electrical System - Groups 15/54/82

Electrical System, Engine – Group 15

Electrical System, Equipment and Instruments Group 54

Removal and Installation of Solenoid Switch

Job No.
15–2

I. Models 180, 180 a, 180 b, 190 D, 190 Db, 220 a, 219, 220 S, and 220 SE

The removal and installation procedures for the solenoid switch are the same as for Model 190.

II. Models 180 D, 180 Db, and 190 SL

The removal and installation procedures are essentially the same as for Model 190 with the difference, however, that the solenoid switch can only be removed and installed when the starter has been removed from the vehicle (for removal and installation of starter see Job No. 15–1).

The adjusting dimension "a" on the solenoid switch with the linkage yoke drawn in (Fig. 15-2/1) is shown in the Table below.

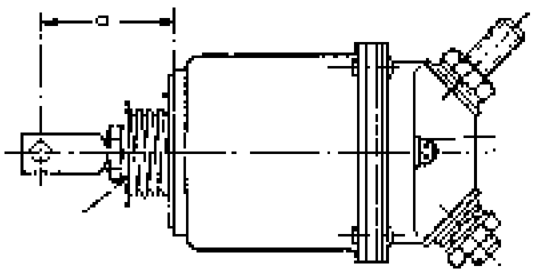


Fig. 15–2/1

Model	Solenoid switch	Adjusting dimension "a" Fig. 15–2/1
180	SSM 120/L 19 Z	32.2 ± 0.1
180 D, 180 Db	SSM 102/E 11 Z	42.0 ± 0.2
190 D, 190 Db	SSM 102/E 12 Z	34.0 ± 0.2
190 SL	SSM 120/L 17 Z	32.4 ± 0.1
180 a, 180 b, 220 a, 219, 220 S, and 220 SE	SSM 120/L 24 Z	32.4 ± 0.1

Servicing Hints for Starter Installed in Vehicle

Job No.
15–3

On Models 180 to 220 SE the servicing hints for the starter installed in the vehicle are the same as on Model 190.

Starter

Job No.
15–0

Both the function and the basic design of the various Bosch starters are the same as those of the type incorporated in Model 190. For the various Bosch starter types installed see Table below.

Type EGD	0.6/6	AR 22	installed in Model 180
Type EJD	1.8/12	R 70	installed in Model 180 D and 180 Db
Type EJD	1.8/12	R 88	installed in Model 190 D and 190 Db
Type EED	0.8/12	R 28	installed in Model 190 SL
Type EED	0.8/12	R 31	installed in Model 190 SL
Type EED	0.8/12	R 25	installed in Model 220 a
Type EED	0.8/12	R 30	installed in Models 180 a, 180 b, 219, 220 S, and 220 SE

Removal and Installation of Starter

Job No.
15–1

I. Models 180 a, 180 b, 190 D, 190 Db, 220 a, 219, 220 S, 220 SE

On these models the removal and installation procedures for the starter are the same as on Model 190.

II. Model 180

On Model 180 the removal and installation procedures for the starter are essentially the same as on Model 190; however, the engine must be gently pushed sideways before the starter can be removed upward. The jointing flange between the starter flange and the crankcase is not required on this model.

III. Models 180 D, 180 Db

The removal and installation procedures are essentially the same as on Model 190, but the following points require attention:

1. Remove the housing vent line to the air filter.
2. Detach the return spring on the venturi control unit linkage and remove together with bracket.

Note: Use special wrench Part No. 636 589 00 01 to unscrew the nut on the upper fixing screw of the starter.

When removing the starter, gently push the engine sideways.

There is no jointing flange between the starter flange and the crankcase.

IV. Model 190 SL

The removal and installation procedures for the starter are essentially the same as for Model 190. Special attention should be given to the following points:

a) Cars with Three-Point Engine Suspension

1. Unscrew the three hexagon screws (1) on the pivot bearing (2) for the steering relay arm (3) (Fig. 15–1/1) and push the pivot bearing downward together with the tie-rod.

Note: As from Engine End No. 7500129 the starter EED 0.8/12 R 31 with silentbloc has been installed and the jointing flange (between starter flange and partition plate) is no longer required.

b) Cars with Four-Point Engine Suspension

1. Unscrew the hexagon nut (8) from the steering shock absorber on the front axle support (4) (Fig. 15–1/1). Pull the steering shock absorber (6) out of the fixing bolt and push it toward the rear.

2. Unscrew the hexagon screws (1) on the pivot bearing (2) for the steering relay arm on the front axle support (4) and push the pivot bearing (2) with the tie-rod downward (Fig. 15–1/1).

3. Turn the two hexagon screws and the cable support (3) sideways on the right rear engine mounting (Fig. 15–1/2).

4. When removing the starter gently push the engine sideways.

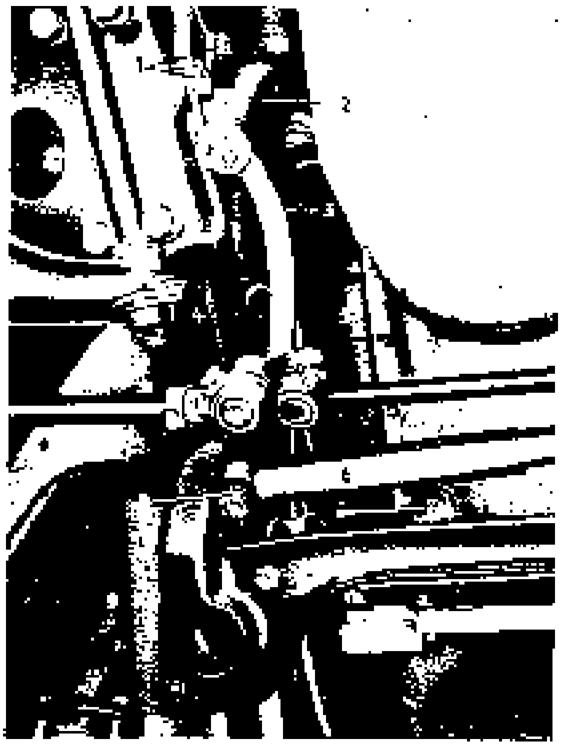


Fig. 15-1/1

1 Hexagon screw M 10 x 15
2 Pivot bearing (for steering relay arm)
3 Steering relay arm
4 Front axle support
5 Starter
6 Steering shock absorber
7 Hexagon nut (lower [illegible] mounting)
8 Hexagon nut for fixing bolt
9 Exhaust pipe

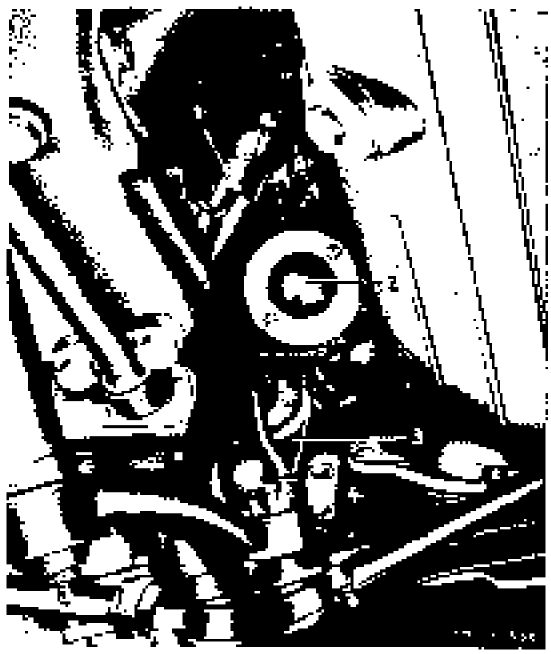


Fig. 15-1/2

1 Electrical connections
2 Starter (in slide back position)
3 Cable support (for starter cable)
4 Partition plate (with fixing hole for right rear engine mounting)

Electrical System, Body – Group 82

Job No.
15–4

Disassembly and Reassembly of Starter

The carbon brush pressure should be **800–900 g** for all starters.

For the starters of Models 180 D, 180 Db, 190 D, and 190 Db the minimum permissible diameter of the commutator is

39.5 mm

and for the starters of all other models

33.5 mm

Job No.
15–5

Electrical Testing of Starter

The testing procedures for the starter on Models 180 to 220 SE are the same as on Model 190.

Test Values for Starter

Model	Starter Bosch	Voltage Volts	Current under load (braked) Amp.	Speed r.p.m.
180	EDG 0.6/6 AR 22	4.5	260—290	675—1000
180 D, 180 Db	EJD 1.8/12 R 73	9.0	320—340	1100—1350
190 D, 190 Db	EJD 1.0/12 R 83	9.0	320—340	1100—1350
190 Sl	EED 0.8/12 R 28 EED 0.8/12 R 31	10.5	[illegible]60—180	1030—1400
180 a, 180 b, 220 a, 219, 220 S and 220 SE	EED 0.8/12 R 30	10.5	160—180	1030—1400

Job No.
15–6

Trouble Shooting Hints for the Starter

The trouble shooting hints for the starter on Models 180 to 220 SE correspond to those described for Model 190.

Generator and Regulator (Three-Element Voltage/Current Regulator)

Job No.
15–10

I. Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 190 SL, 220 a, 219, 220 S

Both the function and the basic design of the various Bosch generators are the same as those of the type incorporated in Model 190. For the various Bosch generator types installed see Table below.

Type LJ/GE	160/6 –2500 R 7	installed in Model 180
Type LJ/GEG	160/12–2500 R 10	installed in Models 180 D, 180 Db
Type LJ/GEG	160/12–2500 R 8	installed in Models 180 a, 180 b, and 190 SL
Type LJ/GEG	160/12–2500 R 9	installed in Models 190 D, 190 Db, 220 a, 219, and 220 S

II. Model 220 SE

The generator

Type LJ/GG 240/12–2400 R 8

has a rated output of 240 watts. The maximum output which the generator is capable of delivering continuously without suffering any damage is 50% above the rated output, that is to say, a continuous output of 360 watts is permissible.

The regulator, a three-element voltage/current regulator Type RS/UA 240/12/39, has a current regulator of the two-contact type. The regulator too, is fixed to the right wheel arch panel. This provides extra safety against overloading the regulator and the generator when the car is constantly driven at maximum engine speed.

Job No.
15–11

Removal and Installation of Generator

On Models 180 to 220 SE the removal and installation procedures for the generator are essentially the same as on Model 190. The electric leads on all models have the same color coding. The only differences are in the generator mounting and are illustrated in the Figures below.

Model 190 (1st version) and 190 SL **Models 190 (2nd version), 180 a, 180 b, 190 D, and 190 Db**

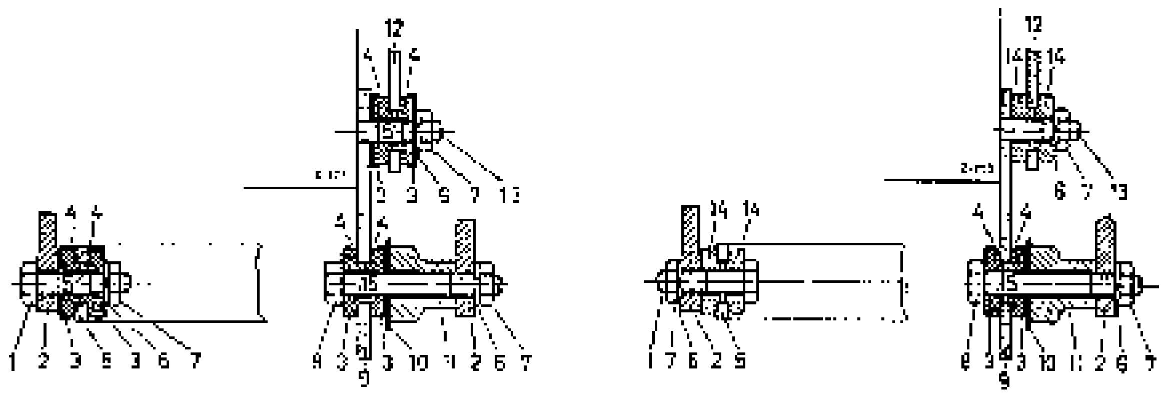


Fig. 15-11/1

1 Hexagon screw M 8 × 32 DIN 931-8 G
2 Generator
3 Cup washer
4 Rubber washer
5 Support
6 Lock washer B 8 DIN 137
7 Hexagon nut M 8 DIN 934-5 S
8 Hexagon screw M 8 × 55 DIN 931-8 G
9 Engine support
10 Washer
11 Spacer sleeve 25.5 mm long
12 Tensioning screw
13 Stud screw M 8 × 38 DIN 939-5 S
14 Washer
15 Sleeve

Models 180, 180 D, and 180 Db

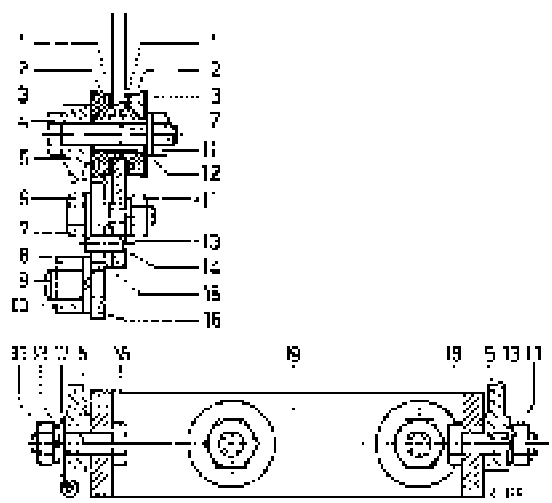


Fig. 15-11/2

1 Washer
2 Rubber washer
3 Cup washer
4 Hexagon screw M 8 × 40 DIN 931-8 G
5 Generator
6 Hexagon screw M 8 × 25 DIN 931-8 G
7 Washer
8 Hexagon nut M 12 DIN 934-5 S
9 Stud screw M 12 in crankcase
10 Lock washer
11 Hexagon nut M 8 DIN 934-5 S
12 Sleeve
13 Lock washer
14 Notched cylindrical pin 8 × 14 DIN 1470
15 Generator bracket
16 Generator retainer
17 Ground lead
18 Hexagon screw M 8 × 28 DIN 931-8 G
19 Generator support

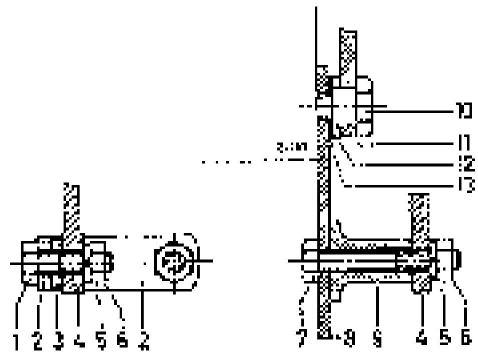


Fig. 15-11/3

1 Hexagon screw M 8 X 30 DIN 931-8 G
2 Generator support
3 Spacer ring 4 mm long
4 Generator
5 Lock washer B 8 DIN 127
6 Hexagon nut M 8 DIN 934-8 S
7 Hexagon screw M 8 X 55 DIN 931 8 G
8 Engine support
9 Spacer sleeve 31 mm long
10 Hexagon screw
11 Tensioning screw
12 Spring washer
13 Lock washer

Job No.
15-12

Servicing Hints for Generator when Removed from the Vehicle

I. Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 190 SL, 220 a, 219, 220 S

The servicing hints given for the generator on Model 190 apply.

II. Model 220 SE

Generator LJ/GG 240/12–2400 R 8 has new brush holders which are offset from the center and are no longer fixed to the commutator bearing but to the armature housing. As a result the carbon brushes are larger. Furthermore the new brush holders reduce the risk of dirty and sticking carbons.

For generator servicing see Job No. 15-13.

Fig. 15-12/1

Generator LJ/GG 240/12 - 2400 R 8 for model 220 SE

Disassembly and Reassembly of Generator

Job No.
15–13

I. Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 190 SL, 220 a, 219, and 220 S

Disassembly and reassembly of the generator are essentially the same as in the case of Model 190.

II. Model 220 SE

Disassembly:

1. Unscrew the nut M 16 × 1 on the armature shaft. Remove the lock washer together with the pulley, paying attention to the Woodruff key.

2. Insert a suitable screw driver under the carbon brush below the connecting wire and carefully push the brush upward until it engages in the gap between the brush holder (Fig. 15-13/1) and the armature housing. In this position the brush spring presses the carbon brush into an oblique position.

Fig. 15-13/1

3. Unscrew the through screws (armature housing screws) for the bearing caps.

4. Take the drive bearing with the armature out of the armature housing. The ball bearing on the collector side is taken out of the housing at the same time.

Note: The cap on the drive side is held in position in the housing by means of a nose, a groove, and a bore.

5. Remove the collector bearing cap from the armature housing, paying attention to the corrugated washer in the ball bearing seat of the collector bearing.

6. Fix the armature in a vise or in a clamping support, using special jaws.

7. Unscrew the three countersunk screws in the drive bearing after having removed the lacquer by means of a scriber.

8. Remove the drive bearing cap.

9. If the ball bearings have to be replaced, use a suitable puller to pull the ball bearings off the armature shaft, paying attention to the splash disk, the cover disk, and the spacer ring (Fig. 15-13/2).

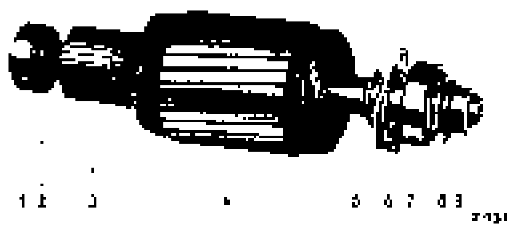


Fig. 15-13/2

1 Annular grooved bearing
2 Splash disk
3 Collector
4 Armature
5 Splash disk
6 Cover disk
7 Annular grooved bearing
8 Splash disk
9 Spacer ring

Checking:

10. Check the collector. The surface must be uniformly smooth, grey-black in color, and free from dust, oil, and grease. Dirty segments must be cleaned with a clean, gasoline-soaked rag and well dried.

Note: There must be no charred spots on the collector.

11. Check the collector for signs of eccentricity. Eccentric or scored collectors should be lightly turned-off. Under no circumstances must emery cloth or a file be used. When turning, do not remove more material from the collector than is absolutely necessary to obtain a perfectly smooth surface.

    The minimum permissible diameter of the collector is 35.5 mm. After turning-off, the segments must be sawn out with a collector saw (e.g. Bosch FFAW 10) appr. 0.5–0.8 mm. After this, the collector must once more be turned-off with a stock removal of 0.1 mm. Do not use the same turning tool for rough-turning and finish-turning and only use carbide-tipped tools (Widia). The maximum permissible run-out of the collector is 0.03 mm and of the armature core laminations 0.05 mm.

    Check the bindings of the armature winding. The winding head diameters must not be greater than the diameter of the armature; the bindings must be in perfect condition.

12. Check the armature and the field coil for short-circuit in windings and short-circuit to ground (see Job No. 15–5).

Note: This check is made in the same way as in the case of the starter.

13. Remove any dirt and oil from the carbon brushes with a clean rag. Badly worn carbon brushes must be replaced.

14. Check the pressure springs for the carbon brushes and if necessary replace them. The brush pressure should be 900 ± 50 g.

Note: Because of the new brush holder arrangement in this generator, the brush pressure cannot be checked in the usual way.

The check should be carried out as follows:

Measurement by means of Contact Pressure Gage

a) Slightly lift the pressure spring with a screwdriver and insert the tongue of the contact pressure gage between carbon brush and spring (Fig. 15–13/3).

b) Move the contact pressure gage upward against the pressure spring until the spring begins to lift from the brush.

c) Read off the contact pressure.

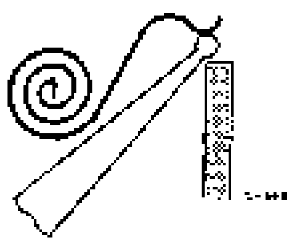
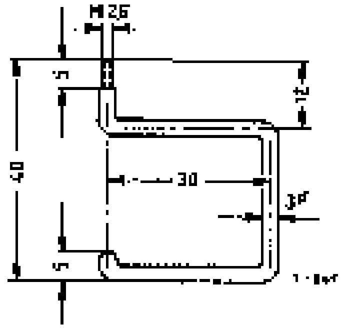


Fig. 15-13/3

Measuring brush pressure with contact pressure gage

Measurement by means of Spring Scale EF 12 44 B

To do this, make a new frame for the spring scale as shown in Fig. 15-13/4.



Free length appr. 105 mm

Fig. 15-13/4

Frame for Spring Scale EF 1244 B

The frame of the spring scale is applied to the center of the spring (see arrow in Fig. 15-13/5) and the spring scale is operated until the spring begins to lift from the carbon brush. For the correct brush pressure of 900 ± 50 g the indicated value should be 1400–1600 g.

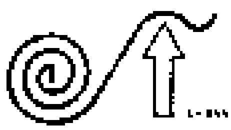


Fig. 15-13/5

Point of attack of spring scale on brush spring

Reassembly:

15. Reassembly is the reverse of the disassembly procedure. When reassembling, grease the ball bearings with Bosch Grease Ft v 22 (blue).

Note: The drive-side ball bearing is fitted to the shaft with a sliding fit and can be moved on the shaft by hand.

16. After reassembly, the generator must be checked with its appropriate regulator on the test stand (see Job No. 15-16).

Job No.
15-14

Removal and Installation of Regulator (Three-Element Voltage/Current Regulator)

On Models 180 to 220 SE the removal and installation procedures for the regulator are essentially the same as on Model 190.

When connecting the electric cables pay attention to the color coding. Incorrect connection of the terminals involves the risk of pole reversal of the generator and destruction of the regulator.

Job No.
15-15

Removal and Installation of Charging Light

I. Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 220 a, 219, 220 S, 220 SE, and 190 SL with Steering Lock

On these models the removal and installation procedures for the charging light are the same as on Model 190.

II. Model 190 SL with Ignition Starter Switch

Removal:

1. Remove the speedometer (see Job No. 54-11).

2. Use a hook wrench to unscrew the escutcheon on the charging light and remove, holding the charging light steady with one hand.

3. Pull the charging light out of the instrument panel toward the rear and remove the bulb from the socket.

Installation:

4. Installation is the reverse of the removal procedure.

Electrical Testing of Generator and Regulator (Three-Element Voltage/Current Regulator)

Job No.
15–16

On Models 180 to 220 SE the testing procedures for the generator and the regulator (three-element voltage/current regulator) and also the color coding of the electric leads are the same as on Model 190.

Test Values for Generator and Regulator

Model	Generator Bosch	Regulation voltage when idling volts	Maximum cut in engine speed r.p.m.	At rated output maximum load engine speed		Regulation voltage or cut in of current regulator at rated output and 1.5 x rated engine speed	Reverse current amps.	Regulator Bosch
				watts	r.p.m.			
180	LJ/GE 160/12/2600 R 7	7.0—7.6	1560	160	2550	41—45 amps warm	4.5—6.5	RS/UA 160/6/30
180 D 180 Db	LJ/GEG 160/12/2500 R 10	13.6—14.8	2000	160	2550	17.5—20.5 amps.	2.5—6.5	RS/UA 160/12/15
180 a, 180 b, 190 SL	LJ/GEG 160/12/2500 R 8	13.6—14.8	2000	160	2550	17.5—20.5 amps.	2.5—6.5	RS/UA 160/12/15
190 D 190 Db, 220 a 219, 220 S	LJ/GEG 160/12/2500 R 9	13.8—14.8	2000	160	2550	17.5—20.5 amps.	2.5—6.5	RS/UA 160/12/15
220 SE	LJ/GG 240/12/2400 R 8	13.6—14.8	1800	240	2350	27—31 amps.	5—9	RS/UA 240/12/30

Trouble Shooting Hints for the Generator

Job No.
15–17

The trouble shooting hints for the generator given for Model 190 also apply to Models 180 to 220 SE.

Ignition System

Job No.
15-20

The ignition system on Models 180 to 220 SE is essentially the same as on Model 190.

As from Chassis End No. 85 01864 of Model 190 SL the ignition starter switch on the instrument panel has been replaced by an ignition switch on the steering column bracket.

On Models 220 a, 219, 220 S, and 220 SE the firing order is 1 – 5 – 3 – 6 – 2 – 4.

Suppressors for Distant Interference Suppression

On Models 180 to 220 SE the following suppressors are required for distant interference suppression of the ignition system:

1. One suppressed distributor plug with a resistance of 5 K-Ohms.

2. Four or six spark plug suppressor caps with a resistance of 1 K Ohm.

   For designation and Part Nos. of the suppressors see Job No. 82–21 (Interference suppressors for radio)

Removal and Installation of Ignition Switch

Job No.
15-21

I. Models 180, 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE

On these models the removal and installation procedures for the ignition switch are the same as on Model 190.

II. Model 190 SL with Ignition Starter Switch

Removal:

1. Disconnect the ground cable at the negative terminal of the battery.

2. Use a hook wrench to unscrew the escutcheon of the ignition starter switch and remove it; while doing this hold the ignition starter switch steady with one hand from behind the instrument panel.

3. Pull the ignition starter switch from the instrument panel toward the rear.

4. Disconnect the electric leads.

Installation:

Installation is the reverse of the removal procedure.

When connecting the electric leads pay attention to the color coding.

Connect the red cable to terminal 30, the black cable to terminal 15, the black/red cable to terminal 50.

Note: Terminal 54 remains free because it is needed for the installation of a radio set.

Job No
15-22

Ignition Coil

Models 180, 180 a, 180 b, 190 SL, 219, 220 a, 220 S, and 220 SE

On these models the testing procedure for the ignition coil is the same as on Model 190.

Table of Ignition Coils Installed

Model	Ignition coil
180	TK 6 A 6
180 a, 180 b, 190 SL	TK 12 A 3
219, 220 a, 220 S	TK 12 A 10
220 SE	TK 12 A 9

Ignition coils TK 6 A 6 and TK 12 A 3 are closed-circuit proof without series resistance.

Closed-circuit proof means that the primary winding of the ignition coil is such that there is no danger of overheating the ignition coil when the ignition is switched on, the contact breaker points of the distributor are closed, and the engine is not operating.

Ignition coils TK 12 A 9 and TK 12 A 10 require a series resistance to be closed-circuit proof, this resistance is installed between the terminals 15/54 and 15 of the ignition coil (see Job No. 54-0/2 Wiring Diagram).

Test Values for Ignition Coils

Ignition coil Bosch	Spark length in mm	Adjustment resistance Ohms
TK 6 A 6	14	2.5
TK 12 A 3	14	1.2
TK 12 A 9	14	1.3
TK 12 A 10	14	1.5

Distributor

Job No.
15–23

Table of Distributors Installed

Model	Distributor Bosch
180	VJU 4 BR 1
180 a	VJU 4 BR 22 1st version VJUR 4 BR 27 2nd version
180 b	VJUR 4 BR 28
190 SL	VJ 4 BR 11 1st version VJR 4 BR 24 2nd version
220 a, 219 220 S	VJUR 6 BR 24 1st version VJUR 6 BR 38 2nd version
220 SE	VJUR 6 BR 32

A. Removal and Installation of Distributor

The removal and installation procedures for the distributor are described in Job No. 01-4, Section C, and the ignition setting in Job No. 01-3, Section E.

B. Checking Distributor on the Tester

Models 180, 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE

On these models the checking procedure for the distributor is essentially the same as on Model 190.

Contact-Point Distance of Contact Breaker Points

on distributors VJU 4 BR 1, VJU 4 BR 22,
VJUR 4 BR 27, VJUR 4 BR 28, VJ 4 BR 11 and
VJR 4 BR 24

0.40–0.50 mm

on distributors VJUR 6 BR 24, VJUR 6 BR 38, and
VJUR 6 BR 32

0.30–0.40 mm

a) Checking the Angle of Closure

The angle of closure should be on distributors

VJU 4 BR 1
VJU 4 BR 22
VJUR 4 BR 27
VJUR 4 BR 28
VJ 4 BR 11 and
VJR 4 BR 24 48°–52°

on distributors

VJUR 6 BR 24
VJUR 6 BR 38 and
VJUR 6 BR 32 34°–38°

b) Checking the Firing Interval

The firing interval is equal to $\frac{360°}{\text{number of cylinders}}$ with a tolerance of $\pm$ 1°, which in the case of distributors for

four-cylinder engines = 90° ± 1°
six-cylinder engines = 60° ± 1°

The firing interval should be measured at an engine speed of n = 150 r.p.m. and n = 1500 r.p.m. (speed of distributor).

c) Checking the Adjustment Curve

The adjustment curve must be checked with reference to the automatic governor control. The change in adjustment must be uniform and must take place without jerks.

Then the adjustment curve should be checked with reference to the automatic vacuum control and the vacuum control should be checked for air-tightness.

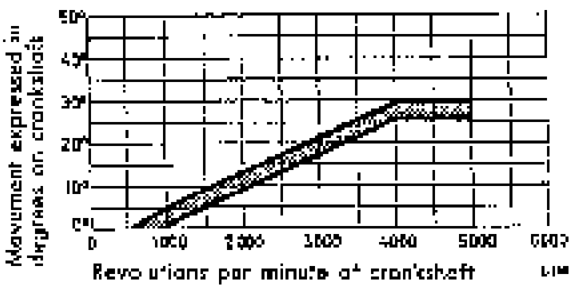
The air-tightness test should be made at a vacuum of 600 mm Hg. The vacuum must not fall off by more than 10% over a period of 2 minutes.

The movement is limited by the chamfered hexagon nut which is installed on the pull-rod of the automatic vacuum control. The adjustment range can be increased by screwing out the pull-rod and decreased by screwing it in. When this is done care must be taken to ensure that the pull-rod remains screwed in far enough; if necessary, the chamfered hexagon nut should be adjusted after releasing the lock nut.

Automatic governor control

Automatic vacuum control

for distributor VJU 4 BR 1



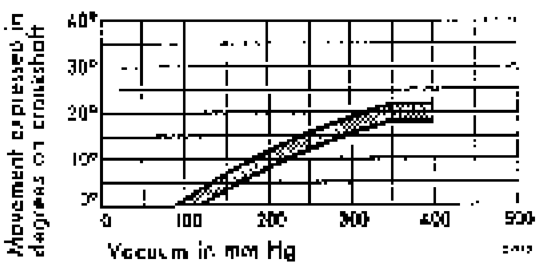
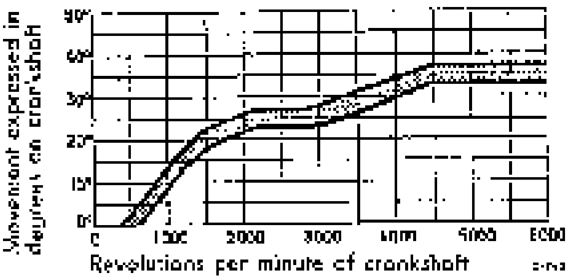


Fig 15–23/1

Automatic governor control

Automatic vacuum control

for distributors VJU 4 BR 22 and VJUR 4 BR 27



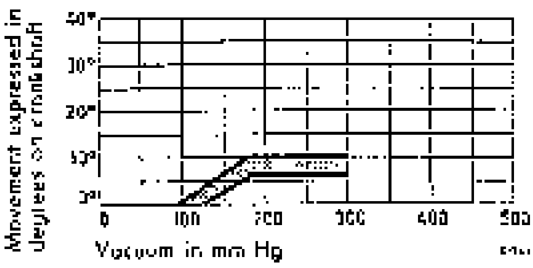
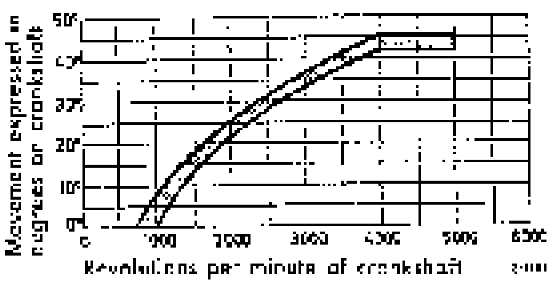


Fig. 15-23/2

Automatic governor control

Automatic vacuum control

for distributor VJUR 4 BR 28



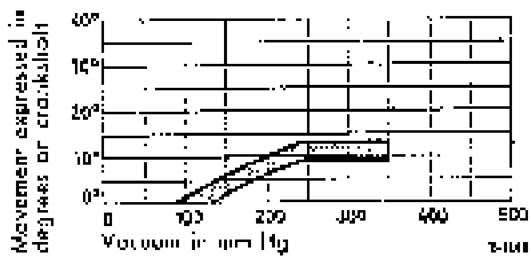
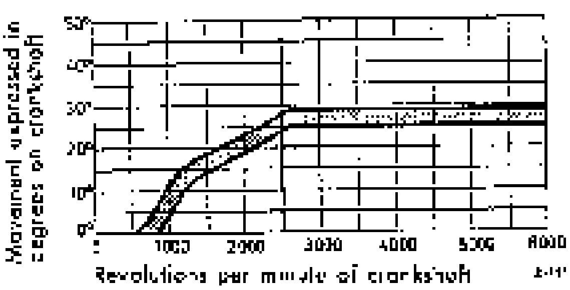


Fig. 15-23/3

Automatic governor control

Automatic vacuum control

for distributors VJ 4 BR 11 and VJR 4 Br 24

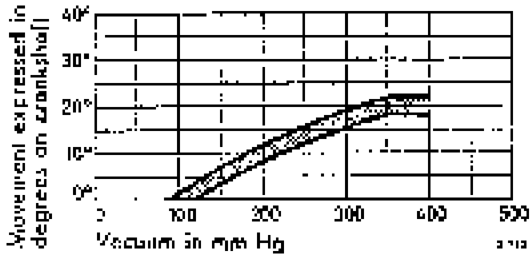


no automatic vacuum control

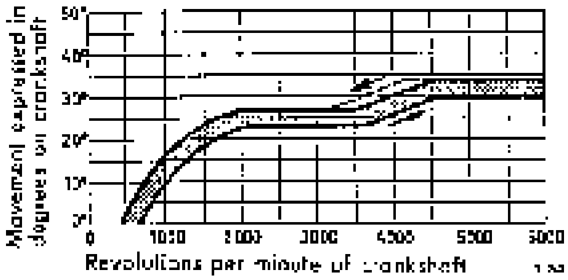
Fig. 15-23/4

Automatic governor control **Automatic vacuum control**

for distributors VJUR 6 BR 24 and VJUR 6 BR 38



VJUR 6 BR 24



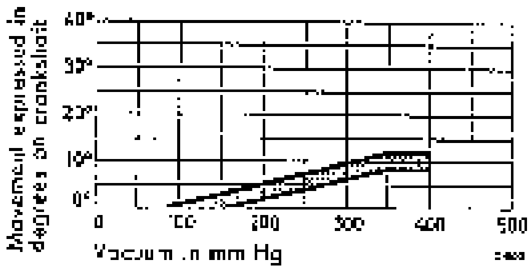
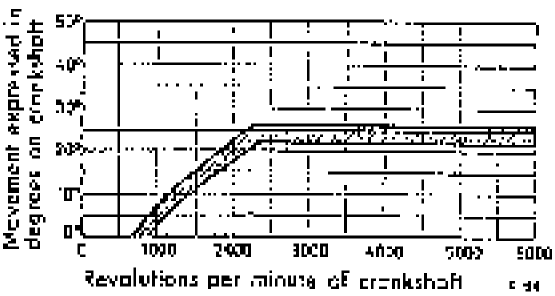


Fig. 15–23/5 VJUR 6 BR 38

Models 219 and 220 S with a compression ratio of – 8.7:1 have recently been fitted regularly with the distributor VJUR 6 BR 38 with an automatic vacuum control movement of 10° on the crankshaft (previously 20°) (Fig. 15–23/4). This distributor is also supplied as a replacement part for Models 220 a, 219, and 220 S.

Automatic governor control **Automatic vacuum control**

for distributor VJUR 6 BR 32



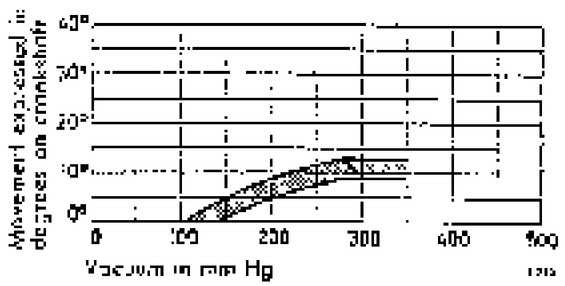


Fig. 15–23/6

The continuous run test, the maximum speed test, the starting output test, the removal and installation procedures for the contact breaker points, the automatic vacuum control, and the distributor coupling are essentially the same as on Model 190.

Job No.
15–24

Ignition Leads and Ignition Lead Connectors

Models 180, 180 a, 180 b, 190 SL, 219, 220 a, 220 S, and 220 SE

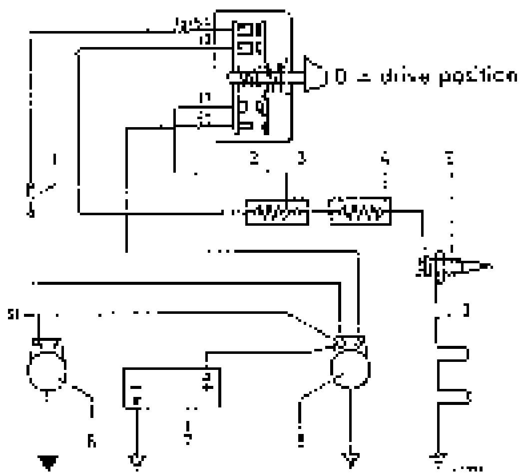
The testing procedures for ignition leads and ignition lead connectors are the same as on Model 190.

Glow Plug System

Job No.
15-30

The purpose of the glow plug system is to ensure the cold start of the engine by increasing the temperature of the compressed air and by igniting fuel particles on the surface of the glow plug filament.

In a Diesel engine combustion is brought about by self-ignition of the fuel injected into the highly compressed and therefore extremely hot combustion air. When the Diesel engine has reached its working temperature, the compression temperatures are in the range of 700–900° C. However, when the cold engine is started without a pre-heating process, the compression temperatures are only approx. 300° C and this temperature is not sufficient for the self-ignition of the fuel.



1 Main switch
2 Glow plug starter switch
3 Glow plug indicator resistor
4 Glow plug series resistance
5 Glow plugs
6 Generator
7 Battery
8 Starter

Fig. 15-30/1

Electrical circuit diagram of a glow plug system with glow plug starter and stop switch

The glow plugs are supplied with heating current from the 12 volt battery via the glow plug starter switch. In accordance with their rated voltage they are series-connected with the glow plug indicator resistor (3) and the additional glow plug series resistance (4) (see Fig. 15-30/1) so that the sum of all individual rated voltages, including the voltage drop in the leads, corresponds to the rated voltage of the battery.

When the engine is being started, the glow plug indicator resistor is short-circuited in order to ensure that the efficacy of the glow plug does not decrease too much in relation to the decreasing battery voltage (see Fig. 15-30/1 and Job No. 15-33, description of the four switch positions, Section 4).

The time required for pre-heating depends on the temperature of the engine and on the outside temperature.

Average pre-heating times with the engine cold:

Outside temperature + 20° C approx. 20 seconds
Outside temperature 0° C approx. 40 seconds
Outside temperature — 5° C approx. 1 minute
at lower temperatures 2 minutes maximum.

There are two different versions of the glow plug system:

1st Version: Glow plugs with a rated voltage of 1.4 volts each plus the glow plug indicator resistor with a rated voltage of 1.4 volts and the glow plug series resistance with a rated voltage of 5.0 volts.

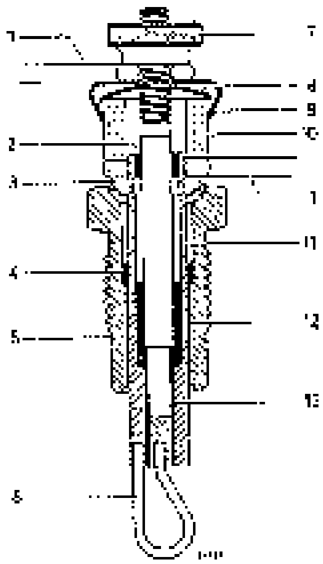
2nd Version: Glow plugs with a rated voltage of 0.9 volts each plus the glow plug indicator resistor with a rated voltage of 0.9 volts and the glow plug series resistance with the rated voltage of 6.6 volts.

The rated voltage of glow plugs, glow plug indicator resistor, and glow plug series resistance is clearly marked on these parts. To avoid damage to the glow plug system make sure that only replacement parts of the correct rated voltage are installed.

Glow Plugs

Job No.
15-31

Fig. 15-31/1 shows the constructional details of a glow plug. According to the position of the plug the current is supplied by a contact bar (1) or a connector cable to the center electrode (13) or to the annular fitting (3) on the outer electrode (11). The center electrode (13) and the outer electrode (11) are connected by the glow plug filament (6). The two electrodes are insulated from one another by the insulating compound (12) and are insulated against the body of the plug (5) by the insulating compound (4). Furthermore a plastic insulator (2) has been installed at the upper part of the glow plug between the outer and the center electrode. The insulator (10) insulates the two current connections. The corrugated washer (8) on the insulator works as a lock for the knurled nut (7) (see Fig. 15-31/1).



1 Contact bar
2 Plastic insulator
3 Annular fitting (on outer electrode)
4 Insulating compound
5 Plug body
6 Glow plug filament
7 Knurled nut
8 Corrugated washer
9 Sheet-metal cap on insulator
10 Insulator
11 Outer electrode
12 Insulating compound
13 Center electrode

Fig. 15-31/1

The service life of the glow plug depends to a large extent on the condition of the injection nozzles and on the combustion process. Insufficient injection pressure, binding nozzle needles, carburised or dripping nozzles, and advanced injection may cause premature breaking of the filament. Bridge formation by oil carbon may produce a ground connection of the filament and may cause the filament to fuse.

During the pre-heating period the temperature of the filament is approx. 900–1000° C, and as a consequence of the combustion heat in the engine under normal running conditions it is 600–800° C. Continuous running temperatures above 800° C will damage the glow plugs.

Type designations of the various glow plugs:

Glow plugs with a spiral-shaped filament and a rated voltage of 1.4 volts.

Bosch KE/GA 2/2
Beru 202/GE

Glow plugs with a loop-shaped filament and a rated voltage of 0.9 volts.

Bosch KE/GA 1/3
Beru 214/GF

Job No.
15-32

Checking of Glow Plugs

To provide a means of checking the glow plug system, the instrument panel is equipped with a glow plug indicator resistor which has the same rated voltage as one of the glow plugs installed (see Job No. 15-30).

During the pre-heating period the glow plug indicator resistor glows with the same intensity (bright red) as the glow plugs and thus provides a check on the condition of the plugs.

If the indicator resistor does not glow, it can be assumed that the filament of one of the glow plugs is either broken or has fused as a result of a ground connection. In order to check which of the plugs is damaged, connect the contact bars of the individual plugs in turn by means of a screw driver (Fig. 15-32/1)

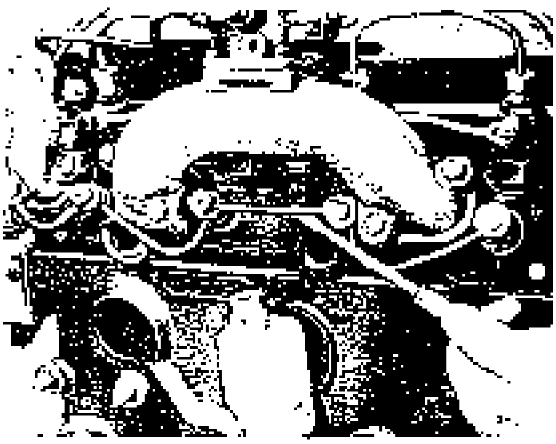


Fig. 15-32/1

While doing this, switch the glow plug starter switch to position 1 (pre-heating). Glowing of the indicator resistor while the contact bars are being connected as described above is an indication that the plug is defective.

If the glow plug system is grounded, the glow plug indicator resistor glows much more rapidly and to a brighter red. If the glow plug indicator resistor continues to glow after the ground cables of the glow plug system have been disconnected, this is an indication that the glow plug system is grounded.

In this case the contact bars should be checked for a possible ground connection to the cylinder head. If the contact bars show no defect one of the glow plugs may be grounded. In order to find the damaged glow plug, disconnect the contact bars one after another, with the glow plug system switched on and proceeding from the ground side. When the contact bars of the grounded glow plug are disconnect the flow of current is interrupted and the glow plug indicator resistor will stop glowing.

Note: When installing new glow plugs always check their rated voltage!

Glow Plug Starter and Stop Switch

Job No.
15-33

I. Model 180 D

The mechanical-electrical glow plug starter and stop switch is a rotary switch with four switch positions, i. e. stop position, drive position, pre-heating position, and starting position. The glow plug starter and stop switch is provided with a locking mechanism which makes it impossible to remove the key unless the switch is in the stop position.

Fig. 15-33/1 shows the wiring diagram for the individual components involved in the starting process. In this wiring diagram the glow plug starter and stop switch is shown in its drive position (0).

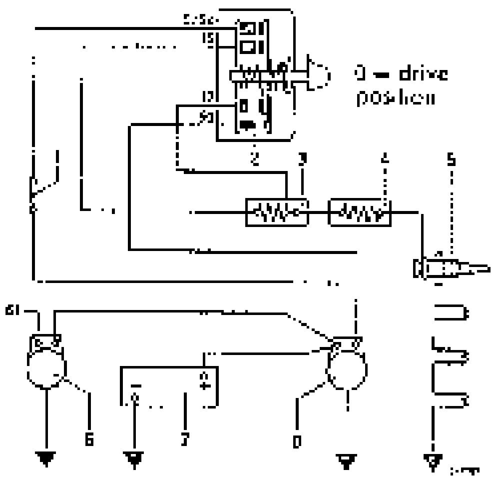


Fig. 15-33/1

1 Main switch
2 Glow plug starter and stop switch
3 Glow plug indicator resistor
4 Series resistance
5 Glow plug
6 Generator
7 Battery
8 Starter

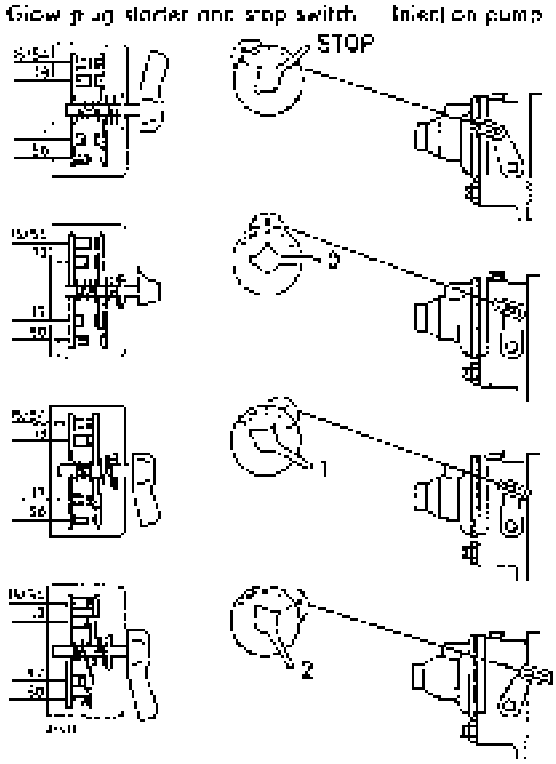


Fig. 15-33/2

S = Stop position
0 = Drive position
1 = Pre-heating position
2 = Starting position

Description of the Four Switch Positions (see Fig. 15-33/2)

The whole system can only be operated after the main switch (1) has been closed, which is done by turning the key to the position "Fahrt" (drive).

a) Stop — Stop Position

In the stop position the handle of the rotary switch is pressed upward toward the left; the Bowden cable pulls the adjusting lever on the injection pump as far back as it will go. In this position of the adjusting lever, the control rod is in the stop position, the pistons are at the no-delivery position, the engine is no longer supplied with fuel and stops. In this position, terminals 19, 50, and 17 are dead.

The main switch key can be removed.

b) 0 = Drive Position

In the drive position the Bowden cable in relation to the slot on the adjusting lever is in such a position that the bolt of the adjusting lever is approximately in the center of the slot so that the adjusting lever is not being actuated. In this position terminals 19, 50, and 17 are dead.

The main switch key **cannot** be removed in this position.

c) 1 = **Pre-Heating Position**

From the drive position turn the handle of the rotary switch toward the right to position 1 until a certain resistance is encountered. The switch must be held in this position until the pre-heating process is finished, which depends on the outside temperature and the working temperature of the engine. In this position of the switch terminal 19 is supplied with current and causes the glow plugs (5) to glow via the indicator resistor (3) and via the series resistance (4) (Fig. 15-33/1). Terminals 50 and 17 are dead.

In the pre-heating position the Bowden cable in relation to the slot on the adjusting lever is in such a position that the slot does not rest against the bolt of the adjusting lever so that the lever is not being actuated.

d) 2 = Starting Position

When the pre-heating is finished the handle of the rotary switch is turned fully toward the right as far as the stop (the small resistance must be overcome) and it is held in this position until the engine starts.

In the starting position the bolt of the adjusting lever rests against the other side of the slot (in contrast to the stop position) and pushes the adjusting lever right forward. As a result the control rod is shifted in the direction "voll" (full load) beyond the full load stop and the injection pump supplies the amount required for starting.

In the starting position not only terminal 19 but also terminals 50 and 17 are supplied with current. The starter (8) is actuated via terminal 50. Via terminal 17 the glow plugs (5) continue to be supplied with current also in the starting position but the glow plug indicator resistor (3) is by-passed by lead (17) and therefore inoperative (see Fig. 15-33/1). By-passing the indicator resistor prevents the glow plug output from dropping too much during starting.

When the handle of the rotary switch is released after the engine has started, it returns to the 0 position (drive position).

II. Model 190 D

On Model 190 D the glow plug starter and stop switch takes the form of a push-pull switch and not of a rotary switch as on Model 180 D. However, this new push pull switch cannot be installed in cars with right-hand drive so that these are equipped with the rotary switch used on Model 180 D.

The mechanical electrical glow plug starter and stop switch has four switch positions, i. e. stop position, drive position, pre heating position, and starting position. The glow plug starter and stop switch is provided with a locking mechanism which makes it impossible to remove the key unless the switch is in the stop position. The push-pull switch works on the same principle as the rotary switch previously installed.

Fig. 15-33/3 shows the wiring diagram for the individual components involved in the starting process. In this wiring diagram the push-pull switch is shown in the drive position (F). The whole system can only be operated after the main switch (1) has been closed which is done by turning the key to the position "Fahrt" (drive).

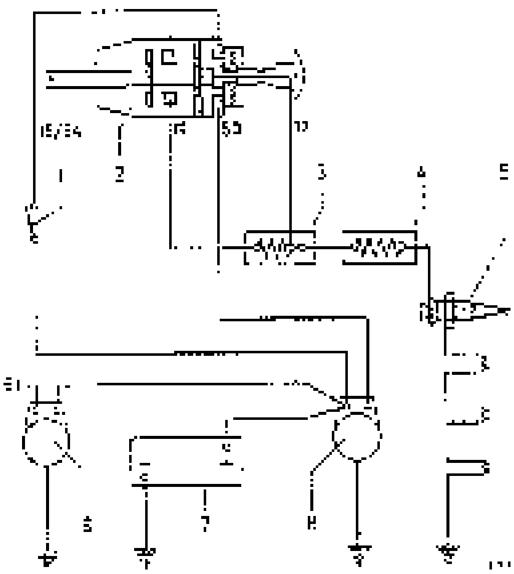


Fig. 15-33/3

1 Main switch
2 Push-pull switch
3 Glow plug indicator resistor
4 Series resistance
5 Glow plug
6 Generator
7 Battery
8 Starter

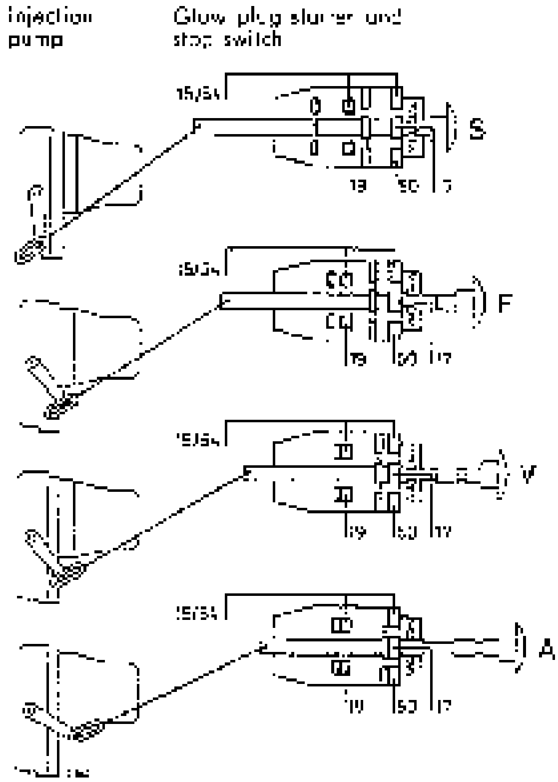


Fig. 15-33/4

S = Stop position
F = Drive position
V = Pre heating position
A = Starting position

Description of the four switch positions:

1. S = Stop position

In the stop position the knob of the push-pull switch is pressed in completely and the Bowden cable pulls the adjusting lever on the injection pump right forward. In this position of the adjusting lever the control rod is in the stop position, the pistons are at the no-delivery position, the engine is no longer supplied with fuel and stops. In this position terminals 19, 50, and 17 are dead.

The key in the steering lock can be removed.

2. F = Drive position

In the drive position the Bowden cable in relation to the slot on the adjusting lever is in such a position that the slot does not rest on the bolt of the adjusting lever so that the lever is not being actuated. The switch knob, when pulled out of the stop position, engages in the next notch and remains in this position as long as the engine is running. Terminals 19, 50, and 17 are dead.

The key in the steering lock **cannot** be removed.

3. V = Pre-heating position

In the pre-heating position both Bowden cable and adjusting lever operate in the same way as in the drive position F.

When the knob of the push-pull switch is pulled from the drive position to the pre-heating position a small resistance becomes noticeable. The knob must be held in this position until the pre-heating process is finished, which depends on the outside temperature and the working temperature of the engine. In this position of the switch, terminal 19 is supplied with current and causes the glow plugs (5) to glow via the indicator resistor (3) and the series resistance (4) (Fig. 15-33/3). Terminals 50 and 17 are dead.

4. A = Starting position

When the pre-heating is finished, the knob of the switch, by overcoming the small resistance, is pulled out as far as it will go and is held in this position until the engine starts.

In the starting position the bolt of the adjusting lever rests against the other side of the slot (in contrast to the stop position) and pulls the adjusting lever right back. As a result the control rod is moved in the direction "voll" (full load) beyond the full load stop and the injection pump supplies the amount required for starting.

In the starting position not only terminal 19 but also terminals 50 and 17 are supplied with current. The starter (8) is actuated via terminal 50.

Via terminal 17 the glow plugs (5) continue to be supplied with current also in the starting position but the glow plug indicator resistor (3) is by-passed by lead (17) and therefore inoperative (see Fig. 15-33/3). When the glow plug indicator resistor is by-passed, the glow plugs are supplied with more current and as a result the starting process is improved.

When the knob of the push-pull switch is released after the engine has started, it returns automatically to the drive position.

Job No.
54-0

Electrical System

A. General

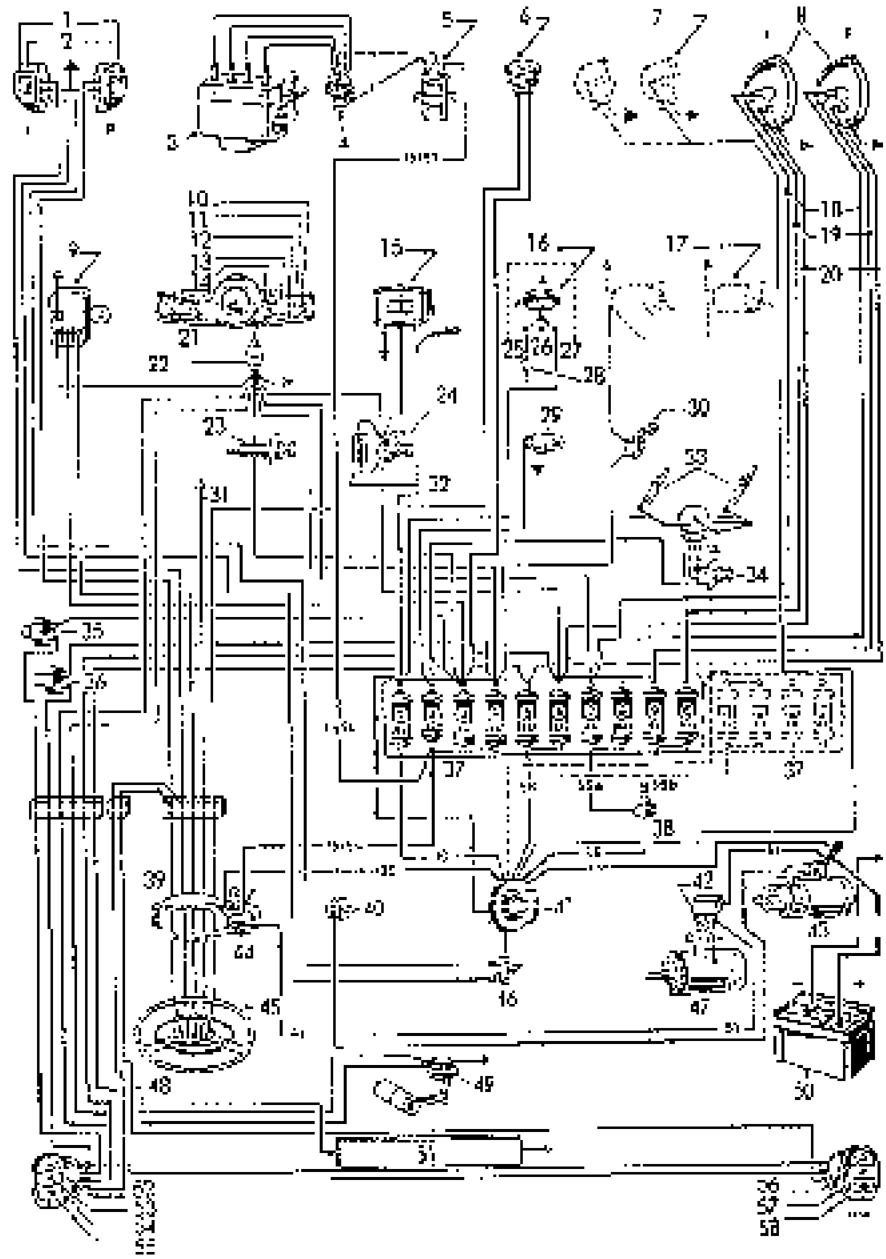
On Models 180 to 220 SE the electrical system is essentially the same as on Model 190 but contrary to the other models the voltage of the electrical system on Model 180 is 6 volts.

B. Bulbs

Model		180	180 a, 190 b, 180 D, 180 Db, 190 D, 190 Db, 190 SL, 219, 220 a, 220 S, 220 SE
Operating voltage	volts	6	12
Headlight (symmetrical)	watts	35/35	35/35
Headlight (asymmetrical)	watts	45/40	45/40
Parking light	watts	5	5
Fog light	watts	35	35
Stop light	watts	15	15
Tail light	watts	5	5
Flash signals front/rear	watts	15	15
License-plate lighting	watts	5	10
Instrument and clock lights	watts	2	2
Pilot lights	watts	2	2
Interior lighting	watts	5	10
Clearance light front/rear	watts	2	2
Charging light	watts	3	3
Reversing Light	watts	10	15

C. Circuit Diagrams

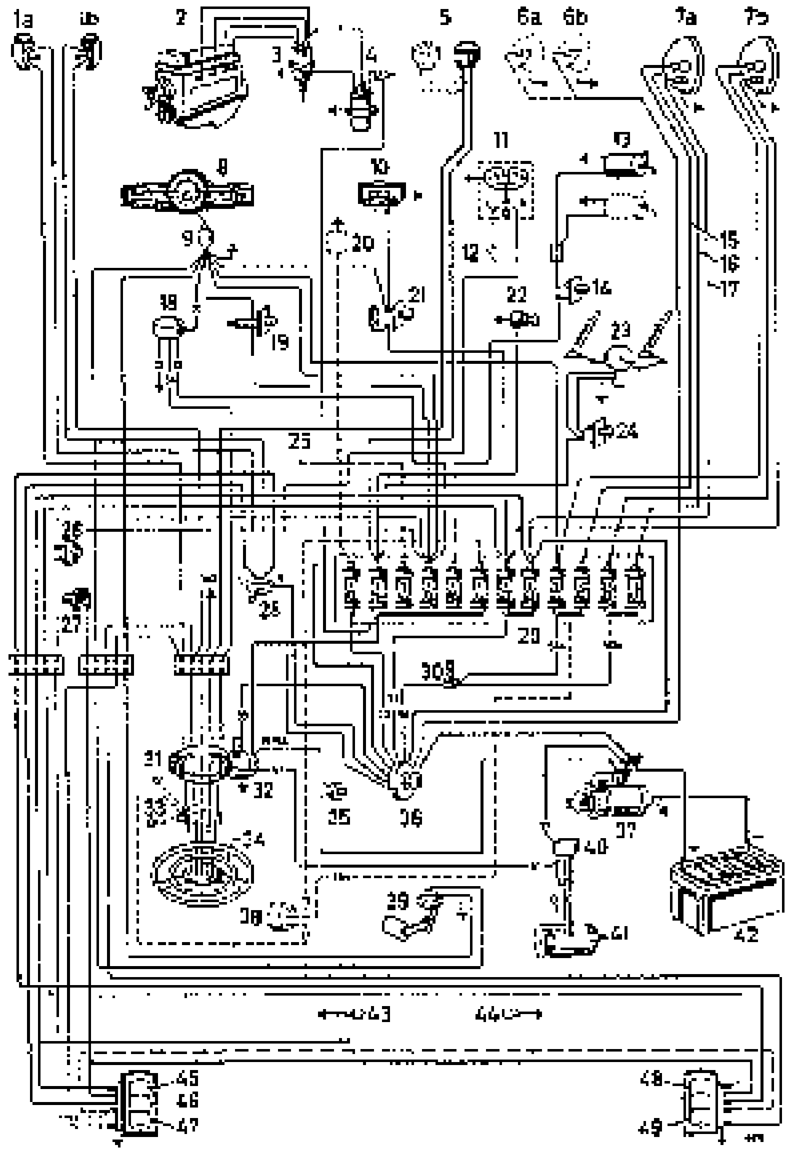
I. Model 180



The small numbers shown on the leads denote the numbers of the corresponding terminals.

1 Flash signal
2 Clearance light
3 Engine
4 Distributor
5 Ignition coil
6 Horn
7 Fog light
8 Headlight
9 Flash signal mechanism
10 Flash signal pilot light
11 Choke control
12 Upper beam
13 Fuel gauge
14 Fuel reserve pilot light
15 Clock
16 Roof light with switch
17 Defroster blower
18 Upper beam
19 Lower beam
20 Parking light
21 Instrument cluster
22 Coupling
23 Choke control
24 Instrument lighting switch
25 Left
26 Center
27 Right
28 Horn control switch
29 Cigar lighter
30 Switch
31 Ground, chassis
32 Dropping resistance
33 Windshield wiper
34 Switch with [illegible] mechanism
35 Reversing light switch
36 Stop light switch
37 Fuses
38 Foot dimmer switch
39 Steering lock
40 Starter push-button switch
41 Rotary light switch with positions for clearance light and pull switch for fog lights
42 Regulator
43 Starter 6 volts
44 Charging light
45 Steering wheel
46 Clearance light change-over switch
47 Generator 6 volts
48 Horn ring and flash signal switch
49 Fuel level indicator
50 Battery 6 volts 84 Ah
51 License plate lighting
52 Stop light (tail)
53 Reversing light
54 Tail light
55 Flash signal
56 Stop light (signal)
57 Tail light
58 Flash signal

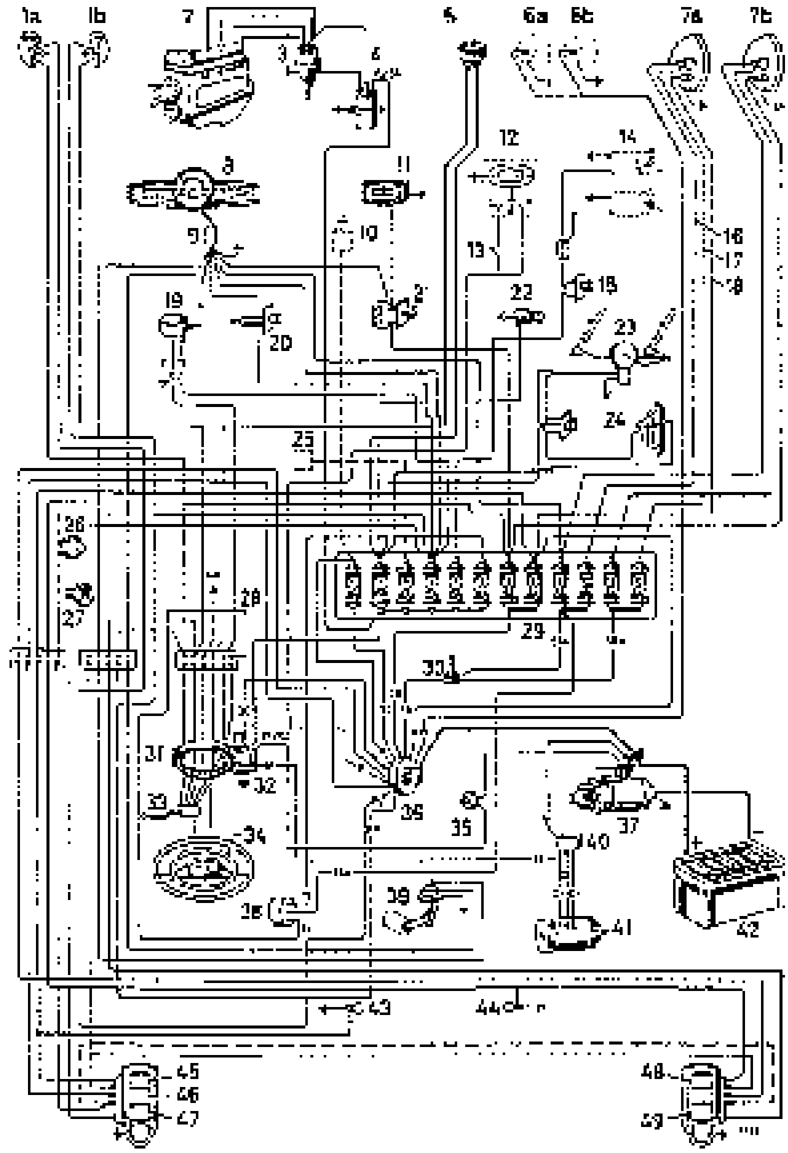
II. Model 180 a



The small numbers shown on the leads denote the numbers of the corresponding terminals.

1a Clearance light and flash signal, left
1b Clearance light and flash signal, right
2 Engine
3 Distributor
4 Ignition coil
5 Horn
6a Fog light, left
6b Fog light, right
7a Headlight, left
7b Headlight, right
8 Instrument cluster
9 Coupling
10 Clock
11 Interior light with switch
12 Door contact
13 Heater blower motor (optional)
14 Heater blower motor switch
15 Cable for upper beam
16 Cable for lower beam
17 Cable for parking light
18 Flash signal mechanism
19 Choke control
20 Socket (optional)
21 Instrument lighting switch
22 Cigar lighter
23 Windshield wiper
24 Windshield wiper switch
25 Tree for optional extra
26 Reversing light switch
27 Stop light switch
28 Clearance light changeover switch
29 Fuses
30 Foot dimmer switch
31 Ignition switch and steering lock
32 Charging light
33 Upper beam flash signal switch (optional)
34 Horn ring and flash signal switch
35 Starter button
36 Rotary light switch with positions for clearance light and pull switch for fog lights
37 Starter 12 v
38 Upper beam flash signal mechanism (optional)
39 Fuel level indicator
40 Regulator
41 Generator 12 v
42 Battery 12 v
43 License plate lighting, left
44 License plate lighting, right
45 Tail, stop, clearance light, left
46 Reversing light, left
47 Flash signal, left
48 Tail, stop, clearance light, right
49 Flash signal, right

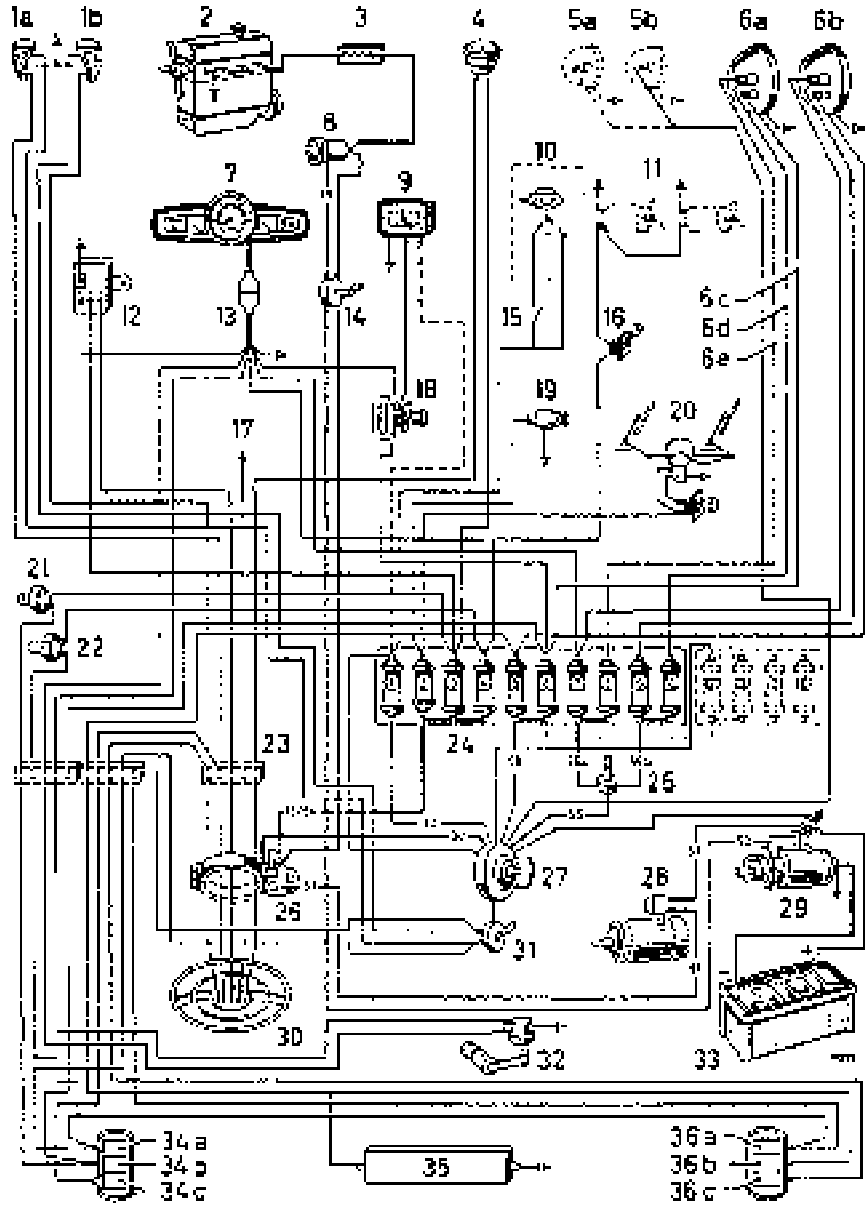
III. Model 180 b



The small numbers shown on the leads denote the numbers of the corresponding terminals.

1a Clearance light and flash signal, left
1b Clearance light and flash signal, right
2 Engine
3 Distributor
4 Ignition coil
5 Horn
6a Fog light, left
6b Fog light, right } (Optional)
7a Headlight, left
7b Headlight, right
8 Instrument cluster
9 Coupling
10 Socket (optional)
11 Clock
12 Interior light with switch
13 Door contact
14 Heater blower motors (optional)
15 Heater blower motor switch
16 Cable for upper beam
17 Cable for lower beam
18 Cable for parking light
19 Flash signal mechanism
20 Choke control
21 Instrument lighting switch
22 Cigar lighter
23 Windshield wiper with switch
24 Foot pump for windshield washer with windshield wiper switch
25 Free for optional extras
26 Reversing light switch
27 Stop light switch
28 Cable connector
29 Fuses
30 Foot dimmer switch
31 Ignition switch and steering lock
32 Charging light
33 Flash signal switch
34 Main map
35 Starter button
36 Rotary light switch with positions for clearance light and pull switch for fog lights
37 Starter 12 v
38 Upper beam flash signal mechanism
39 Fuel level indicator
40 Regulator
41 Generator 12 v
42 Battery 12 v, 56 Ah
43 License plate and trunk compartment lighting, left
44 License plate and trunk compartment lighting, right
45 Tail, stop, clearance light, left
46 Reversing light, left
47 Flash signal, left
48 Tail, stop, clearance light, right
49 Flash signal, right

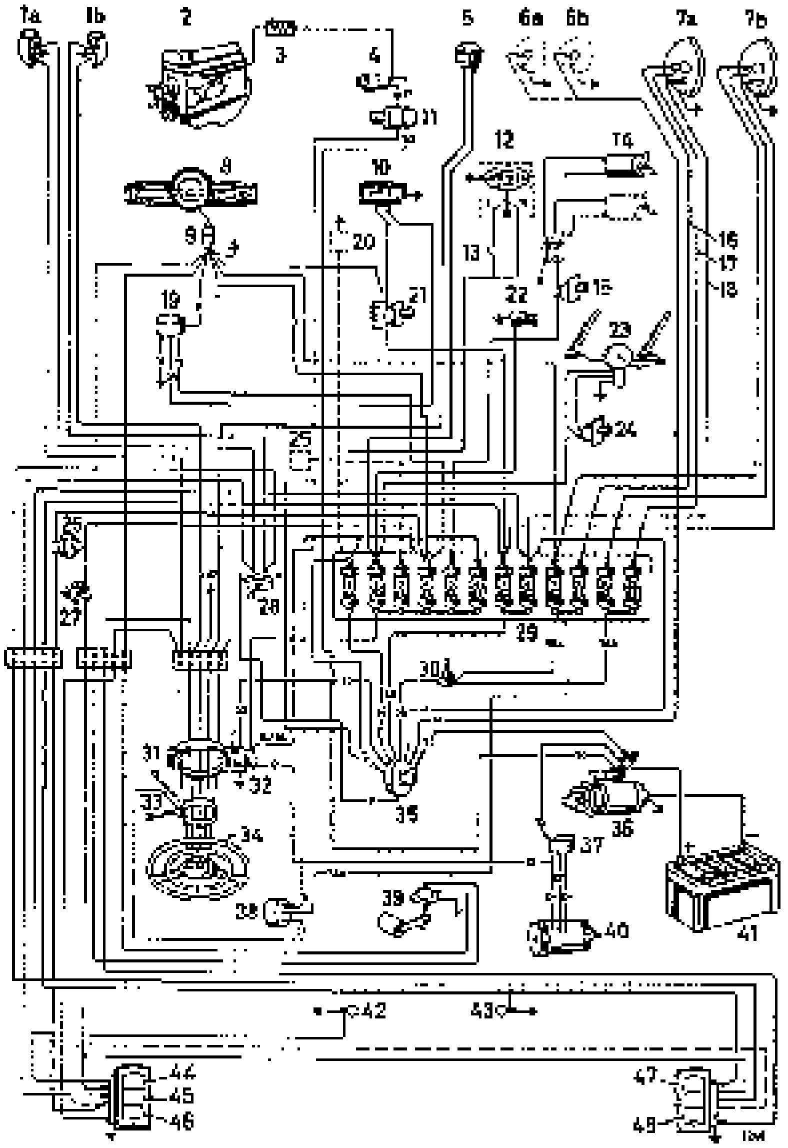
IV. Model 180 D



The small numbers shown on the leads denote the numbers of the corresponding terminals

1a Flash signal, left
1b Flash signal, right
2 Engine
3 Glow plug resistance
4 Horn
5a Fog light, left
5b Fog light, right
6a Headlight, left
6b Headlight, right
6c Cable for parking light
6d Cable for lower beam
6e Cable for upper beam
7 Instrument cluster
8 Glow plug indicator resistor
9 Clock
10 Roof light with switch
11 Heater blower motors (optional)
12 Flash signal mechanism
13 Coupling
14 Glow plug starter switch
15 Door contact
16 Switch with pilot light for heater blower motors
17 Ground, chassis
18 Switch for instrument lighting and dimmer resistance
19 Cigar lighter
20 Windshield wiper and switch with limit stop mechanism
21 Reversing light switch
22 Stop light switch
23 Cable connector
24 Fuses
25 Foot dimmer switch
26 Steering lock with charging light
27 Rotary light switch with position for clearance light and pull switch for fog lights
28 Generator 12 V with regulator
29 Starter 12 V
30 Steering wheel with horn ring and flash signal switch
31 Clearance light changeover switch
32 Fuel tank indicator
33 Battery
34a Clearance and stop light, left
34b Reversing light and tail light, left
34c Flash signal, left
35 License plate lighting
36a Clearance and stop light, right
36b Tail light, right
36c Flash signal, right

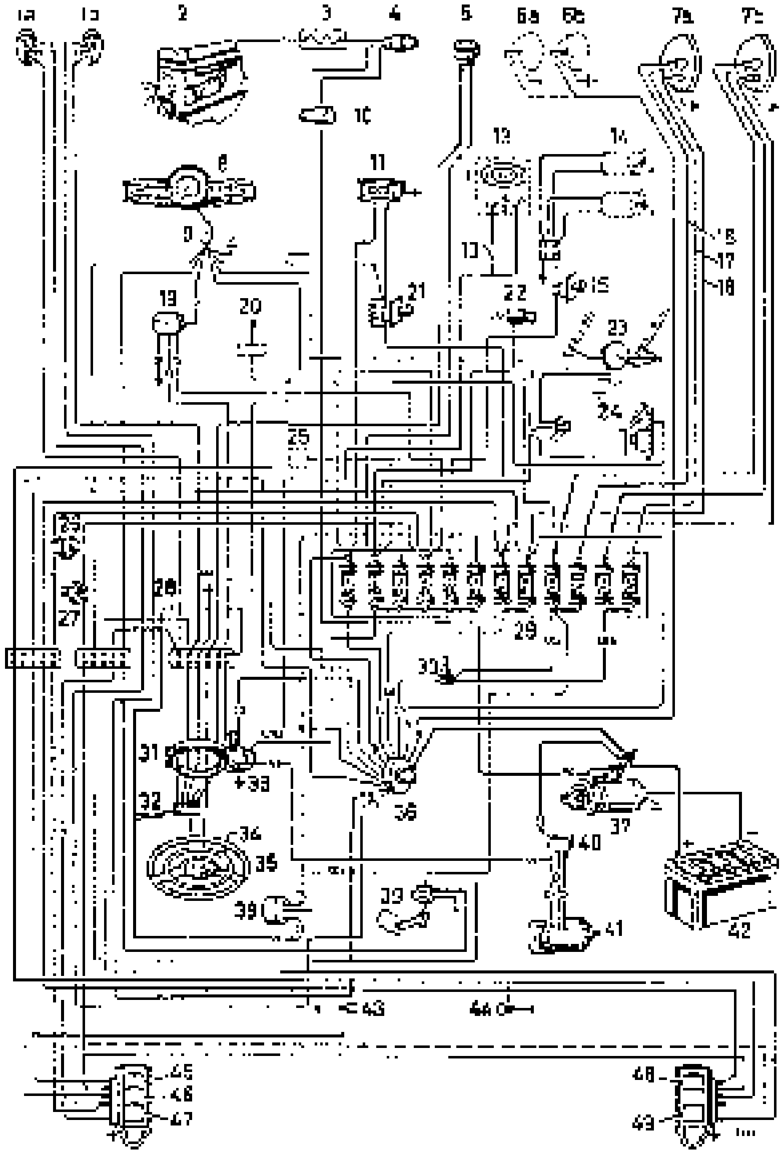
V. Model 190 D



The small numbers shown on the leads denote the numbers of the corresponding terminals.

- 1a Clearance light and flash signal, left
- 1b Clearance light and flash signal, right
- 2 Engine with glow plugs
- 3 Glow plug resistance
- 4 Glow plug indicator resistor
- 5 Horn
- 6a Fog light, left
- 6b Fog light, right
- 7a Headlight, left
- 7b Headlight, right
- 8 Instrument cluster
- 9 Coupling
- 10 [illegible]
- 11 Glow plug starter switch
- 12 Interior light with switch
- 13 Door contact
- 14 Heater blower motor
- 15 Heater blower motor switch
- 16 Cable for upper beam
- 17 Cable for lower beam
- 18 Cable for parking light
- 19 Flash signal mechanism
- 20 Socket (optional)
- 21 Instrument lighting switch
- 22 Cigar lighter
- 23 Windshield wiper
- 24 Windshield wiper switch
- 25 Free for optional extra
- 26 Reversing light switch
- 27 Stop light switch
- 28 Clearance light changeover switch
- 29 Fuses
- 30 Floor dimmer switch
- 31 Steering lock with glow plug and starter main switch
- 32 Charging light
- 33 Upper beam flash signal switch
- 34 Horn ring and flash signal switch
- 35 Rotary light switch with positions for clearance light and pull switch for fog lights
- 36 Starter 12 v
- 37 Regulator
- 38 Upper beam flash signal indicator
- 39 Fuel level indicator
- 40 Generator 12 v
- 41 Battery
- 42 License plate and trunk compartment lighting, left
- 43 License plate and trunk compartment lighting, right
- 44 Tail, stop, clearance light, left
- 45 Reversing light, left
- 46 Flash signal, left
- 47 Tail, stop, clearance light, right
- 48 Flash signal, right

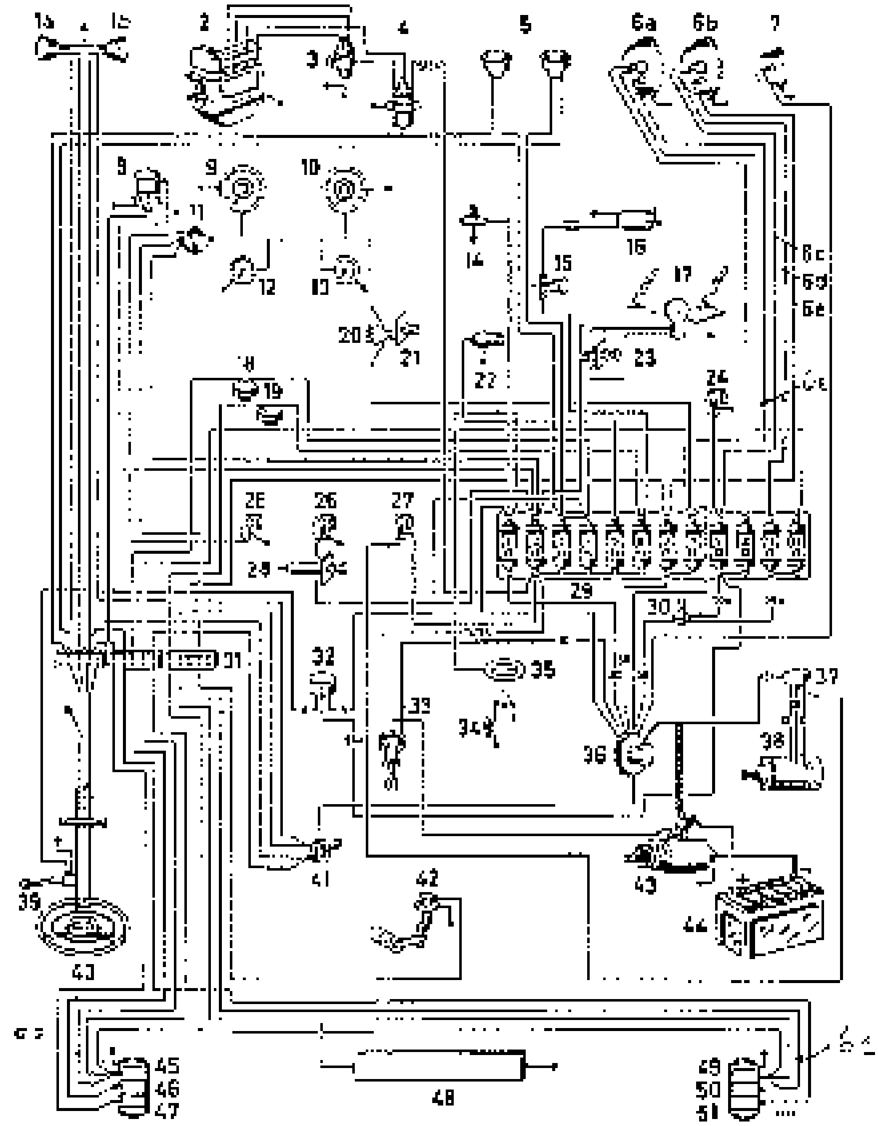
VI. Models 180 Db, 190 Db



The small numbers shown on the leads denote the numbers of the corresponding terminals.

1a Clearance light and flash signal, left
1b Clearance light and flash signal, right
2 Glow plugs (engine)
3 Glow plug resistor
4 Glow plug indicator resistor
5 Horn
6a Fog light, left } optional
6b Fog light, right } optional
7a Headlight, left
7b Headlight, right
8 Instrument cluster
9 Coupling
10 Glow plug starter switch
11 Clock
12 Interior light with switch
13 Door contact
14 Heater blower motor (optional)
15 Heater blower motor switch
16 Cable for upper beam
17 Cable for lower beam
18 Cable for parking light
19 Flash signal mechanism
20 Socket (optional)
21 Instrument lighting switch
22 Cigar lighter
23 Windshield wiper with switch
24 Foot pump for windshield washer with windshield wiper switch
25 Free for optional extra
26 Reversing light switch
27 Stop light switch
28 Cable connector
29 Fuses
30 Foot dimmer switch
31 Steering lock
32 Flash signal switch
33 Charging light
34 Horn ring
35 Steering wheel
36 Rotary light switch with pushbutton for clearance light and pull switch for fog lights
37 Starter 12 V
38 Upper beam flash signal mechanism
39 Fuel level indicator
40 Regulator
41 Generator
42 Battery 12 V, 56 Ah
43 License plate and trunk compartment lighting, left
44 License plate and trunk compartment lighting, right
45 Tail, stop, and clearance light, left
46 Reversing light, left
47 Flash signal, left
48 Tail, stop and clearance light, right
49 Flash signal, right

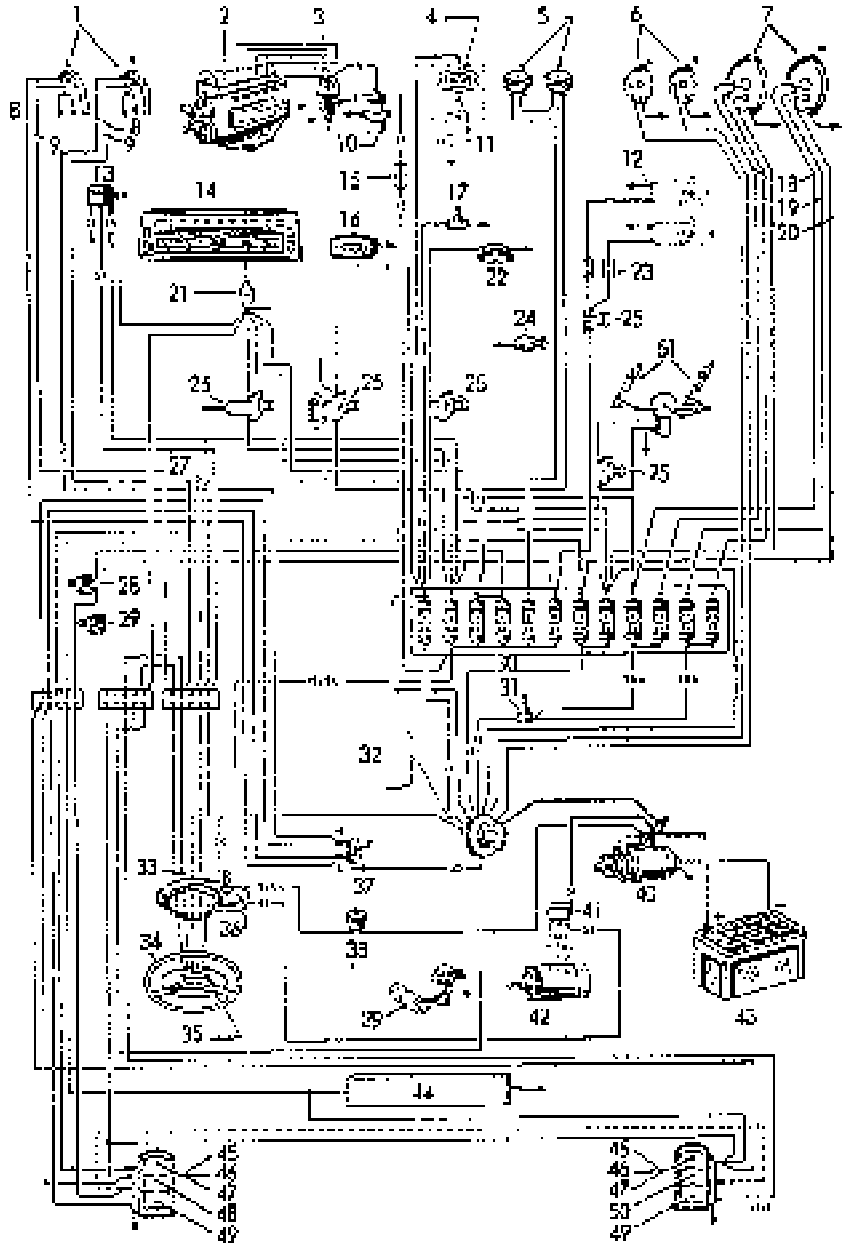
VII. Model 190 SL



The small numbers shown on the leads denote the numbers of the corresponding terminals.

1a Clearance light and flash signal, left
1b Clearance light and flash signal, right
2 Engine
3 Distributor
4 Ignition coil
5 Horn
6a Headlight, left
6b Headlight, right
6c Upper beam
6d Lower beam
6e Parking light
7 Fog light
8 Flash signal mechanism
9 Revolution counter
10 Speedometer
11 Fuel reserve gage
12 Oil pressure gage
13 Cooling water thermometer
14 Socket
15 Heater blower switch
16 Blower motor
17 Windshield wiper
18 Reversing light switch
19 Stop light switch
20 Dimmer resistance
21 Instrument lighting switch
22 Cigar lighter
23 Push-pull switch for windshield wiper, two speed
24 Upper beam pilot light
25 Flash signal pilot light
26 Choke control pilot light
27 Charging light
28 Choke control
29 Fuses
30 Foot dimmer switch
31 Cable connector
32 Upper beam flash signal mechanism
33 Ignition and starter switch
34 Door contact
35 Interior light
36 Rotary light switch
37 Regulator
38 Generator
39 Upper beam flash signal switch
40 Steering wheel horn ring with flash signal contact
41 Clearance light changeover switch
42 Fuel level indicator
43 Starter
44 Battery
45 Clearance, stop, and tail light, left
46 Reversing light
47 Flash signal, left
48 License plate and trunk compartment lighting
49 Clearance, stop, and tail light, right
50 Free for reversing light on right-hand drive cars
51 Flash signal, right

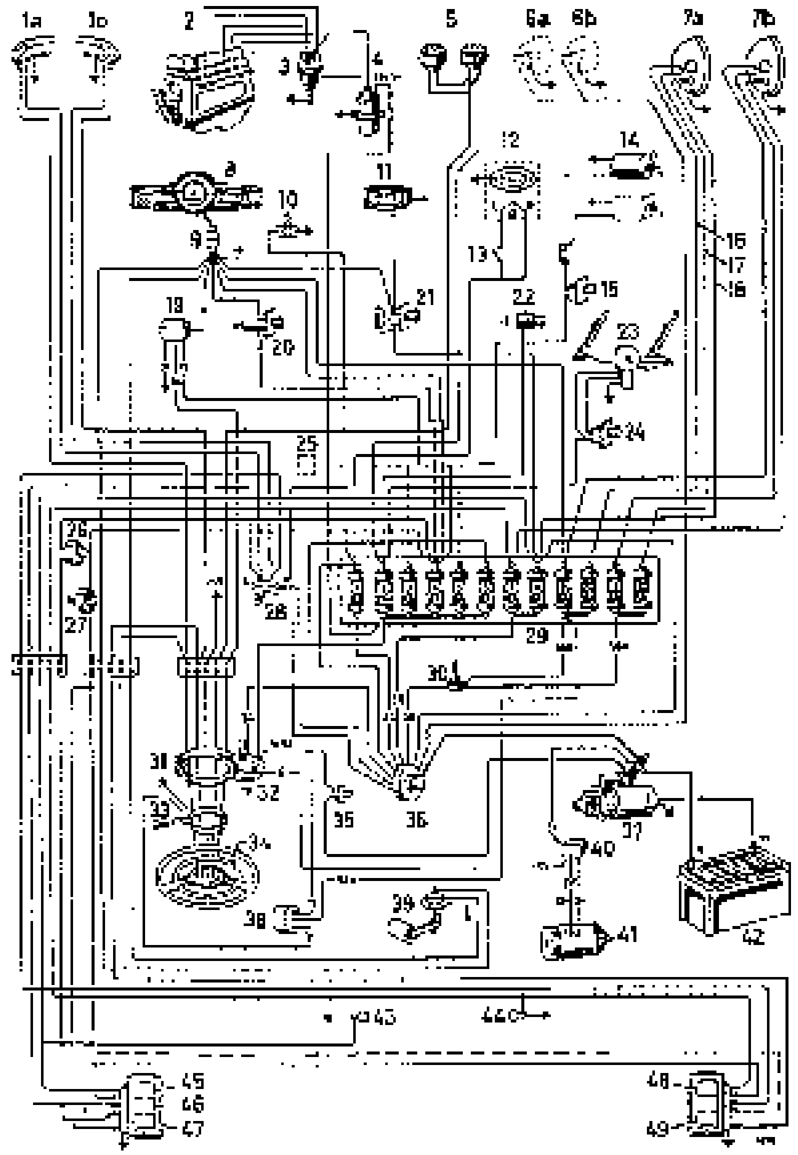
VIII, Model 220 a



The small numbers shown on the leads denote the numbers of the corresponding terminals

1 Clearance lights and flash signals
2 Engine
3 Distributor
4 Reading light
5 Horn
6 Fog lights
7 Headlights
8 Clearance light
9 Flash signal
10 Ignition coil
11 Door contact
12 Heater blower motors
13 Flash signal transmitter
14 Instrument cluster
15 Series resistance
16 Clock
17 Socket
18 Upper beam
19 Lower beam
20 Parking light
21 Coupling
22 Roof light
23 Cable connector
24 Cigar lighter
25 Switch
26 Choke control
27 Ground, chassis
28 Reversing light switch
29 Stop light switch
30 Fuses
31 Foot dimmer switch
32 Rotary light switch with positions for clearance light and pull switch for fog lights
33 Steering lock
34 Steering wheel
35 Horn ring and flash signal switch
36 Charging light
37 Clearance light change-over switch
38 Starter button
39 Fuel level indicator
40 Starter 12 volts
41 Regulator
42 Generator 12 volts
43 Battery 12 volts
44 License plate and trunk compartment lighting
45 Tail light
46 Stop light
47 Clearance light
48 Reversing light
49 Flash signal
50 Free for reversing light (right-hand drive)
51 Windshield wipers

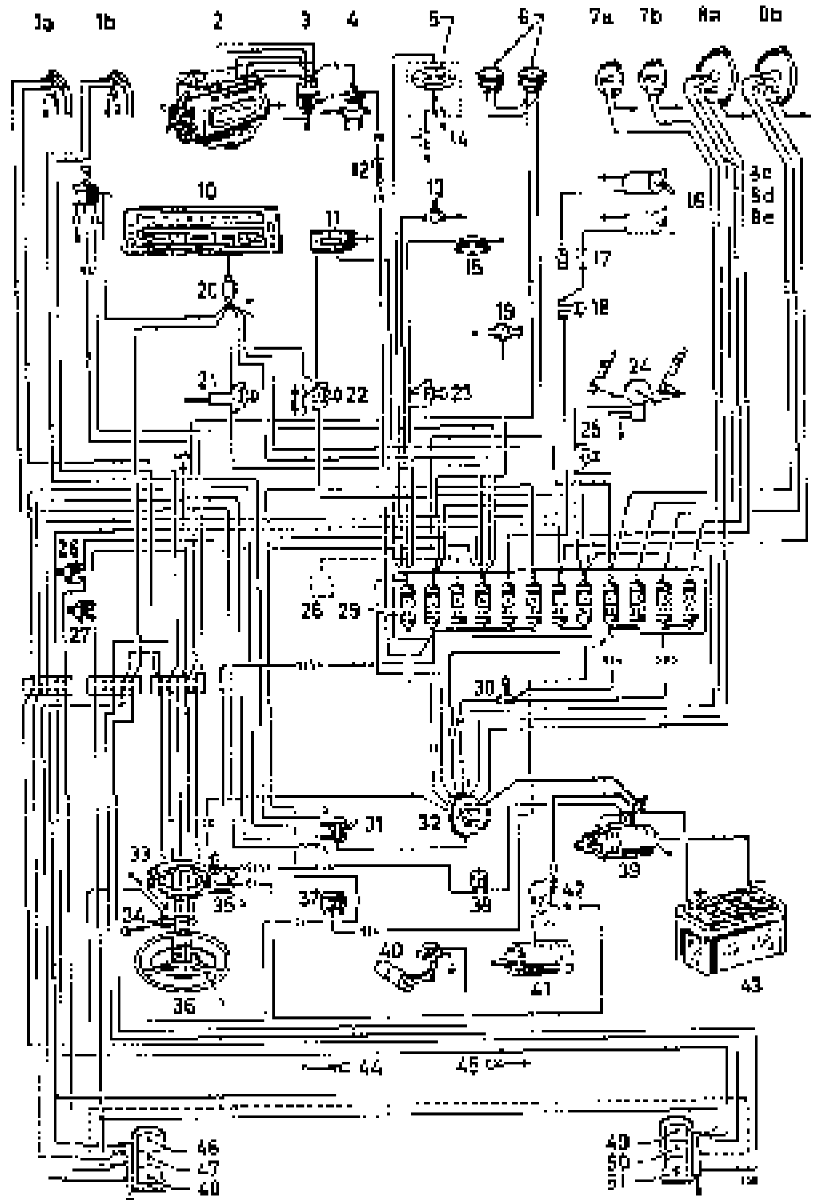
IX. Model 219



The small numbers shown on the leads denote the numbers of the corresponding terminals.

1a Clearance light and flash signal, left
1b Clearance light and flash signal, right
2 Engine
3 Distributor
4 Ignition coil
5 Horn
6a Fog light, left
6b Fog light, right
7a Headlight, left
7b Headlight, right
8 Instrument cluster
9 Coupling
10 Socket
11 Clock
12 Interior light with switch
13 Door contact
14 Heater blower motor
15 Switch
16 Cable for upper beam
17 Cable for lower beam
18 Cable for parking light
19 Flash signal mechanism
20 Choke control
21 Instrument lighting switch
22 Cigar lighter
23 Windshield wiper
24 Windshield wiper cable
25 Cable for automatic clutch (optional)
26 Reversing light switch
27 Stop light switch
28 Clearance light changeover switch
29 Fuses
30 Foot dimmer switch
31 Ignition switch and steering lock
32 Charging light
33 Upper beam flash signal switch
34 Horn ring and flash signal switch
35 Starter button
36 Rotary light switch with positions for clearance light and pull switch for fog lights
37 Starter 12 v
38 Upper beam flash signal mechanism
39 Fuel level indicator
40 Regulator
41 Generator 12 v
42 Battery 12 v, 56 Ah
43 License plate lighting, left
44 License plate lighting, right
45 Tail, stop, clearance light, left
46 Reversing light, left
47 Flash signal, left
48 Tail, stop clearance light, right
49 Flash signal, right

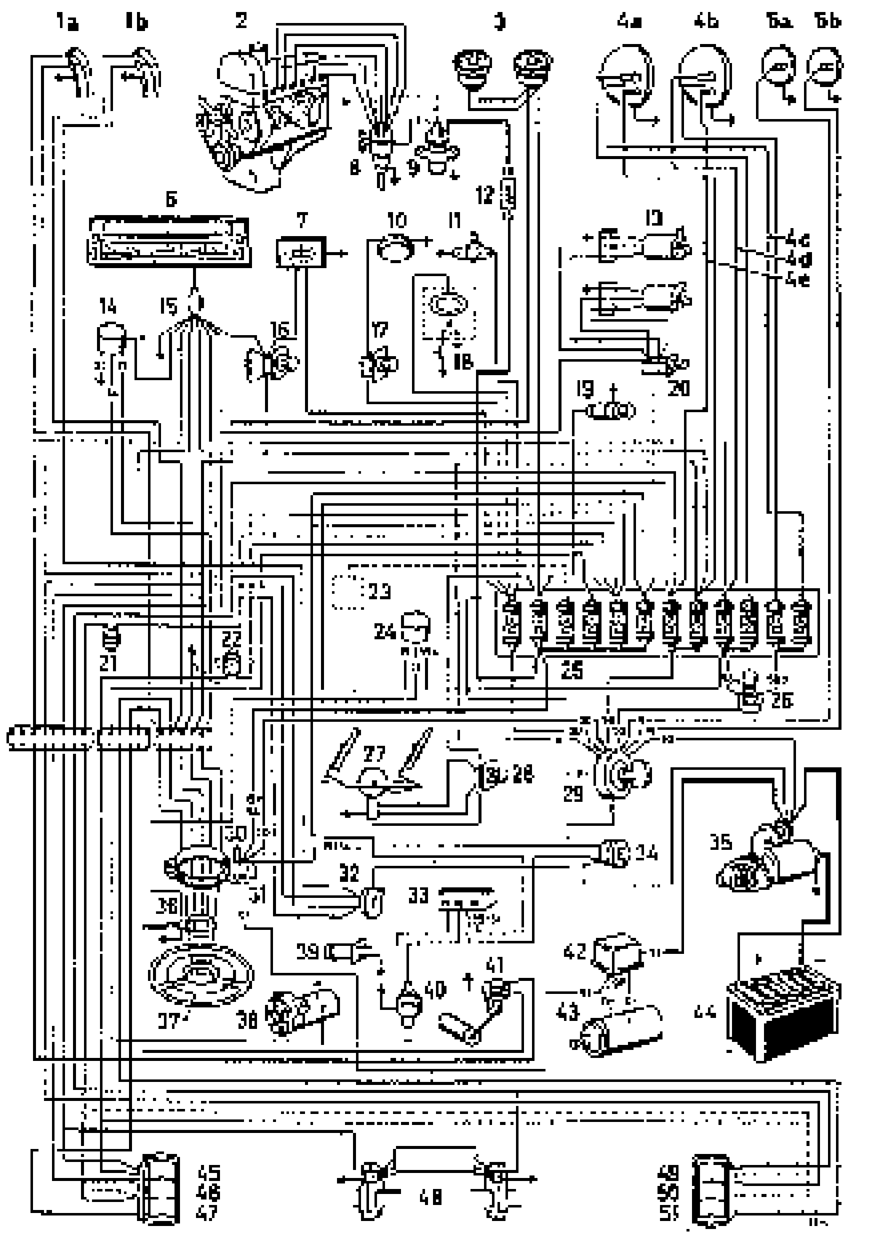
X. Model 220 S



The small numbers shown on the leads denote the numbers of the corresponding terminals

1a Clearance light and flash signal, left
1b Clearance light and flash signal, right
2 Engine
3 Distributor
4 Ignition coil
5 Reading light
6 Horns
7a Fog light, left
7b Fog light, right
8a Headlight, left
8b Headlight, right
8c Cable for upper beam
8d Cable for lower beam
8e Cable for parking light
9 Flash signal mechanism
10 Instrument cluster
11 Clock
12 Series resistance
13 Socket
14 Door contact
15 Roof light
16 Interior blower motors, left, right (optional)
17 Cable connector
18 Heater blower motor switch
19 Cigar lighter
20 Coupling
21 Choke control
22 Instrument lighting switch
23 Roof light switch
24 Windshield wiper
25 Windshield wiper switch
26 Reversing light switch
27 Stop light switch
28 Cable for automatic clutch (optional)
29 Fuses
30 Foot dimmer switch
31 Clearance light changeover switch
32 Rotary light switch with positions for clearance light and pull switch for fog lights
33 Ignition switch and steering lock
34 Upper beam flash signal switch
35 Charging light
36 Horn ring and flash signal switch
37 Upper beam flash signal mechanism
38 Starter push button switch
39 Starter 12 v
40 Fuel level indicator
41 Generator 12 v
42 Regulator
43 Battery 12 v
44 License plate and trunk compartment lighting, left
45 License plate and trunk compartment lighting, right
46 Tail, stop, and clearance light, left
47 Reversing light, left
48 Flash signal, left
49 Tail, stop, and clearance light, right
50 Fuse for reversing light on right-hand drive cars
51 Flash signal, right

XI. Model 220 SE



The small numbers shown on the leads denote the numbers of the corresponding terminals.

1a Flash signal, left
1b Flash signal, right
2 Engine
3 Horn
4a Headlight, left
4b Headlight, right
4c Cable for lower beam
4d Cable for upper beam
4e Cable for parking light
5a Fog light, left
5b Fog light, right
6 Instrument cluster
7 Clock
8 Distributor
9 Ignition coil
10 Roof light
11 Socket
12 Series resistance
13 Heater blower motors, left (right optional)
14 Flash signal mechanism
15 Coupling
16 Instrument lighting switch (with dimmer resistance)
17 Roof light switch
18 Reading light with door contact
19 Cigar lighter
20 Heater blower motor switch
21 Reversing light switch
22 Stop light switch
23 Contacts for hydraulic automatic clutch (scheme)
24 Upper beam flash signal mechanism
25 Fuses
26 Foot dimmer switch
27 Windshield wiper
28 Windshield wiper switch
29 Rotary light switch with positions for clearance light and pull switch for fog lights
30 Steering lock
31 Charging light
32 Clearance light changeover switch
33 Relay, automatic starter and
34 Starter push-button switch
35 Starter
36 Upper beam flash signal switch
37 Horn ring and flash signal switch
38 Fuel feed pump
39 Magnet for mixture enrichment
40 Fuel level indicator
41 Fuel level indicator
42 Regulator
43 Generator
44 Battery
45 Tail, stop, clearance light, left
46 Reversing light
47 Flash signal, left
48 License plate lighting
49 Tail, stop, clearance light, right
50 Free for reversing light on right-hand drive cars
51 Flash signal, right

D. Connections at Fuse Box

I. Model 180

Fuse No.	Fuse element amp.	Lead	Consumer units	Remarks
1	8	30	Clearance lights, roof light, (electric clock)	Permanently live circuit
2	25	54	Cigar lighter, wipers	Can be switched off by ignition starter switch
3	8	54	Choke control pilot light, flash signals, horn, reversing light	
4	8	54	Stop light, fuel gage, (defroster blower)	
5	8	58	License plate light, tail light, right, parking light, right	
6	8	58	Tail light, left, parking light, left, instrument lighting	
7	8	56 a	Upper beam, right, upper beam pilot light	Can be switched over by foot dimmer switch
8	8	56 a	Upper beam, left	
9	8	56 b	Lower beam, right	
10	8	56 b	Lower beam, left	

The units in brackets are optional and are installed only if ordered specially.

II. Models 180 a, 180 b

Fuse No.	Fuse element amp.	Lead	Consumer units	Remarks
1	8	30	Clearance lights, roof light, (socket, electric clock)	Permanently live circuit
2	25	54	Wipers, horn, (2nd and 3rd horn and horn relay), cigar lighter	Can be switched off by ignition starter switch
3	8	54	Free for optional extra	
4	8	54	Flash signal system, stop lights, reversing light, fuel reserve gage, choke control pilot light	
5	8	54	Defroster blower, left (and right)	
6	8	54	(Upper beam flash signal)	
7	8	58	Tail light, right, license plate light, right, parking light, right, instrument lighting	
8	8	58	Tail light, left, license plate light, left, (fog light)	
9	8	56 a	Upper beam, right, upper beam pilot light	Can be switched over by foot dimmer switch
10	8	56 a	Upper beam, left	
11	8	56 b	Lower beam, right	
12	8	56 b	Lower beam, left	

The units in brackets are optional and are installed only if ordered specially.

III. Models 180 D, 180 Db

Fuse No.	Fuse element amp.	Lead	Consumer units	Remarks
1	8	30	Clearance lights, roof light, electric clock	Permanently live circuit
2	25	54	Cigar lighter, wipers	Can be switched off by ignition starter switch
3	8	54	Flash signals, horn, reversing light	
4	8	54	Stop light, fuel gage, (defroster blower)	
5	8	58	License plate light, right, tail light, right, parking light, right	
6	8	58	License plate light, left, tail light, left, parking light, left, instrument lighting	
7	8	56 a	Upper beam, right, upper beam pilot light	Can be switched over by foot dimmer switch
8	8	56 a	Upper beam, left	
9	8	56 a	Lower beam, right	
10	8	56 b	Lower beam, left	

The units in brackets are optional and are installed only if ordered specially.

IV. Models 190 D, 190 Db

Fuse No.	Fuse element amp.	Lead	Consumer units	Remarks
1	6	30	Clearance lights, roof light, electric clock, (socket)	Permanently live circuit
2	25	54	Wipers, cigar lighter, 1st horn, (2nd and 3rd horn and horn relay)	Can be switched off by ignition starter switch
3	6	54	Free for optional extra	
4	8	54	Flash signal system, stop light, reversing light, fuel gage, electric fuel reserve gage	
5	6	54	Defroster blower, left (and right)	
6	8	54	Upper beam flash signal	
7	8	58	Tail light, right, parking light, right, instrument lighting, license plate light, right	
8	8	58	Tail light, left, parking light, left, license plate light, left, fog light	
9	8	56 a	Upper beam, right, upper beam pilot light	Can be switched over by foot dimmer switch
10	8	56 a	Upper beam, left	
11	8	56 b	Lower beam, right	
12	8	56 b	Lower beam, left	

The units in brackets are optional and are installed only if ordered specially.

V. Model 190 SL

Fuse No.	Fuse element amp.	Load	Consumer units	Remarks
1	8	30	Clearance lights, interior light, socket	Permanently live circuit
2	8	54	Wipers, flash signal system, fuel gage, choke control pilot light	Can be switched off by ignition starter switch
3	8	54	Horns — connected in parallel	
4	8	54	Reversing light, upper beam flash signal	
5	8	54	Cigar lighter	
6	8	54	Stop lights, defroster blower	
7	8	56	License plate light, tail light, right, parking light, right	
8	8	58	Tail light, left, parking light, left, instrument lighting, (fog light)	
9	8	56 a	Upper beam, right, upper beam pilot light	Can be switched over by foot dimmer switch
10	8	56 a	Upper beam, left	
11	8	56 b	Lower beam, right	
12	8	56 b	Lower beam, left	

The units in brackets are optional and are installed only if ordered specially

VI. Model 220 a

Fuse No.	Fuse element amp	Lead	Consumer units	Remarks
1	8	30	Clearance lights, electric clock, roof light, reading light, socket	Permanently live circuit
2	8	54	Choke control pilot light, fuel gage, flash signal system, wipers	Can be switched off by ignition starter switch
3	8	54	1st and 2nd horn (connected in parallel)	
4	8	54	Reversing light, 3rd horn, upper beam flash signal	
5	8	54	Cigar lighter	
6	8	54	Stop lights, (defroster blower)	
7	8	58	License plate light, tail light, right, parking light, right	
8	8	58	Tail light, left, parking light, left, instrument lighting, fog light	
9	8	56 a	Upper beam, right, upper beam pilot light	Can be switched over by foot dimmer switch
10	8	56 a	Upper beam, left	
11	8	56 b	Lower beam, right	
12	8	56 b	Lower beam, left	

The units in brackets are optional and are installed only if ordered specially.

VII. Model 219

Fuse No.	Fuse element amp.	Lead	Consumer units	Remarks
1	8	30	Clearance lights, roof light, socket, electric clock	Permanently live circuit
2	25	54	Wipers, 1st and 2nd horn, (3rd horn and horn relay), cigar lighter	
3	8	54	Free for optional extra	
4	8	54	Stop lights, reversing light, fuel gage, choke control pilot light, flash signal system	Can be switched off by ignition starter switch
5	8	54	Defroster blower, left and right	
6	8	54	Upper beam flash signal	
7	8	58	Tail light, right, parking light, right, license plate light, right	
8	8	58	Tail light, left, parking light, left license plate light, left, instrument lighting (fog light)	
9	8	56 a	Upper beam, right, upper beam pilot light	
10	8	56 a	Upper beam, left	Can be switched over by foot dimmer switch
11	8	56 b	Lower beam, right	
12	8	56 b	Lower beam, left	

The units in brackets are optional and are installed only if ordered specially.

VIII. Model 220 S

Fuse No.	Fuse element amp.	Lead	Consumer units	Remarks
1	8	30	Clearance lights, roof light, socket, electric clock, reading light	Permanently live circuit
2	25	54	Wipers, 1st and 2nd horn, (3rd horn and horn relay), cigar lighter	Can be switched off by ignition starter switch
3	8	54	Free for optional extra	
4	8	54	Flash signal system, stop light, reversing light, fuel gage, choke control pilot light	
5	8	54	Defroster blower, left (and right)	
6	8	54	Upper beam flash signal	
7	8	58	Tail light, right, parking light, right, license plate light, right	
8	8	58	Tail light, left, parking light, left, license plate light, left, instrument lighting, fog light	
9	8	56 a	Upper beam, right, upper beam pilot light	Can be switched over by foot dimmer switch
10	8	56 a	Upper beam, left	
11	8	56 b	Lower beam, right	
12	8	56 b	Lower beam, left	

The units in brackets are optional and are installed only if ordered specially.

IX. Model 220 SE

Fuse No.	Fuse element amp	Lead	Consumer units	Remarks
1	8	30	Clearance lights, roof light, socket, electric clock, reading light	Permanently live circuit
2	25	54	Wipers, 1st and 2nd horn, (3rd horn and horn relay), cigar lighter	Can be switched off by ignition starter switch
3	8	54	Free for optional extra	
4	8	54	Fuel feed pump	
5	8	54	Flash signal system, stop light, reversing light, fuel gage	
6	25	54	Automatic starter aid, upper beam flash signal, defroster blower, left (and right)	
7	8	58	Tail light, right, license plate light, right, parking light, right, instrument lighting	
9	8	58	Tail light, left, license plate light, left, parking light, left, fog light	
9	8	56 a	Upper beam, right, upper beam pilot light	Can be switched over by foot dimmer switch
10	8	56 a	Upper beam, left	
11	8	56 b	Lower beam, right	
12	8	56 b	Lower beam, left	

The units in brackets are optional and are installed only if ordered specially

Job Nos.
54–2

Tail Light Wiring Harness

On Models 180 to 220 SE the color coding of the cables for the various electric consumers is the same as on Model 190.

Connect the individual cables to the cable connector of the tail light wiring harness in such a way that the color coding of the cables of the tail light wiring harness corresponds to the color coding of the cables of the main wiring harness.

Note: The tail light wiring harness of Model 220 SE contains an additional cable from the cable connector to the fuel feed pump; the basic color of the cable is white, the code color green, and the cross-section 2.5 mm².

Job Nos.
54–2 to 54–5

On Models 180 to 220 SE the cable harness for the steering tube, the cable harness from the generator to the regulator, and the cable harness for the reversing light switch are the same as on Model 190.

On Models 180 b, 180 Db, 190 Db the cable harness for the steering tube has been changed and is explained in the Table below.

Explanation of Cable Harness in Steering Tube

Lead No.	Basic color	Color coding	Wiring position	Cross section of lead in mm²
1	black	yellow	from cable connector steering to horn ring switch (horn contact)	1.5
2	black	white green	from cable connector steering to flash signal switch terminal 54	1.5
3	black	white	from cable connector steering to flash signal switch terminal flash signal, left	1.5
4	black	green	from cable connector steering to flash signal switch terminal flash signal, right	1.5
5	black	—	from cable connector steering to flash signal switch upper beam flash signal	0.75
6	brown	—	from cable connector steering (ground) to horn ring switch	1.5
7	brown	—	from horn ring switch (ground) to upper beam flash signal (ground)	1.5

Job Nos
54-8 to 54-10

Battery

The general remarks about the battery, the removal and installation procedures, and the battery servicing instructions given for Model 190 also apply to Models 180 to 220 SE.

Models 180 is equipped with a battery of an operating voltage of 6 volts and a capacity of 84 Ah.

On Models 180 D and 190 D the battery capacity is likewise 84 Ah.

Job No.
54-11

Removal and Installation of Instrument Cluster

I. Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, 220 a, and 219

On these models the removal and installation procedures for the instrument cluster are the same as on Model 190.

II. Models 220 S and 220 SE

The removal and installation procedures are essentially the same as on Model 190, but before the instrument cluster is removed unscrew the pull-button for the trip recorder on the instrument panel, unscrew the retaining nut and the lock nut and pull the trip recorder cancelling cable out of the rubber grommet from the engine side.

III. Model 190 SL

A. Removal and Installation of Speedometer or Revolution Counter

Removal:

1. Loosen the milled nut of the speedometer drive shaft behind the instrument panel by hand and pull the speedometer drive shaft out of the instrument.

2. Unscrew the two milled nuts above the fixing strap and remove the fixing strap from the instrument.

3. Take the instrument out of the instrument panel and disconnect the two connections for the instrument light.

Installation:

4. Installation is the reverse of the removal procedure.

B. Removal and Installation of Oil-Pressure Gage

Removal:

1. Remove the rotary light switch (see Job No. 82-15). Push the electric leads behind the instrument panel to one side to make the rear of the oil-pressure gage accessible.

2. Disconnect the oil-pressure gage lead at the instrument.

3. Unscrew the two milled nuts and remove the holding strap.

4. Pull the oil-pressure gage out of the instrument panel and disconnect the electric leads for the instrument light.

Installation:

5. Installation is the reverse of the removal procedure.

C. Removal and Installation of Fuel Gage

Removal:

1. Unscrew the two milled nuts behind the fuel gage and remove the holding strap.

2. Pull the fuel gage out of the instrument panel and disconnect the electric leads.

Installation:

3. Installation is the reverse of the removal procedure.

Note: Align the instrument so that the dial figures are vertical.

D. Removal and Installation of Cooling Water Thermometer

Removal:

1. Disconnect the capillary tube at the engine and push it inside the car through the cowl.

2. Unscrew the two milled nuts behind the cooling water thermometer and remove the holding strap.

3. Pull the cooling water thermometer out of the instrument panel and disconnect the electric lead for the instrument light

Installation:

4. Installation is the reverse of the removal procedure.

Removal and Installation of Clock

Job No.
54–12

I. Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db, and 219

The removal and installation procedures for the clock are the same as on Model 190.

II. Models 220 a, 220 S, and 220 SE

After removing the ashtray press the clock out by reaching behind the instrument panel (Fig. 54–12/1).

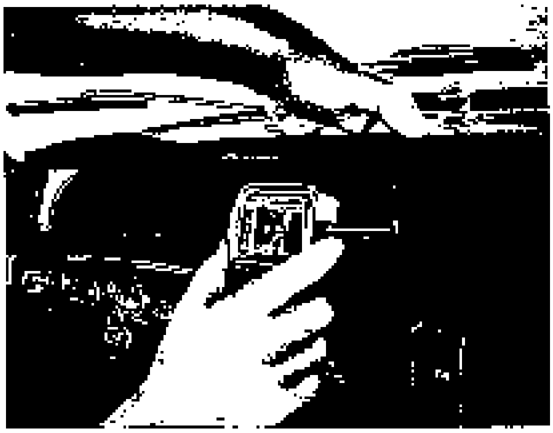


Fig. 54–12/1

III. Model 190 SL

After opening the glove compartment lid unscrew the two knurled nuts for the clock mounting.

Removal and Installation of Stop Light Switch

Job No.
54–13

On Models 180 to 220 SE the removal and installation procedures for the stop light switch are the same as on Model 190.

On recent models with an ATE power brake the stop light switch is located on the power brake (see Fig. 42–14/1 in Workshop Manual Model 190).

Job Nos.
54–14 to 54–18

On Models 180 to 220 SE the removal and installation procedures for the foot dimmer switch, the horn assembly, the flash signal mechanism, the upper beam flash signal switch, and the push-pull switch with dimmer resistance for the instrument lighting are the same as on Model 190.

On Models 180 b, 180 Db, and 190 Db a combination switch for the flash direction signal system and the upper beam flash signal system has been installed.

Removal:

1. Disconnect the ground cable at the negative terminal of the battery.

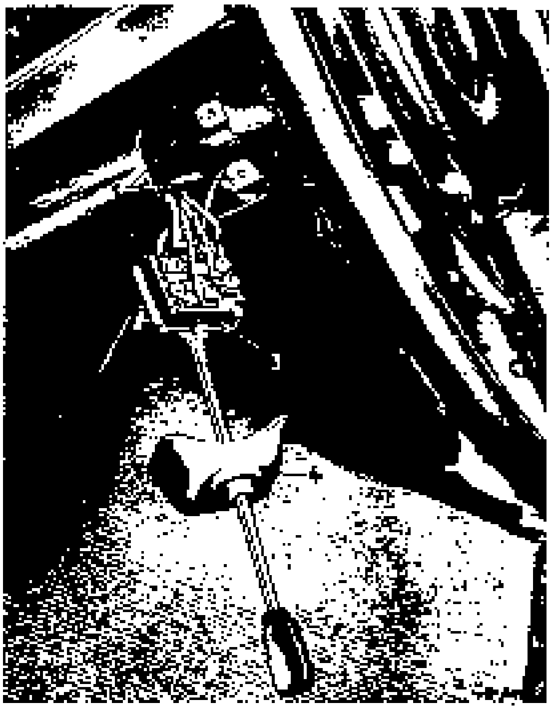


Fig. 54-17/1

1 Base of steering column jacket
2 Angle bracket
3 Switch
4 Rubber sleeve

2. Pull the rubber sleeve (4) out of the steering column jacket and push it back (Fig. 54-17/1).

3. Unscrew the two cross-recess head screws on the angle bracket (2) from the base (1) of the steering column jacket.

4. Pull the switch (3) outward and disconnect the electric cables (Fig. 54-17/1).

Installation:

5. During installation pay attention to the color coding. Connect:

the black/yellow cable to the horn contact,
the black/white/green cable to terminal 54,
the black/white cable to the terminal flash signal left,
the black/green cable to the terminal flash signal right,
the black cable to terminal 31 (upper beam flash signal),
the brown cable to the signal ring switch (ground) and the short brown cable from the signal ring switch (ground) to the flash signal switch (ground).

Job No.
54-19

Removal and Installation of Starter Push-Button Switch

I. Models 180, 180 a, 180 b, 220 a, 219, 220 S, 220 SE, and 190 SL with Steering Lock

On these models the removal and installation procedures for the starter push-button switch are the same as on Model 190.

II. Model 190 SL with Ignition Starter Switch

See Job No. 15–21

III. Models 180 D 180 Db, 190 D, and 190 Db

See Job No. 15 33 Glow Plug Starter and Stop Switch.

Headligths

Job No.
82-1

A. Removal and Installation of Left or Right Headlight

On Models 180 to 220 SE the removal and installation procedures for the headlights are the same as on Model 190. The cable colors for the various terminals are identical on all models.

Note: When sealed-beam headlights are installed, the headlight recess on the fender is provided with a five-pin cable connector to which the main wiring harness is connected. When connecting the short headlight cable end plug to the cable connector make sure that the color coding of the cables of the main wiring harness corresponds to the color coding of the cables of the short headlight cable end plug.

When sealed-beam units are installed, the parking light is located not in the headlight itself but in a fitted light below the headlight (see Fig. 82-1/1).

Fig. 82-1/1

1 Glass lens
2 Rubber sealing ring
3 Fitted light
4 Seal

Headlights with sealed-beam unit have no bulb and the headlight lens cannot be replaced. In case of damage the whole sealed-beam unit must be replaced.

B. Replacement of Left or Right Bulb for Asymmetrical Headlight, Lower Beam

In the case of asymmetrical headlights the bulb and the bulb socket form a unit which can only be replaced as such (see Fig. 82-1/2).

First pull off the cable plug (1), then disengage the lamp holder (2) by pressing it down and turning it toward the left out of the bayonet catch and remove it. Then remove the bulb with the socket (3). When a new bulb is installed, the two fixing lugs (4) on the bulb socket must engage in the recess (5) on the reflector neck of the headlight: the bayonet catch of the lamp holder can only be engaged in this position of the bulb.

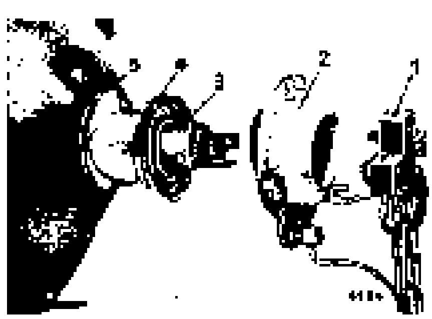


Fig. 82-1/2

1 Cable plug
2 Lamp holder
3 Bulb with socket
4 Fixing lugs
5 Recess on reflector neck

Headlight Adjustment

A. Adjustment of Headlights

a) On Models 180 to 220 SE the adjustment procedures for the headlights of a previous design and for the headlights with sealed-beam units are the same as on Model 190, with the difference, however, that according to the latest German regulations a load of 70 kg must be placed in the middle of the rear seats.

b) For the adjustment of headlights with asymmetrical lower beam (distinguished by the prism sector on the left side of the diffusing lens) see Fig. 82-2/1.

Fig. 82-2/1

1. If the headlights are adjusted with the headlight adjusting device, make sure that the device is aligned exactly parallel to the longitudinal axis of the car.

2. The closer the adjustment device and its collecting lens is moved toward the headlight, the more accurate the adjustment.

3. Headlights with asymmetrical lower beam are adjusted **only with relation to the lower beam.** The light-dark boundary runs horizontal on the left side and rises at the center at an angle of 15° toward the right (see Fig. 82-2/2).

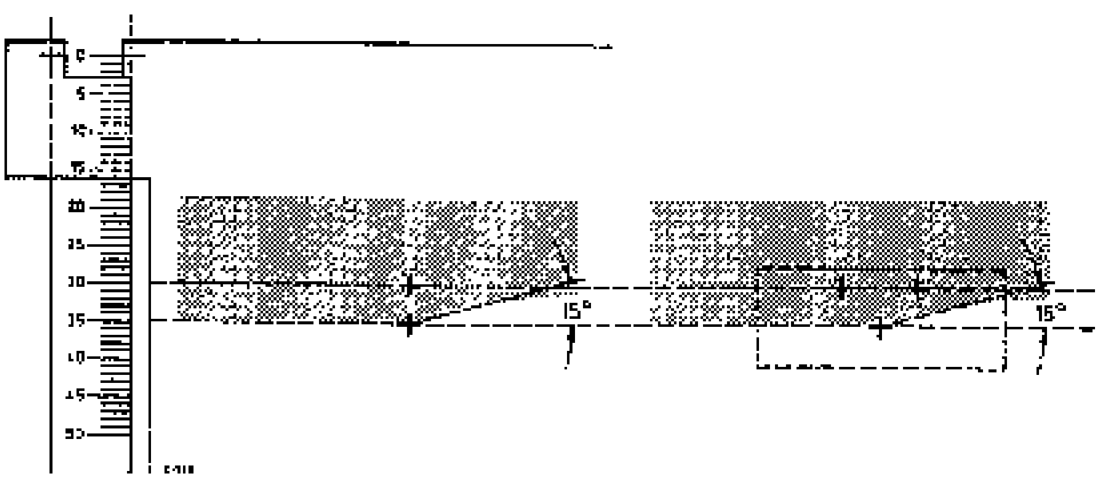


Fig. 82-2/2

Horizontal Beam Aiming

Aim the headlight beams horizontally in such a way that the break in the light-dark boundary coincides with the lower cross on the adjusting screen (see Fig. 82-2/2). If the break is not clearly visible, the situation can be approved by covering the gusset on the left side of the diffusing lens several times by hand.

Vertical Beam Aiming

The headlight beams are aimed vertically in such a way that the light-dark boundary runs horizontally to the left of the break and coincides with the lower line on the adjusting screen (see Fig. 82-2/2).

When the headlights are adjusted in front of an adjusting screen, mark the height H of the headlights above the ground and their distance B or $\frac{B}{2}$ symmetrically to the longitudinal axis of the car. This gives two adjusting crosses from which two lines should be plotted at an angle of 15° rising toward the right. Then draw in the boundary line for the light-dark boundary 5 cm below the adjusting crosses (see Fig. 82-2/3).

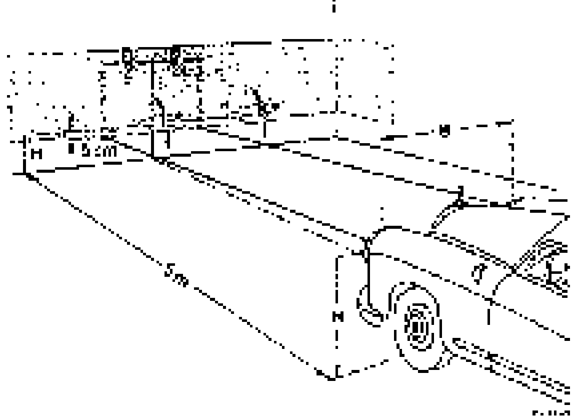


Fig. 82-2/3

Adjust the headlights **only with relation to the lower beam.** In this case the light-dark boundary must run **horizontally** on the left side as far as the lower adjusting cross and then rise at an angle of 15° toward the right (see Fig. 82-2/3).

B. Adjustment of Fog Lights

On Models 180 to 220 SE the adjustment procedure for the fog lights is the same as on Model 190; please note that according to the new German regulations a load of 70 kg must be placed in the middle of the rear seats.

Job No.
82-3

Removal and Installation of Left or Right Flash Signal with Clearance Light

I. Models 180, 180 a, 180 b, 180 D, 180 Db, 190 D, 190 Db

The removal and installation procedures for the flash signal and clearance light are the same as on Model 190.

II. Model 190 SL

In the case of standard headlights the flash signal and clearance light are installed in a fitted light below the headlight and in the case of headlights with sealed-beam unit the flash signal, clearance and parking lights are installed in this fitted light.

III. Models 220 a, 219, 220 S, 220 SE

On these models the flash signal and the clearance light are located on the fender (see Figs. 82-3/1 and 82-3/2).

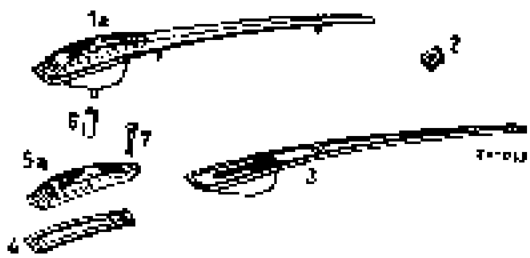


Fig. 82-3/1

1a Flash signal and clearance light, right
2 Ring clamp with nut M 6
3 Rubber seal
4 Weather strip
5a Transparent pane, right
6 Rubber grommet
7 Oval head countersunk screw M 4

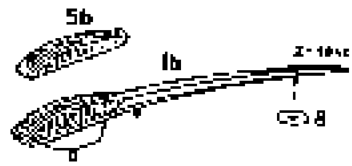


Fig. 82-3/2

1b Flash signal and clearance light, left
5b Transparent pane, left
8 Rubber ring

Job Nos.
82-4 to 82-11

On Models 180 to 220 SE the removal and installation procedures for the windshield wiper motor, the plate with drive mechanism as well as coupling rod and drive rod for the windshield wipers, the wiper arm with wiper blade, the wiper blade of the windshield wiper, the rubber blade, the push pull switch for the windshield wipers, and the cigar lighter are the same as on Model 190.

License Plate Lighting

Job No.
82-12

On recent cars of Models 180 to 220 SE the license plate lights are installed in the guards of the bumper (see Fig. 82-12/1).

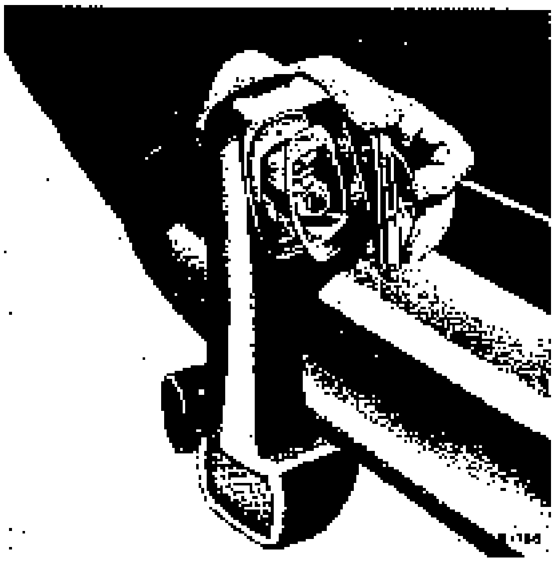


Fig. 82-12/1

Job Nos.
82-13 to 82-17

On Models 180 to 220 SE the removal and installation procedures for the stop and tail lights, the rotary light switch, the toggle change-over switch for the clearance light, and the toggle switch for the blowers are essentially the same as on Model 190.

Interference Suppression for Radio

Job No.
82-21

In order to obtain good radio reception with regard to the various sensitivities of the individual frequency ranges of the radio sets, the following instructions for interference suppression should be adhered to.

Models 180, 180 a, 180 b, 190 SL, 220 a, 219, 220 S, and 220 SE

	optional		Remarks
	Bosch Part No.	Beru Part No.	
1. Spark plugs with suppressors (5 K Ohms)	see Table "Spark Plugs"		
2. 4 or 6 spark plug suppressor caps (1 K Ohm)	EM/W 1/14 1) 000 159 12 42 EM/W 1/11 000 156 15 10	BEJ 4/10 1) 000 159 13 42 OEJ 4/10 000 156 16 10	1) Only for Model 220 SE
3. 5 or 7 distributor suppressor caps (1 K Ohm)	EM/W 1/20 000 156 17 10	VESJ 5 K 000 156 18 10	
4. 5 or 7 rubber caps	G 1 PL 000 159 07 95	Beru	Only for older cars. New cars with distinct interference suppression have distributor rotor arms with suppressor as standard parts.
5. 1 distributor rotor arm with suppressor (5 K Ohms)	ZVVT 5 Z 4 Z 000 158 05 31 ZVVT 5 Z 5 Z 1) 000 158 11 31	EVL 4/6 7	1) For dust-proof distributor types
6. 1 suppressor condenser with insulated return cable to ignition coil terminal 15	EMKO 20 Z 1 Z 000 156 29 01	SK 215 R 000 156 31 01	Bosch 2.5 MF Beru 3 MF
7. 1 feed-through condenser at regulator terminal 51	EMKO 15 Z 12 Z 000 155 37 01	SK 211 R 000 156 20 01	Bosch 2.5 MF Beru 3 MF
8. 1 feed-through condenser at regulator terminal 61 (with torsion protection)	EMKO 15 Z 10 Z 000 156 26 01	SK 219 R 000 156 33 01	0.5 MF
9. 1 suppressor filter at regulator terminal DF	EM/SO 3/1 000 156 28 01	SK 168 L 000 156 34 01	0.005 MF
10. 1 feed-through condenser to terminal D + of the generator	EMKO 15 Z 10 Z 000 156 26 01	SK 210 R 000 156 30 01	0.5 MF

11. 2 complete wheel hub contacts for front wheels.

12. 1 ground strap between capillary tube of radiator thermometer and cowl, 400 mm long, approx. 10 mm². Part No. 10 120 820 00 72

13. 1 ground strap between speedometer drive shaft and cowl, 100 mm long, approx. 16 mm². Part No. 180 540 00 41

14. 1 ground strap from the ground connection of the condenser at the ignition coil terminal 15 to the engine 450 mm long, approx. 16 mm². Part No. 180 540 01 41

15. 1 ground strap from the engine to the left radiator mounting (seen in direction of travel), 350 mm long, approx. 16 mm². Part No. 180 540 02 41

16. 1 ground strap from the hood to the cowl, approx. 10 mm². Becker designation 281 Z 407 a.

17. 2 ground straps from regulator ground to regulator support, 120 mm long, approx. 16 mm². Part No. 180 540 03 41

18. The contact surfaces below the regulator or below the interference suppressors on the support of the wheel arch must quite definitely be tinned.

19. The fixing lugs of the ignition cable conduit must quite definitely be tinned.

20. In order to enable the ground straps to be tightened properly, ordinary washers should be installed in addition to the spring washers.

21. Electrically conducting tires.

22. Electrically conducting fan belt for the generator.

Models 180 D and 190 D have no interference suppressors for the ignition system, but everything else is necessary in order to obtain good radio reception also on these two models.