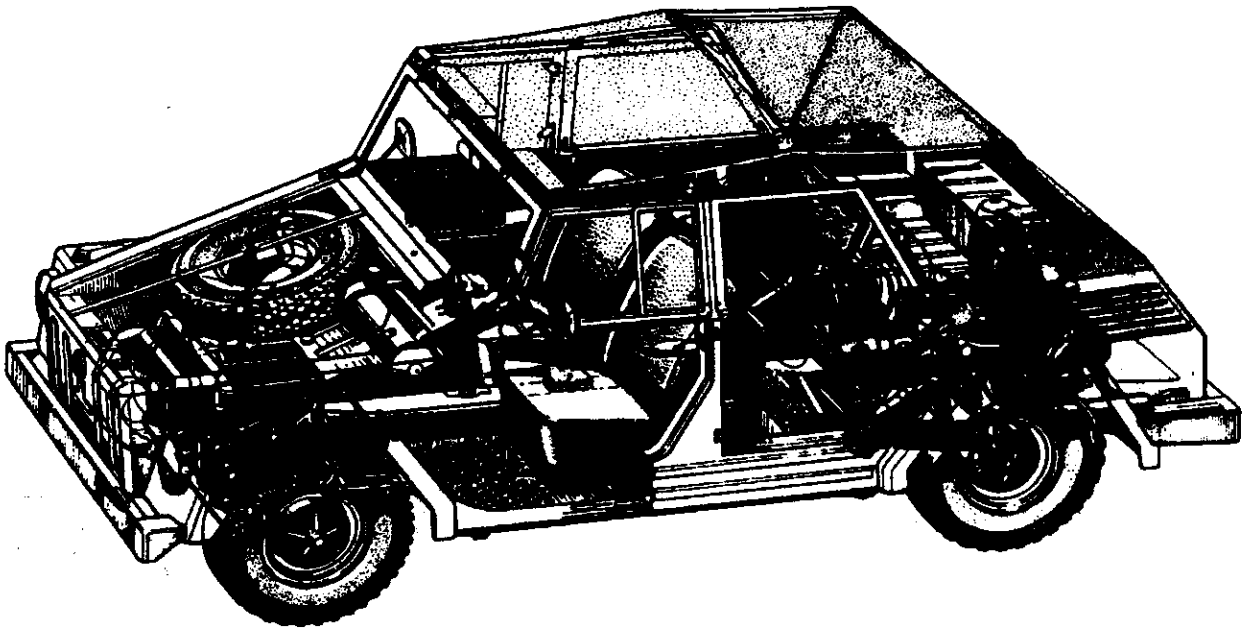
VW Thing



Type 181

Service Manual

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Front Suspension and Steering

Section A
Body

PAINT CODES-U.S.

Colors (73-74)	Paint Code	VW Part Number
Blizzard White	90H	LKLO90H00
Sunshine Yellow	11E	LKLO11E00
Pumpkin Orange	30F	LKLO30F00
(1974 Only)		
Avocado Green	60F	LKLO60F00
(Acapulco Only)		
Cream White	90H	LKLO90H00
Delft Blue	55Z	LKLO55Z00
Misc Colors, All Years		
(For interior trim, seat frames, brake handle etc.)		
Gray/Black	LD43	LKLD4300
(Wheel Color, 1973 and Later)		
Alum. Gray	L97U	Unknown

Description of body

The four-door open body is bolted to the flat frame. The deep side members stiffen the body against distortion as well as provide good fording properties.

The center pillars act as lock pillars for the front doors and as hinge pillars for the rear doors.

The all-welded body consists of the front and rear ends, the side panels with side members and the cross member for the rear seats.

The front luggage and engine compartments have hinged hoods. Air is drawn into the engine compartment through slots in the rear side panels.

Sheet metal thicknesses

Front and side outer panels	0.88 mm (0.035 in.)
Rear outer panels	1.00 mm (0.039 in.)
Fenders	0.88 mm (0.035 in.)
Doors and hoods	0.88 mm (0.035 in.)
Interior panels	0.75 to 1.00 mm (0.029—0.039 in.)

Painting

The Type 1 / Model 181 has three coats of paint, including the electrophoretic prime coat. These coats are as follows:

1. Electrophoretic primer
2. Filler
3. Top coat

The **electrophoretic primer** (and the initial zinc phosphate coating) is applied by a dipping process. This gives protection against corrosion to all parts of the body including those hidden areas and hollow parts which cannot be reached by spraying.

The **filler coat** is the intermediate stage between the primer and the top coat. It covers up slight scratches and sanding marks in the primer coat.

The **top coat** is applied to protect the undercoats against external mechanical and corrosive influences. The main features of a good top coat lie in its color fastness, gloss retention and covering power.

All spare parts such as complete bodies, fenders, doors, hoods and other body parts are covered with a coat of primer applied by the dipping method.

This high quality primer gives the necessary protection against corrosion while the parts are in transit and being stored. It also provides an excellent base for the coats of paint to be applied later.

Undercoat

A layer of vinyl (PVC) undercoating is applied in the factory. This tough flexible coating protects the underside of the fenders and all parts exposed to the road, from stone damage, corrosion and leakage. The floor panels are sprayed with a wax-based undercoat.

Bumpers

The one-piece bumpers with welded support plates are bolted to the front reinforcement panel and to the bumper brackets. They are also bolted to the fenders with brackets.

Fenders

The fenders are bolted to the side panels.

The beading between the side panel and fender is designed so that it can be fitted **after** the fender has been installed. The clearance required for the beading is given by the bent-up metal tabs on the spacer clips.

Hoods

The luggage compartment hood is attached to the body with external hinges.

The hood lock is operated by a pull loop on the passenger side. The hood lock also has a retaining hook to prevent it from opening accidentally.

The hood is held in the open position by a support which is mounted on the wheel housing and engages in the hood inner panel.

The engine compartment lid is mounted on two external hinges and held open by a support.

Doors

The 717 mm (28.2 in.) wide doors are made up of inner and outer panels which are welded all around the outer edge. Rear view mirrors are fitted on the lockable front doors.

The door opening angles are limited to 75° by check straps.

The doors are opened from outside by a trigger fitted in the outer handle and from inside by a handle on the lock.

The doors can be locked by lifting the inside handle.

The doors are hinged on the front side panel and on the center pillar and can be taken off the hinges completely when desired.

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Windows

The windshield is set at an angle of 27° and is 1300 mm (51.1 in.) wide and 370 mm (14.5 in.) high.

At the bottom the windshield is fitted to hinges mounted on the cowl panel and can be folded forward.

The doors are fitted with detachable windows of transparent vinyl (PVC).

The rear window is also made of vinyl (PVC) which is sewn into the top material. The window is 1045 mm (41.1 in.) wide and 450 mm (17.7 in.) high.

Front seats

The adjustable individual seats have hinged backrests and are mounted on inclined runners which give a fore and aft range of movement of 140 mm (5.5 in.) and a height adjustment of 18 mm (0.7 in.).

The backrests can be adjusted to four different angles.

The front seats and backrests are covered with leatherette.

Rear seats

The seat cushion is made up of plastic foam padding with a fiber underlay and flat spring base.

The flat springs are hooked into the transverse seat support and the floor plates.

The two hinged backrests are padded with plastic foam and can be folded forward after releasing the catches.

The seat cushion and backrests are also covered with leatherette.

Heating

The heater works independently of the engine and supplies warm air through defroster vents on the upper edge of the instrument panel and through footwell outlets.

Interior trim

The edges of the instrument panel are covered with padded strips and all projecting metal flanges are trimmed with protective strips.

The floor is covered with perforated rubber matting.

Top

The top consists of a tubular framework with a weatherproof vinyl (PVC) cover.

The tubular framework is secured at the rear with webbing straps and gives the roof its shape.

Lateral stability is given by the side linkage.

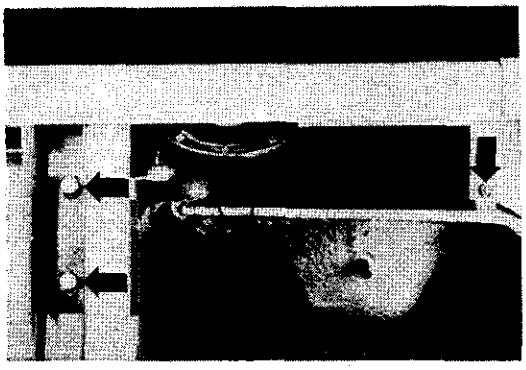
The front bow is located on the windshield frame by two centering pins and secured with two fasteners.

When top is folded back, the tubes lie one above the other and the top cover is folded above the tubes and secured with straps.

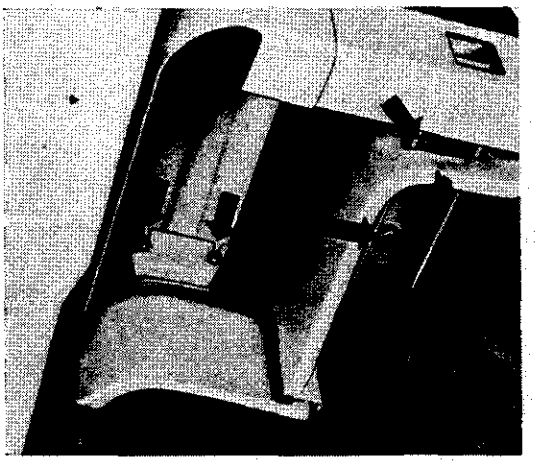
The pivot points of the linkage are covered with vinyl (PVC) caps.

The bumper brackets are mounted by two bolts to the reinforcement under the spare wheel well or to the rear side members.

The bumpers are also attached to small angle brackets on the fenders.



Front bumper



Rear bumper

Removing

Before removing the front bumper, disconnect the wires from the horn.

Loosen the bolts in the fender brackets and take out the bolts under the spare wheel well or in the rear side members.

Installing

1 - Install in the reverse order.

2 - Make sure that the gap between bumper and fender is uniform.

3 - Do not forget the washers.

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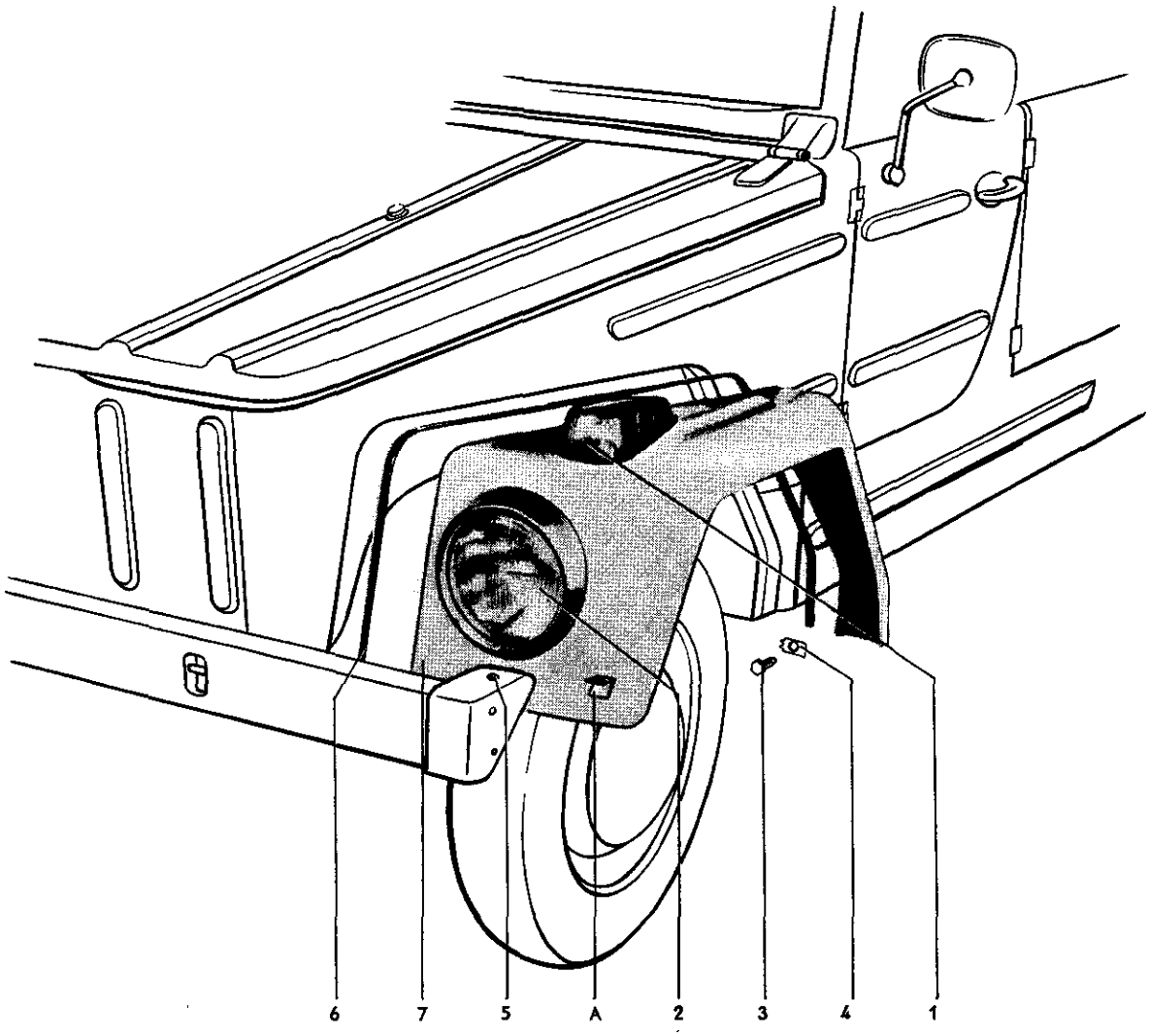

No.	Description	Qty.	Note when removing	Note when installing	Special instructions see
1	Turn signal	1	pull wire out of headlamp housing		E 8.2/1
2	Headlight	1	pull wire out of headlamp housing		E 8.2/1
3	Bolt	8		replace it necessary	
4	Spacer clip	8		replace if necessary	
5	Carriage bolt	1			A 2.3/1
6	Beading with clips	1		check, replace if necessary. Drive in with wooden or plastic block	
7	Fender	1			
A	Angle bracket	1			

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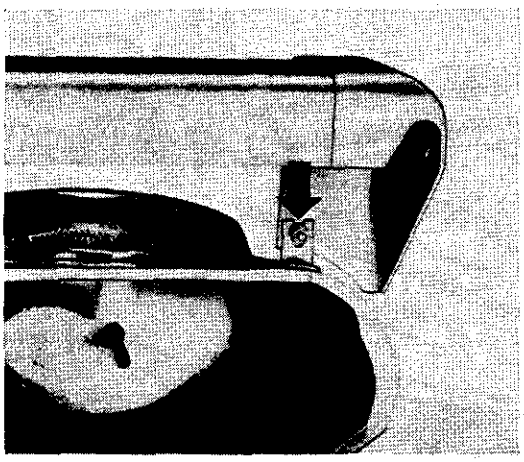
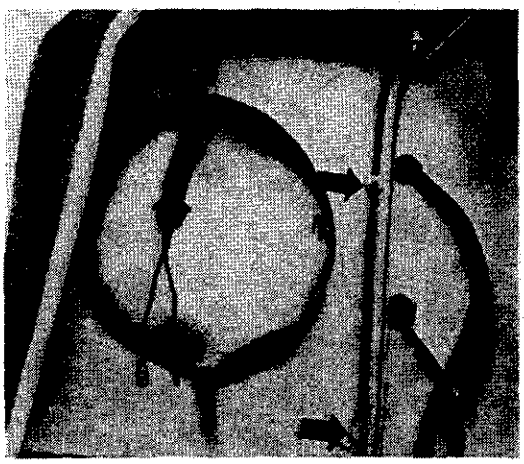


Removing

1 - Remove bolt on angle bracket.

2 - Part the vinyl (PVC)-undercoating material between fender and wheel housing with a sharp knife.



3 - Remove eight bolts under fender.

a - Three bolts at the front (arrows).

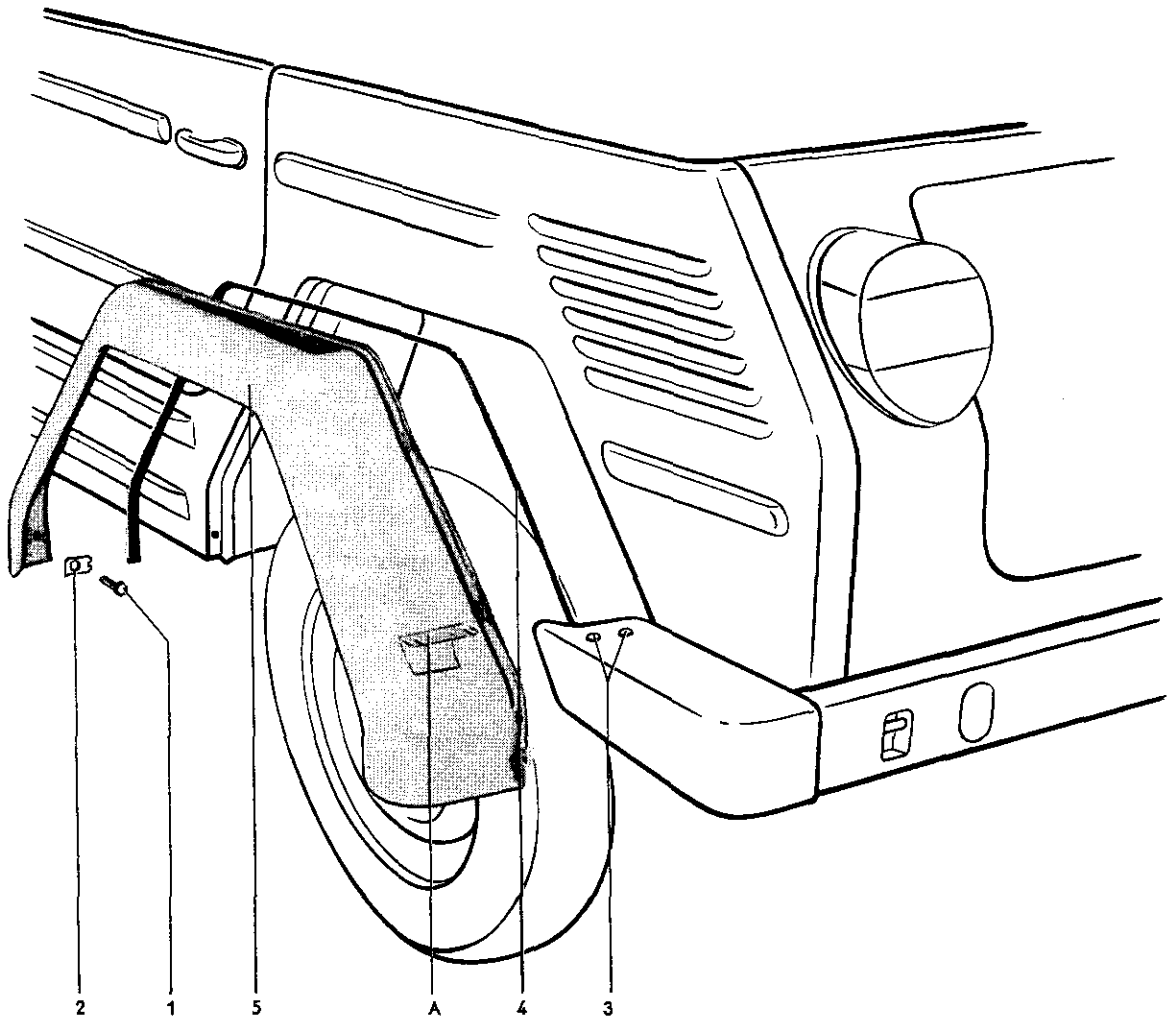
b - Five at the rear (arrows).

4 - Pull rear part of fender outwards and free angle bracket from bumper at front.

Installing

1 - Install beading with wood or plastic block so that it fits properly.

2 - Repair the damaged vinyl (PVC)-undercoating material around the bolts with underbody sealer.



No.	Description	Qty.	Note when removing	Note when installing	Special instructions see
1	Bolt	8		replace if necessary	
2	Spacer clip	8		replace if necessary	
3	Carriage bolt	2			
4	Beading with clips	1		check, replace if necessary. Drive in with wooden or plastic block	
5	Fender	1			
A	Angle bracket	1			

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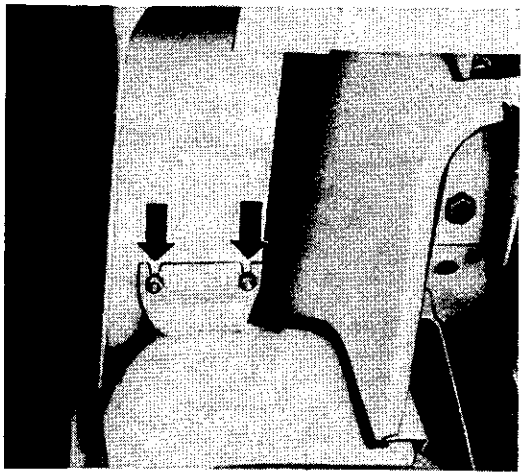
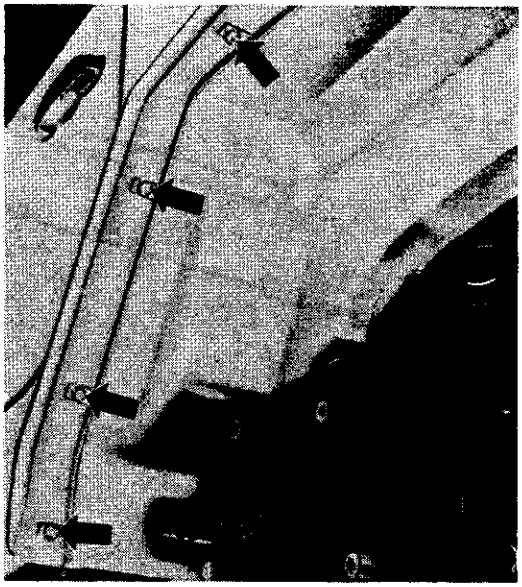


Removing

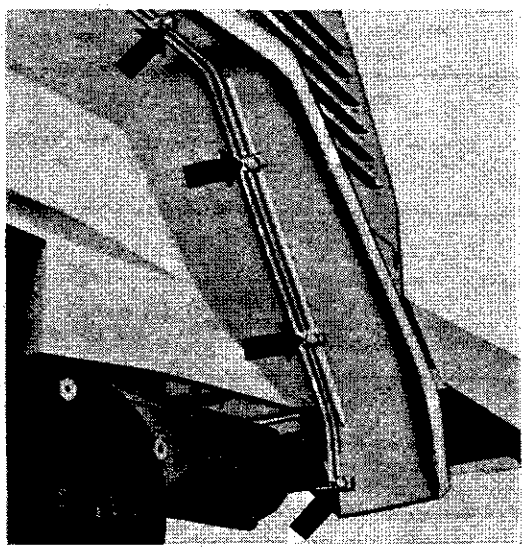
1 - Remove bolts on angle bracket.

2 - Part the vinyl (PVC)-undercoating material between fender and side panel with a sharp knife.



3 - Remove eight bolts under fender.

a - Four bolts at front (arrows).



b - Four bolts at rear (arrows).

4 - Pull front part of fender outward and free angle bracket from bumper at rear.

Installing

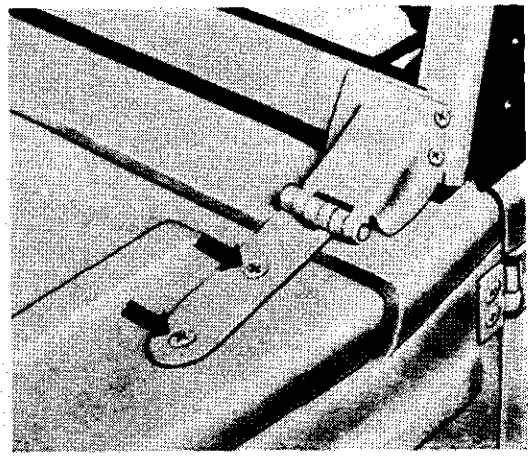
1 - Install beading with wood or plastic block so that it fits properly.

2 - Repair the damaged vinyl (PVC)-undercoating material around the bolts with underbody sealer.

Removing

1 - In order to prevent damage to the paint work when removing and installing the front hood this work should be carried out by two mechanics.

2 - Remove the two Phillips screws holding the hinges on each side and take hood off.



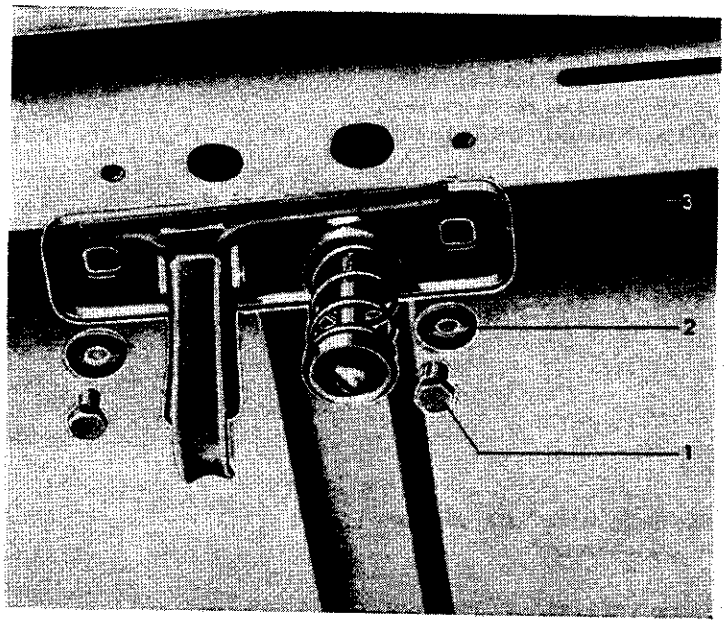
Installing

Before installing the hood, check the condition of the seal. Replace seal if necessary.

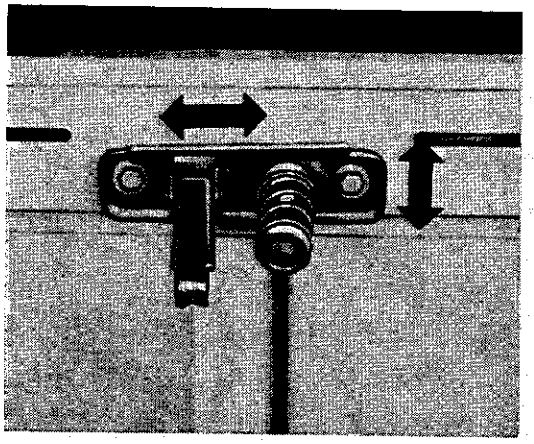
1 - Check Phillips screws and replace if necessary. Lift hinges up and attach hood to each hinge with two screws.

2 - Open and close hood a few times to check operation of lock. If necessary, adjust position of lock upper part in the elongated holes and depth of engagement of lock pin after loosening lock nut.

3 - Then check the tightness of the Phillips screws in the hinges.



No.	Description	Qty.	Note when removing	Note when installing	Special instructions see
1	Bolt	2			
2	Washer	2			
3	Lock upper part	1		adjust	



Installing and adjusting

1 - Check lock upper part, replace if necessary or lubricate with "Door and lock lubricant G 4".

2 - Open and close hood several times to check location of upper part and length of pin.

Note

The lock upper part is fitted with an adjustable pin and a safety catch which engages a hole in the lower part of lock when hood is closed.

3 - If necessary, adjust position of lock upper part by moving it in the square holes (arrows) and alter length of pin after loosening the lock nut.

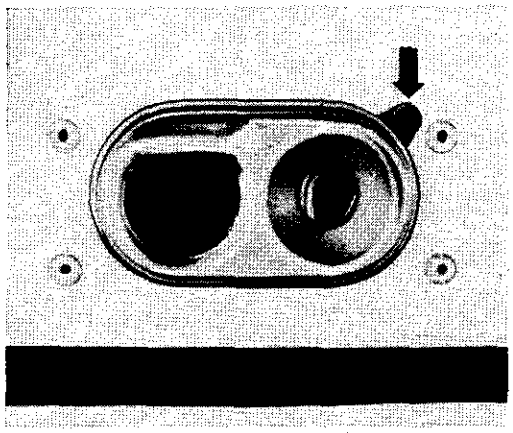
Removing

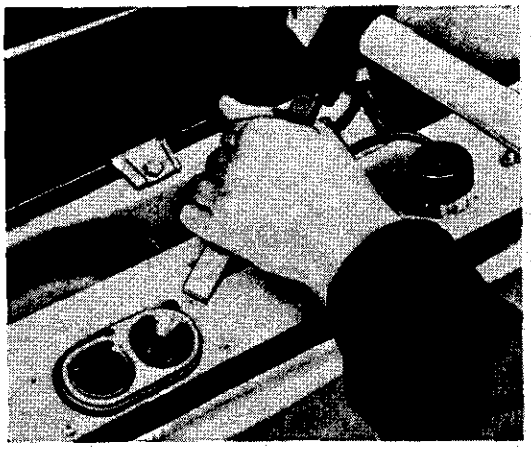
The lock lower part is attached to the lock carrier plate with hollow rivets.

1 - Loosen the Bowden cable clamping screw in the lock plate. An access hole is provided in the lock and lock carrier plate for this purpose (arrow).

2 - Cut the four rivets off with a flat chisel.

3 - Take lock lower part off.

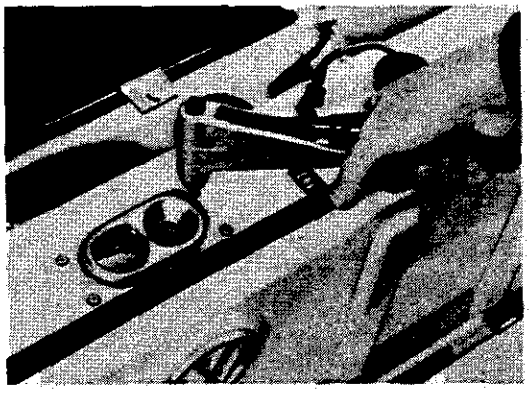




Installing

Check lower part, replace if necessary or grease with "Door and lock lubricant G 4".

When installing a new Bowden cable, grease it lightly before inserting it into the guide tube to prevent rust.



1 - Push cable through the guide in the lower part of lock and attach it to the lock plate temporarily with the clamping screw.

2 - Install lock with rivets or screws.

Note:

Use 4.8 mm diameter hollow rivets or M 5 bolts with washers and nuts.

3 - Loosen Bowden cable clamping screw, pull cable out and tighten screw again. Then bend the end of the cable over behind the clamp.

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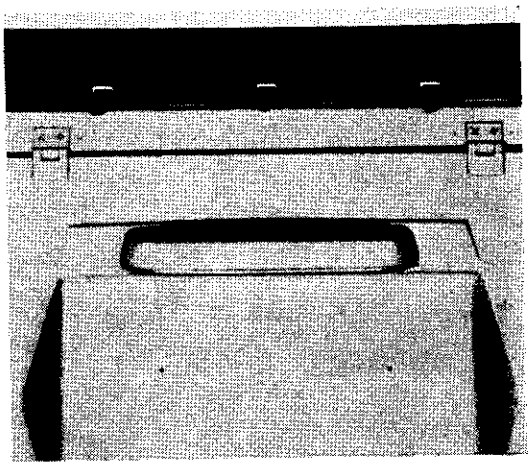
Removing

1 - The hinge screws are removed with the hood closed. If the same hood is being installed again, mark the position of the hinges on the body with a pencil.

2 - Pull wire off license plate light.

3 - Remove two screws from each hinge, open the hood lock and take hood off.

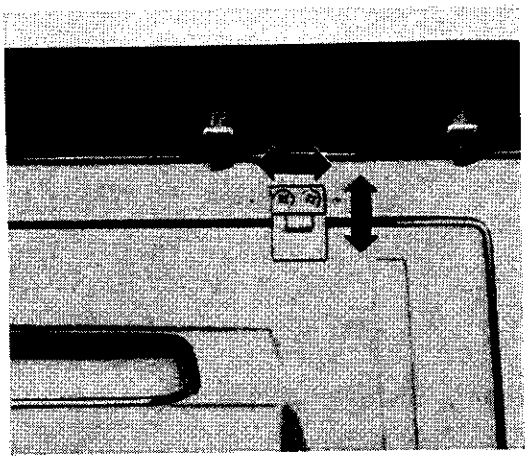


Installing

Before installing hood, check condition of seal. If necessary, glue a new seal on.

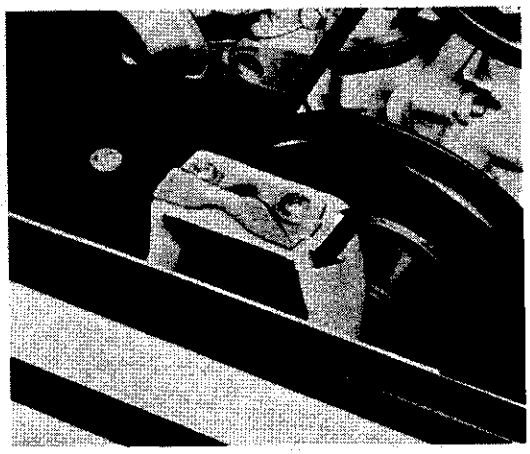
If the same hood is fitted again, align it according to the pencil marks and tighten the screws.

1 - Attach hinges loosely and move hood so that the gap is uniform all around and the hood seals properly. Then tighten screws fully.



2 - Open and close the hood several times to check the position of the lock. If necessary adjust the position of the striker plate by moving it in the elongated holes (arrow).

3 - Connect wire for license plate light.



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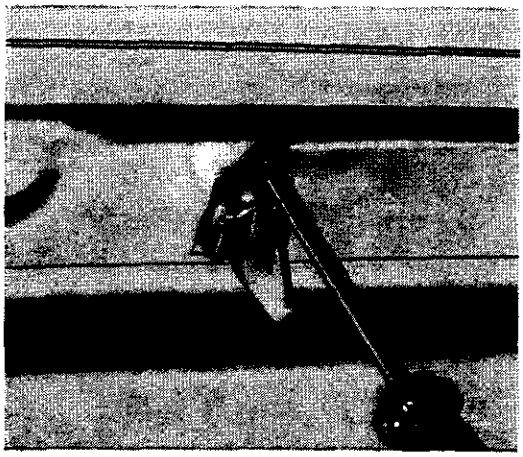


Removing

1 - Open the hood and remove one Phillips screw on the inside of the hood.

2 - Pull lock out.

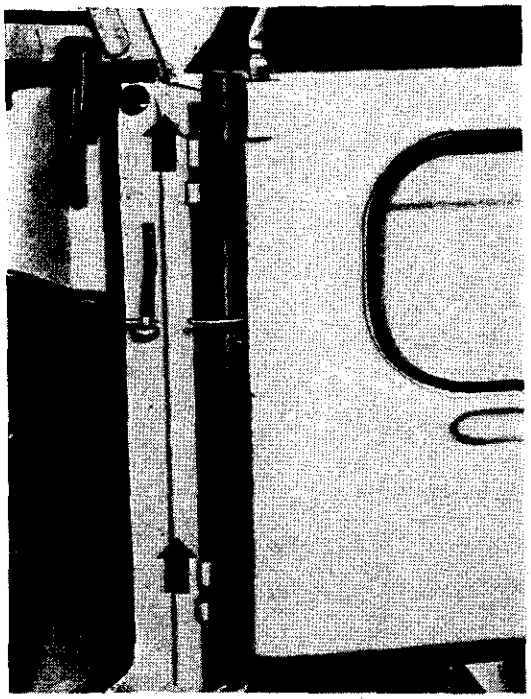
Installing

1 - Check lock and gasket and replace if necessary. Lubricate the moving parts of the lock.

2 - Insert lock into hood.

3 - Insert and tighten Phillips screw.

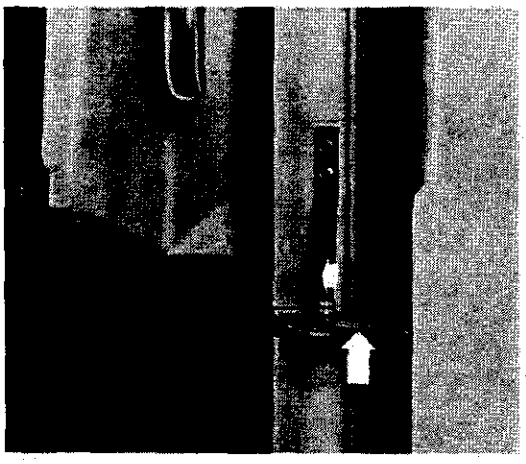
The front and rear doors and hinges are basically the same. These doors are designed so that they can be taken off quickly without tools. All that is necessary is to press in the leaf spring so that the check strap can be taken off the retaining pin. The door is then swung open about 120° and lifted off its hinges. The door is installed in the same way.



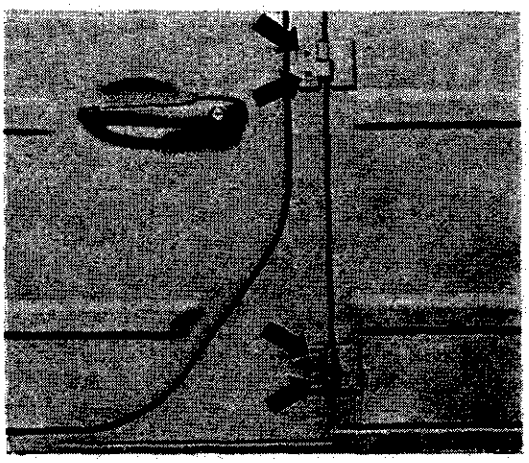
Removing

1 - Press the leaf spring (arrow) in and take check strap off retaining pin.

2 - If the same door is to be installed again, mark the position of the hinges with a pencil.



3 - Remove four Phillips screws and take door off. If the screws are rusted and tight they should be sprayed with a rust solvent and then loosened with an impact screwdriver.



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Installing

1 - Check door weatherstrip and renew if necessary. Glue new weatherstrip on with D 21 adhesive.

2 - If the same door is installed it need only be aligned with the marks made. It is then not necessary to fit the door in the opening.

3 - If a new door is being installed, proceed as follows:

Install door and position it in the body opening so that it contacts the weatherstrip evenly all around and the door can be opened and closed without jamming. When doing this the striker plate should be removed. The door hinges are bolted to movable tapped plates which are located inside the body pillars. This makes it possible to move the door about until it is properly aligned. If the door cannot be aligned with the body outer panels despite this it may be necessary to press the hinges inward or insert packing pieces to move the hinges outward.

4 - Install striker plate again and adjust it so that the top edge of door is in line with the body panels. Make sure that the door is not too far in or out.
Detailed instructions are given in the section "Adjusting striker plate".

5 - Oil hinges.

Lubricating hinges

Remove the small plug (A) and fill the chamber in the hinge with SAE 30 oil.

Oil which drips on to the paint should be wiped off immediately because the additives in the oil can cause discoloration if left on the paint.

Adjusting

Warning

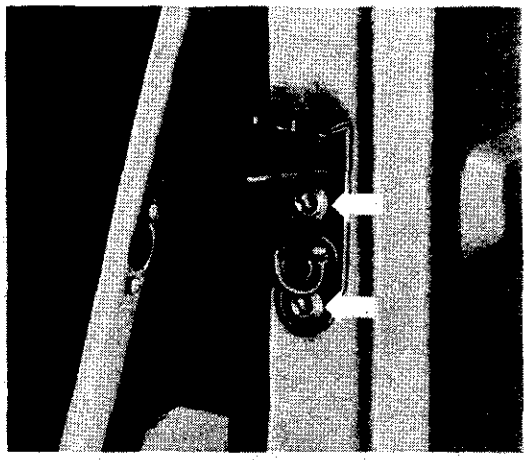
When adjusting the striker plates, the vehicle must not be on a hoist.

To prevent the lock latch moving back and forth due to vibration when the vehicle is driven the striker plate is fitted with a spring-loaded bonded rubber wedge. This wedge is not adjustable.

In isolated cases it may be found that door rattling cannot be entirely eliminated by adjusting the striker plate. In such cases it is necessary to replace the striker plate.

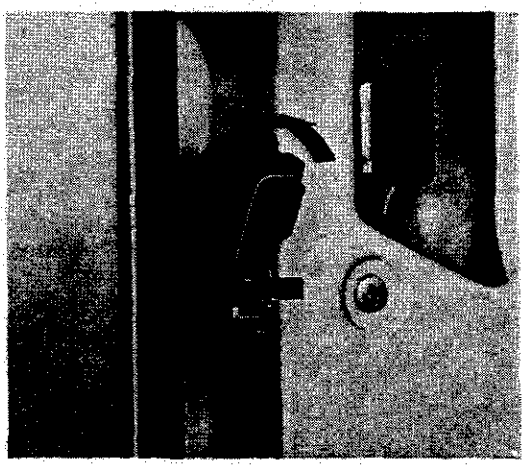
1 - To check if the latch is making good contact with the wedge on the striker plate, proceed as follows:

a - Remove striker plate — two bolts (arrows).

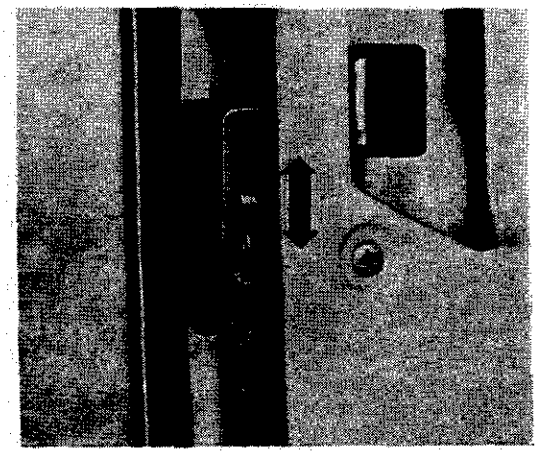


b - Insert striker plate into latch at bottom first, then press latch down fully into locked position.

c - Then swing striker plate upward.



d - If play is felt when moving striker plate up and down in this position, the wedge must be replaced.



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2 - After removing the striker plate, check position of door in door opening as follows:

a - tightness of screws of the hinges.

b - alignment of door with front and rear panels and the center pillar.

c - uniformity of gap between door and door opening.

3 - If these points are not in order, the following operations must be carried out.
Loosen hinges and move door to front, rear, up or down. Then tighten Phillips screws again.

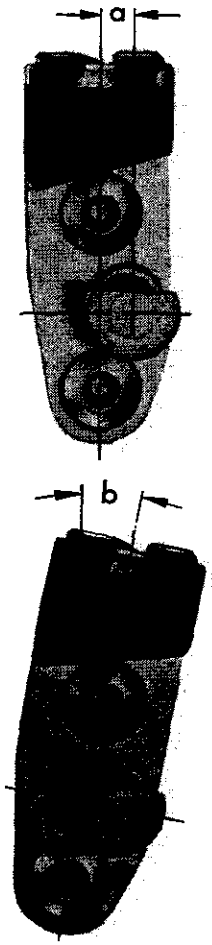
4 - **The door adjustment is correct when:**

a - the door is in line with the front or rear panel and the center pillar.

b - the gap between door and door opening is uniform all around.

c - no play can be felt between lock and striker plate when forcing door in and out with handle.

d - the door can be opened from inside and outside without excessive effort.



5 - **The striker plate position can be corrected as follows:**

a - If the door is difficult to close, the trigger will be hard to operate. This is caused by the striker plate being inclined inward too far.

Remedy
Correct striker plate as shown at "a".

b - If the door springs back to the secondary latching position when slammed instead of closing properly, the striker plate is inclined outwards too far at the top. The door can be opened easily with the trigger.

Remedy
Move striker plate as shown at "b".

c - If the striker plate has been set too high, the door will be difficult to open with the trigger. When it is opened the door will drop slightly instead of remaining parallel to the door opening.

Remedy
Move striker plate down.

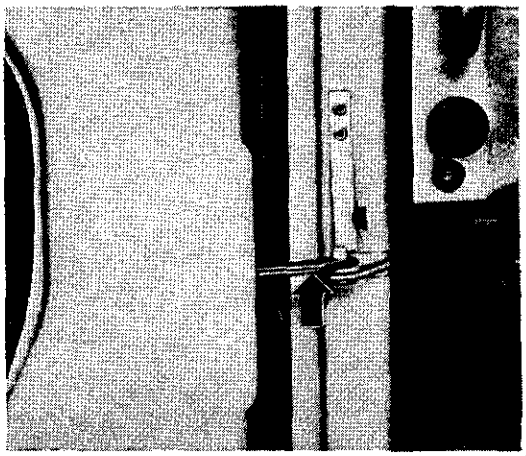
d - If the striker plate has been set too low, the door will spring out of the closed position when slammed shut and merely engage in the secondary latching position.

Remedy
Move striker plate up.

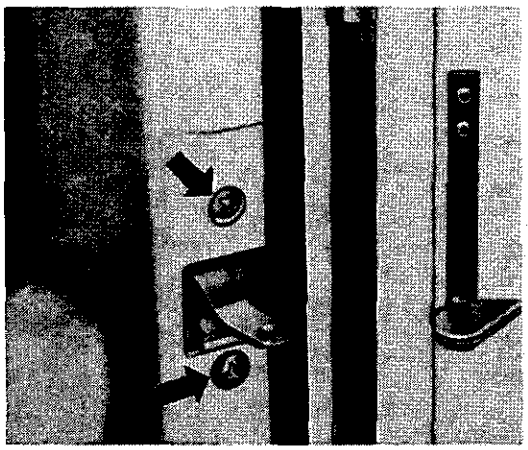
The check strap consists of a rod with a rubber buffer and a supporting bracket. In the door reinforcement there is a welded-on stop plate which the buffer contacts when the door is opened. On the body, the check strap fits over a small pin on a bracket and is secured with a leaf spring.

Removing

1 - Press the leaf spring in and take strap off the pin.



2 - Remove two Phillips screws (arrows) in door end face and take check strap out inward.



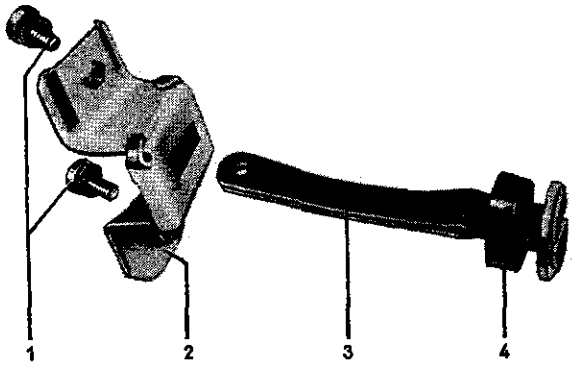
Installing

1 - Screws and spring washers
2 - Bracket
3 - Strap
4 - Buffer

1 - Check the strap and buffer and replace if necessary.

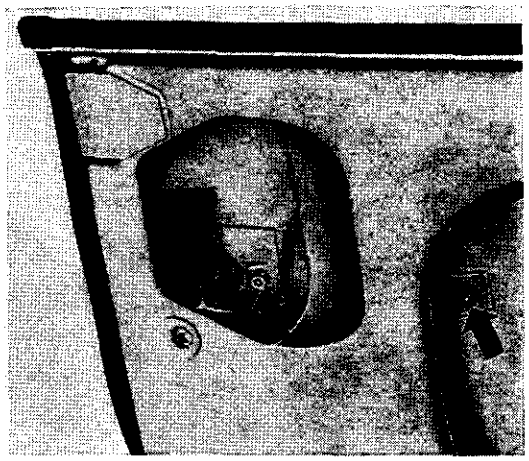
2 - Insert the check strap into the door so that the curved side is inward.

3 - Hook strap on to the retaining pin.



Removing

Remove two socket head screws (arrows) with an Allen wrench.



Installing

1 - Check gaskets and replace if necessary.

2 - Place handle in door.

3 - Insert screws loosely first, check position of gaskets and then tighten screws.

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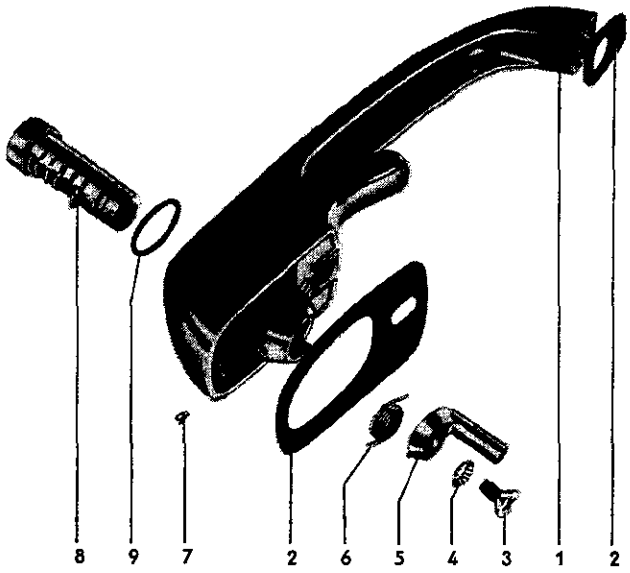
The lock cylinder is fitted in the door handle. To remove the lock cylinder the door handle must be taken off.



No.	Description	Qty.	Note when removing	Note when installing	Special instructions see
1	Door handle	1			
2	Gasket	2			
3	Phillips screw	1		check, replace if necessary	
4	Lock washer	1		check, replace if necessary	
5	Operating pin	1			
6	Spring	1			
7	Setscrew	1			
8	Lock cylinder	1		lubricate with "Door and lock lubricant G 4"	
9	O-ring	1			

Removing

1 - Remove screw and lock washer and take operating pin off lock cylinder.

2 - Take spring off cylinder.

3 - Turn the small setscrew in handle out until the lock cylinder can be pressed out.

Installing

1 - Place key in lock cylinder, fit O-ring and push cylinder into door handle.

2 - Insert setscrew to secure lock cylinder.

3 - Install spring on lock cylinder. The ends of the spring must be under tension against a lug on the handle.

4 - Fit operating pin on square end of lock cylinder and secure with screw and lock washer.

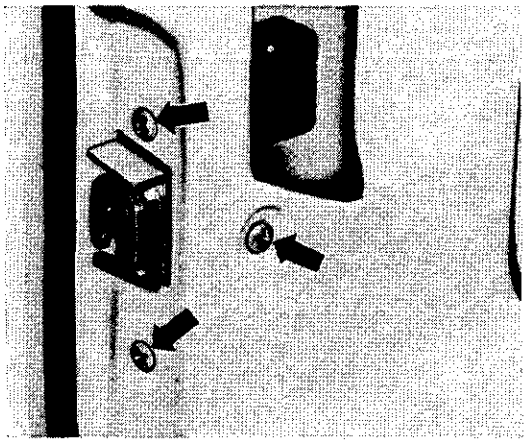
5 - Install handle on door complete with gaskets.

To remove the lock, the door handle must be taken off first.

Removing

1 - Move locking handle to vertical position and remove three Phillips screws.

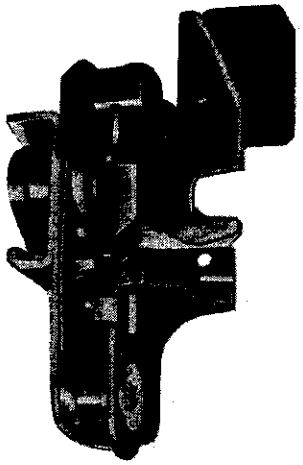
2 - Take lock out downward.



Installing

1 - Check lock for wear and replace if necessary. Lubricate all moving parts with "G 4" lubricant.

2 - Install lock with latch vertical, install door handle and check operation of all parts.



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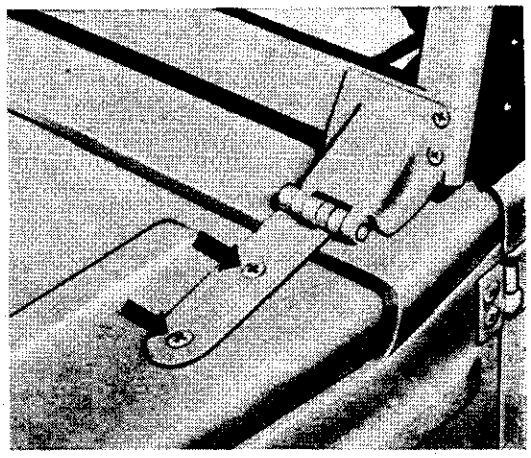
Removing

1 - If a new windshield is to be installed, remove the windshield wiper, sun vizors, interior mirror, etc.

2 - Remove screws attaching hinge to front hood.

Note

Mark position of hinge with a pencil first.

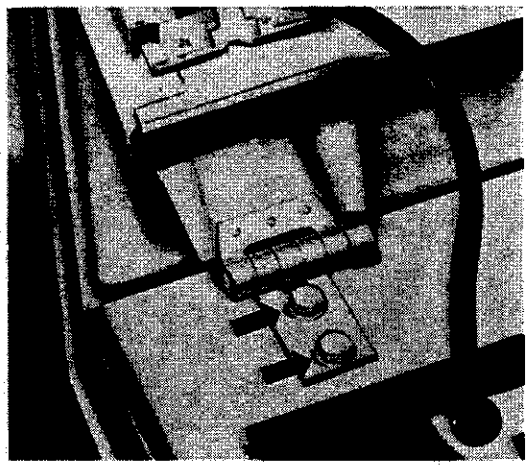


3 - Fold windshield down and remove screws attaching hinge to cowl panel.

Note

Mark position of hinge with a pencil first.

4 - Lift windshield off carefully (two mechanics if possible).



Installing

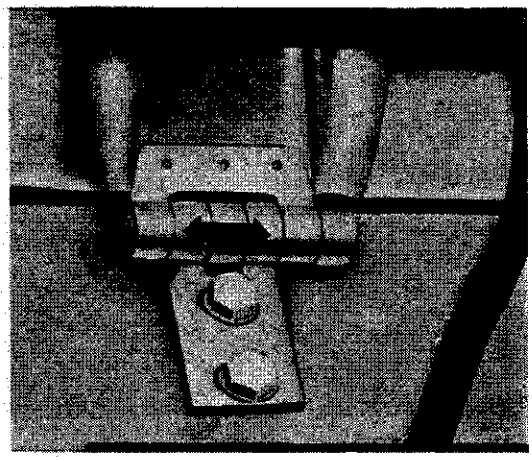
1 - Install windshield on cowl panel and attach hinge to front hood.

2 - Align hinge with the marks made and tighten screws.

3 - Install windshield wiper, sun vizor, interior mirror, etc. on windshield.

4 - Check location of windshield with top and doors closed. If necessary move hinges in elongated holes.

5 - Check location of front hood.



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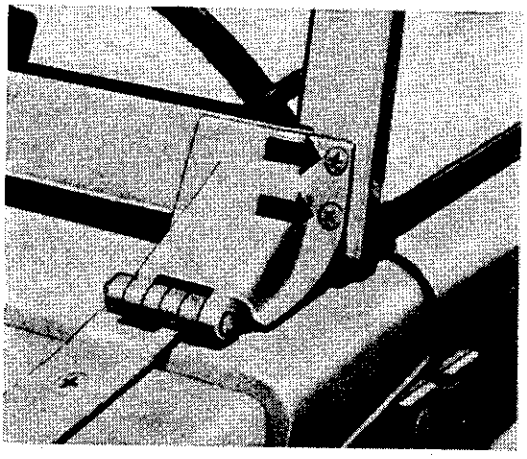
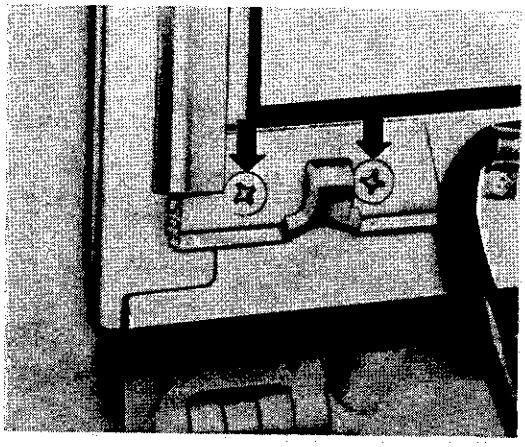
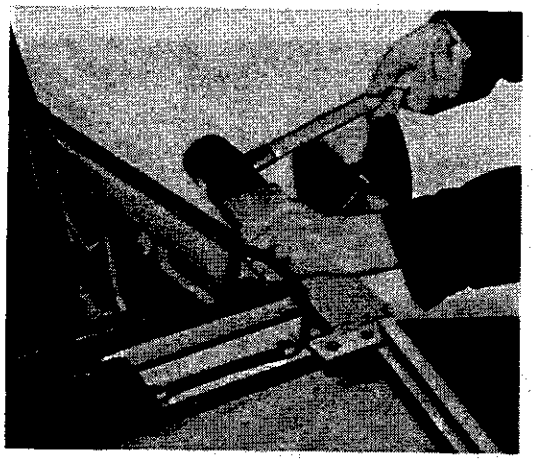


Removing

1 - Remove two Phillips screws on each side of windshield.



2 - Fold windshield down and remove two Phillips screws on each side.

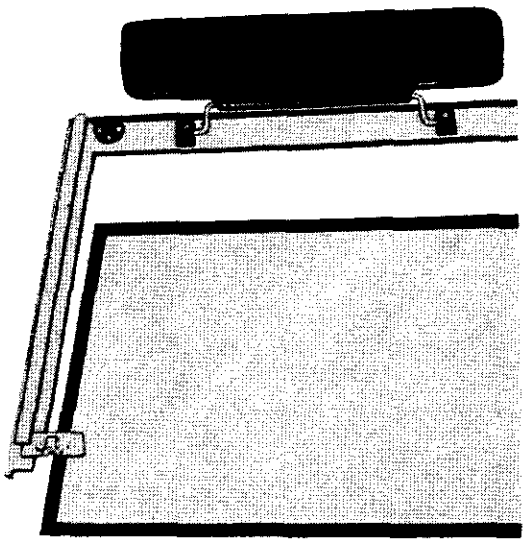


3 - Knock upper part of windshield frame off carefully with a rubber hammer and a block of wood.

Note

This operation should be performed by two mechanics. The front hood should be covered to prevent damage.

4 - Pull glass out of frame complete with rubber seal.



Installing

Note

When installing the glass, ensure that the makers and VW signs are at the upper left corner.

1 - Check seal and replace if necessary.

Coat the seal with talcum powder or glycerine to make it easier to install.

2 - Push glass and seal into frame upper part.

3 - Place upper part of frame in lower part and insert screws.

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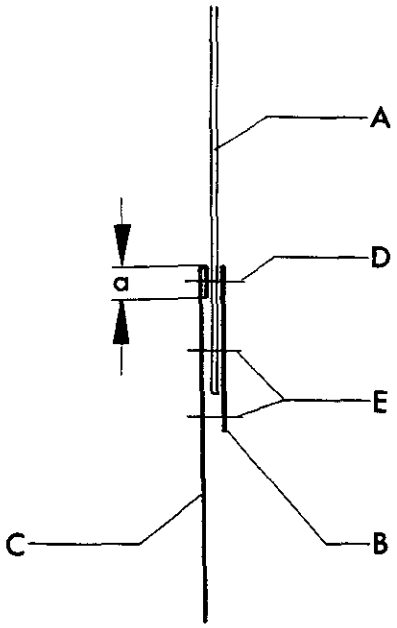


A - Rear window
B - Surround
C - Top material
D - Stitched seam
E - High-frequency welding

a = 8 mm (5/16 in.)

Repair instructions

1 - Take top cover off vehicle (see A 13.3/1).

2 - Cut the stitches of the seam around the window with a sharp knife. Take care not to cut the top material when doing this. Then pull the stitches out.

3 - Part the high-frequency welding between top material and rear window surround carefully with a plastic wedge and take out remaining pieces of Polyglas.

4 - Coat area where window makes contact with acetone adhesive and let it dry.

5 - Fold edge of window opening in about 8 mm (5/16 in.) all around.

6 - Insert window, position it and secure the folded edge with pins.

7 - Sew rear window and surround to the top with nylon thread.

8 - Seal the stitched seam in the surround.

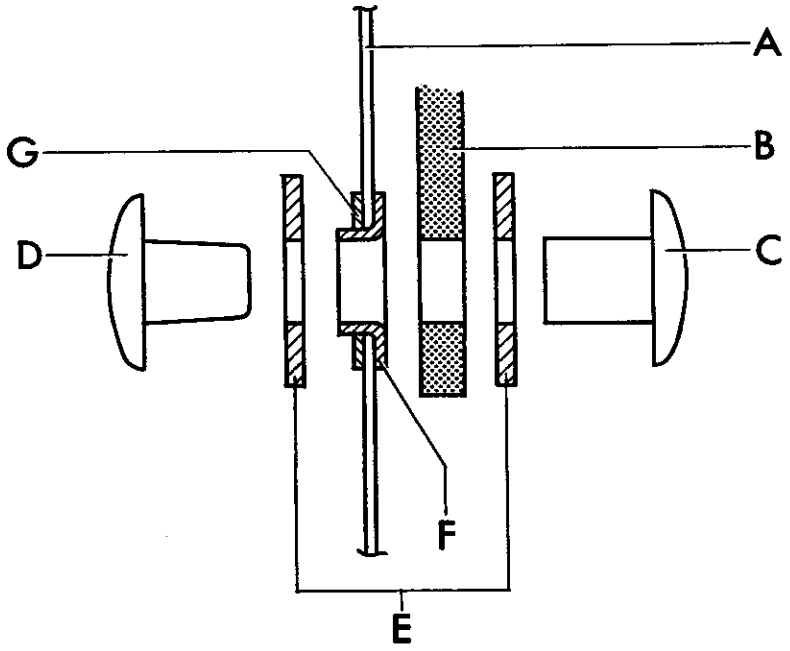
9 - Install top on vehicle.

Repair instructions

The parts for the front detachable windows are available under the following part numbers.

181 837 821 Fastener, upper for left window and lower for right window (see Parts List for colors).
181 837 822 Fastener, lower for left window and upper for right window (see Parts List for colors).
181 837 825 Rivet with window and eyelet.

Where damaged windows can be repaired, use these parts.



A - Vinyl (PVC) window
B - Fastener
C - Rivet, outer part
D - Rivet, inner part
E - Washer
F - Eyelet
G - Washer

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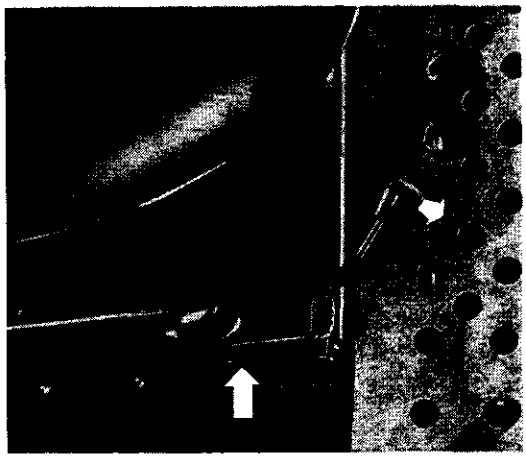
Removing and installing front seat

Lift seat retaining lever and push seat forward until the spring on the left side of the seat frame can be unhooked. Then release leaf spring (arrow) and push seat forward off the runners.



Note

When interchanging the front seats, remove the adjusting knobs and change them over to the other side. The adjusting knob with the lever must be on the outside.

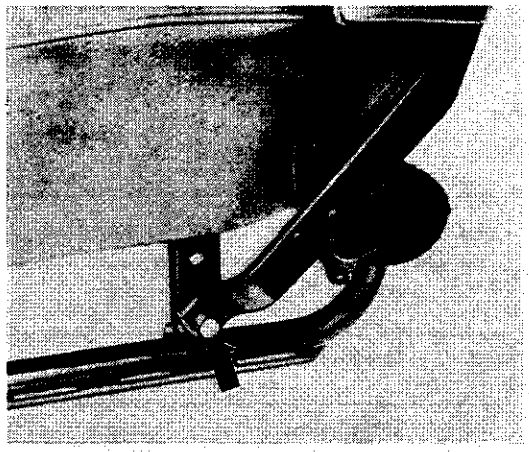
Before installing the seats, clean the runners, remove any burrs on runners and lightly grease them again.

Removing and installing front seat backrest

Removing

1 - Remove cap nut on each side.

2 - Pull the seat frame off the studs and take backrest off.



Installing

1 - Press frame ends apart and install them on the studs.

2 - Attach nuts and tighten them.

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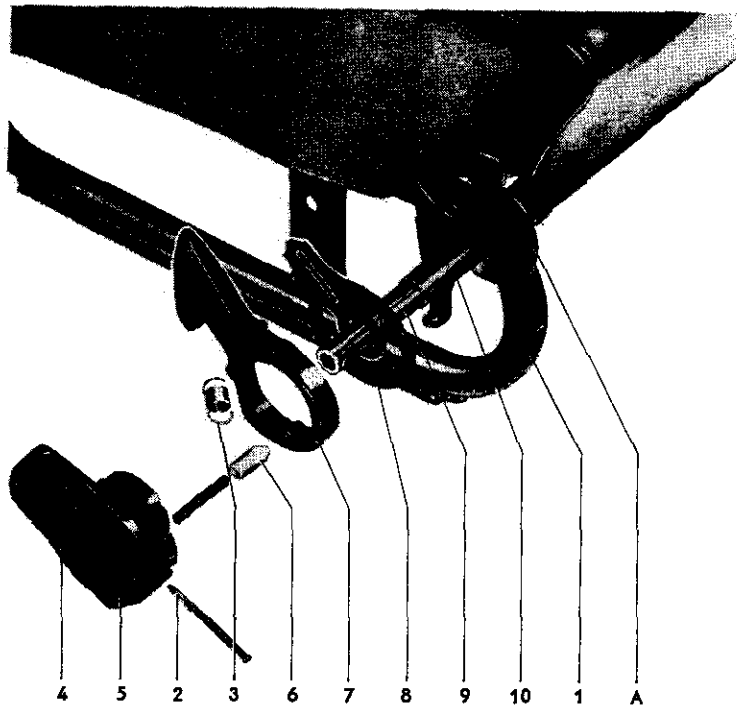


No.	Description	Qty.	Note when removing	Note when installing	Special instructions see
1	Seat frame	1			
2	Threaded nail	2			
3	Spring for lock	2		check tension, replace spring if necessary	
4	Adjusting knob, outer, with lever (inner, without lever)*)	1 (1)			
5	Spring for pin	2		check tension, replace spring if necessary	
6	Pin	2		check, replace if necessary	
7	Backrest lock hook outer (Backrest lock hook inner)*)	1 (1)			
8	Hook operating plate	2		grease	
9	Connecting tube for adjusters	1		grease	
10	Connecting tube for locking hooks	1		grease	
A	Stop washer for pin	2			

*) Parts shown in brackets are different.

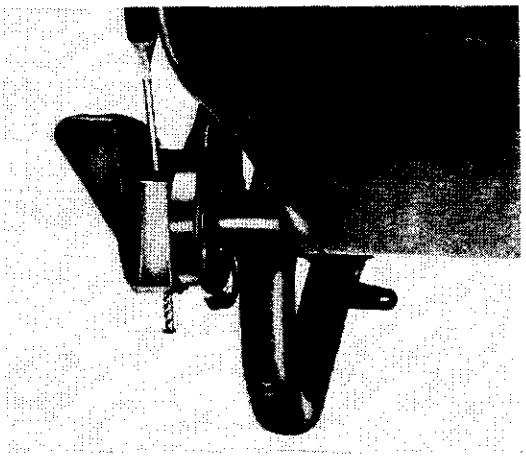
Removing

1 - Knock the threaded nail out of the outer adjuster with a punch and take adjuster off connecting tube.

2 - Pull tube out complete with adjuster on opposite side.

3 - Take hook operating plates off connecting tube.

4 - Pull locking hook connecting tube out.



Installing

Before installing, lightly coat all moving parts with universal grease.

1 - Insert locking hook connecting tube into seat frame tube.

2 - Place operating plates on the connecting tube correctly aligned.

3 - Insert adjuster connecting tube into operating plate connecting tube complete with adjuster and locking hook for one side.

Caution

Make sure that the lug on the hook engages the operating plate. Do not forget the pin and spring.

4 - Install hook and adjuster on the other end of tube. Make sure that the lug on the hook engages the operating plate.

5 - Align second adjuster with first and secure it to the connecting tube with the threaded nail.

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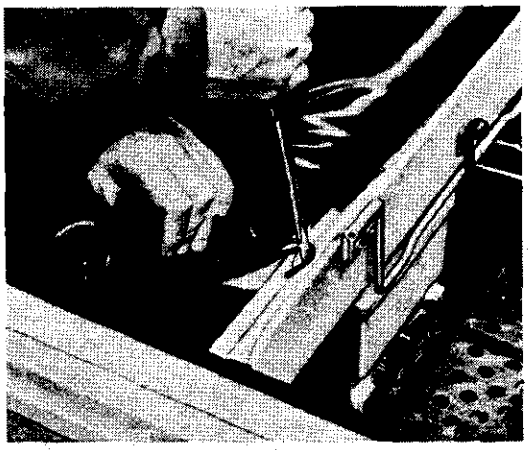
Removing and installing rear seat

Removing

Unhook the springs (in the cushion) from the retaining tabs on both sides.



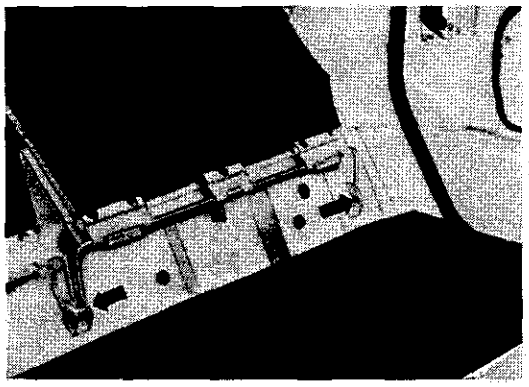
Installing

When installing the seat, hook springs at rear first and then at the front.

Removing and installing rear seat backrest

Removing

Remove screws and washers from backrest brackets.



Installing

1 - Check the brackets and oil lightly.

2 - Secure with the screws.

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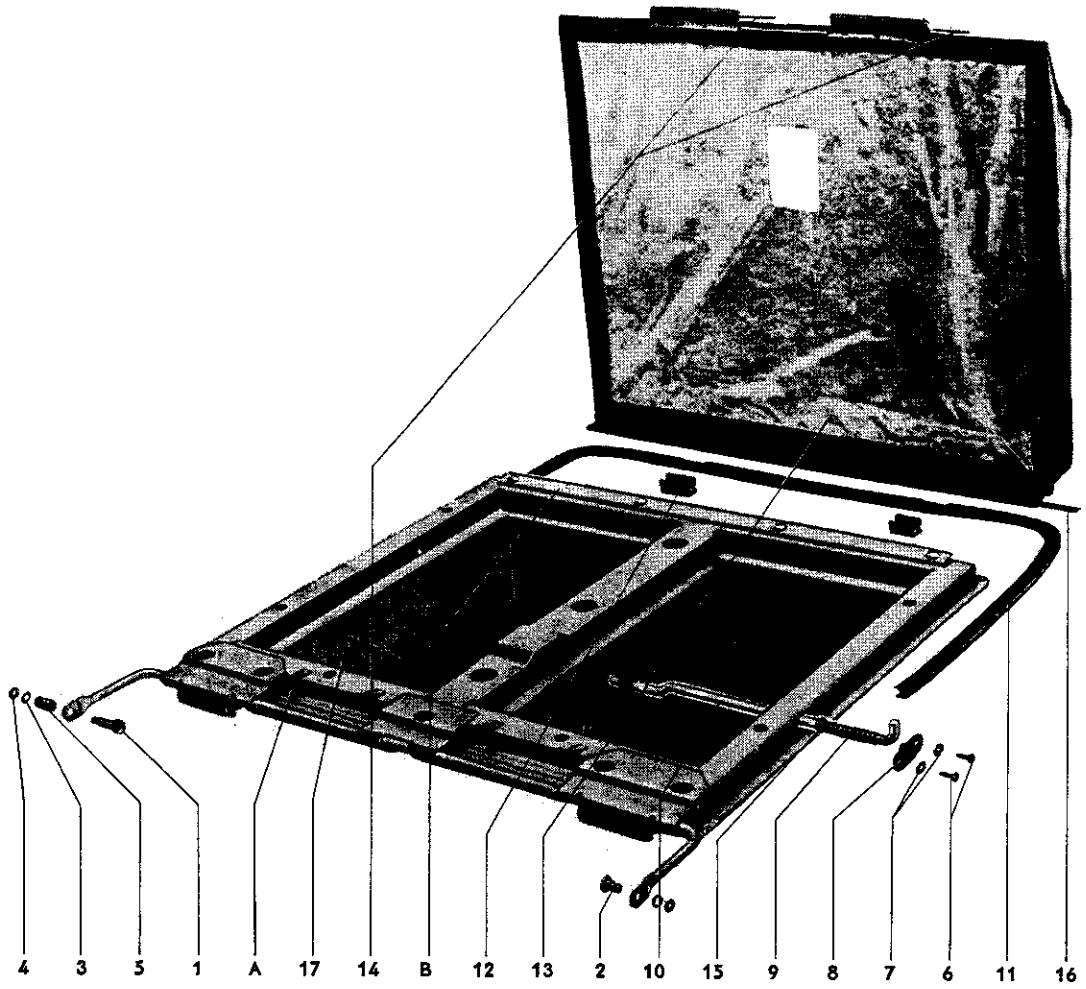


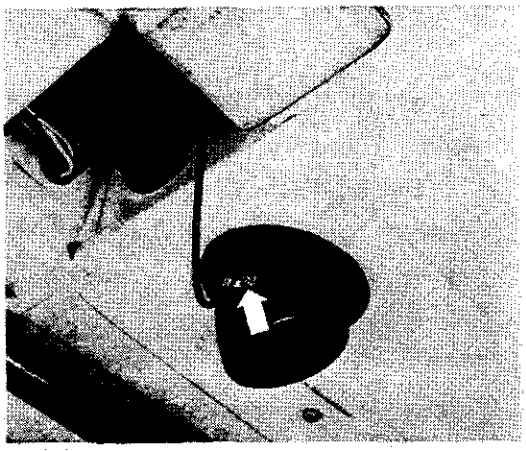
No.	Description	Qty.	Note when disassembling	Note when assembling	Special instructions see
1	Threaded pin	1		check, replace if necessary	
2	Threaded pin	1		check, replace if necessary	
3	Washer	2		check, replace if necessary	
4	Nut	2		check, replace if necessary	
5	Bushing	1			
6	Phillips screw	2		check, replace if necessary	
7	Washer	2		check, replace if necessary	
8	Plate	1			
9	Spring	1		check, replace if necessary	
10	Locking bar	1			
11	Protective strip	1			
12	Rubber for clip	2		check, replace if necessary	
13	Backrest padding	1			
14	Retaining rod	2			
15	Washer	1		check, replace if necessary	
16	Cardboard strip	1		check, replace if necessary	
17	Rear panel	1			
A	Clip	4	bend up	bend down	
B	Retaining strip	1	bend up	press together	

Removing

1 - Remove Phillips screw.
(Retaining nut falls off.)

2 - Remove footwell outlet.

3 - Detach Bowden cable on heater flap.



Installing

1 - Install outlet.

2 - Adjust regulating lever.

3 - Close heater flaps. Pull regulating lever to "closed" position also, and tighten Phillips screw of Bowden cable clamp.

4 - Check operation of outlet.

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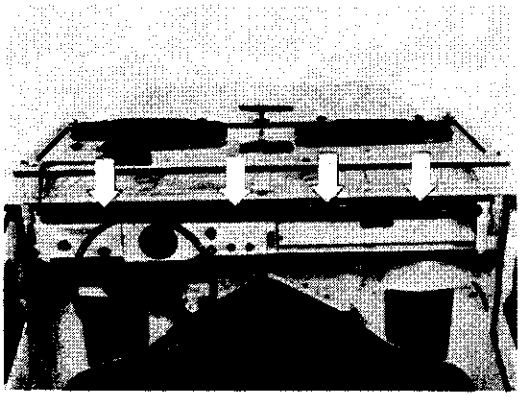

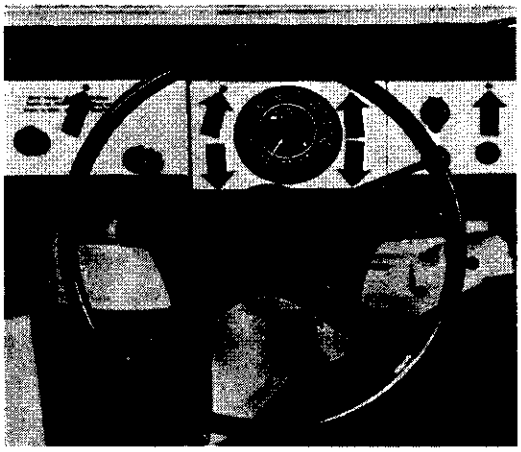

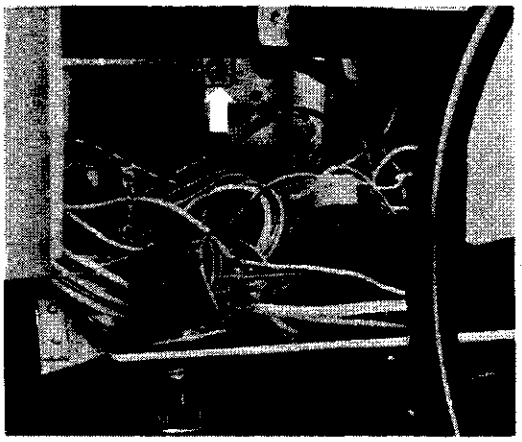

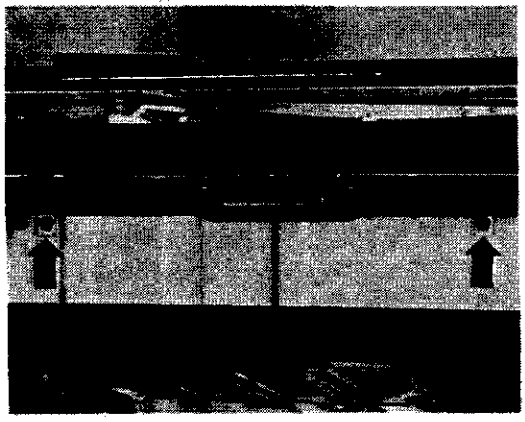

Removing

1 - Fold windshield forward.

2 - Remove four Phillips screws (arrows) from the upper edge of the instrument panel.

Caution

Before performing further work on the instrument panel and particularly on the electrical components, disconnect the battery ground strap.

3 - Remove screws in instrument panel cluster (arrows).

4 - Disconnect speedometer cable and remove steering column tube bolts under the luggage pan.

5 - Parts of the electrical system which prevent access to the left defroster vent should be disconnected or removed.

6 - Remove three Phillips screws in the retaining bracket.

a - One screw (arrow) behind the left cluster.

b - Two screws (arrows) in glove compartment.

7 - Pull heating air elbow off the heater connecting pipe and the left defroster vent.

8 - Pull right defroster vent off the left vent and take it out through the parcel shelf.

9 - Take left vent out to the left carefully while pressing the steering wheel down slightly.

Installing

1 - Install left defroster vent in the instrument panel.

2 - Slide right vent on the left vent.

3 - Install the four Phillips screws at the upper edge of the instrument panel.

4 - Install the Phillips screws with washers in the retaining bracket.

Note

When tightening the screws make sure that the openings of the defroster vents are lined up with the slots in the instrument panel.

5 - Install electrical components and connect speedometer cable.

6 - Install instrument panel clusters.

7 - Connect battery ground strap and check operation of electrical system.

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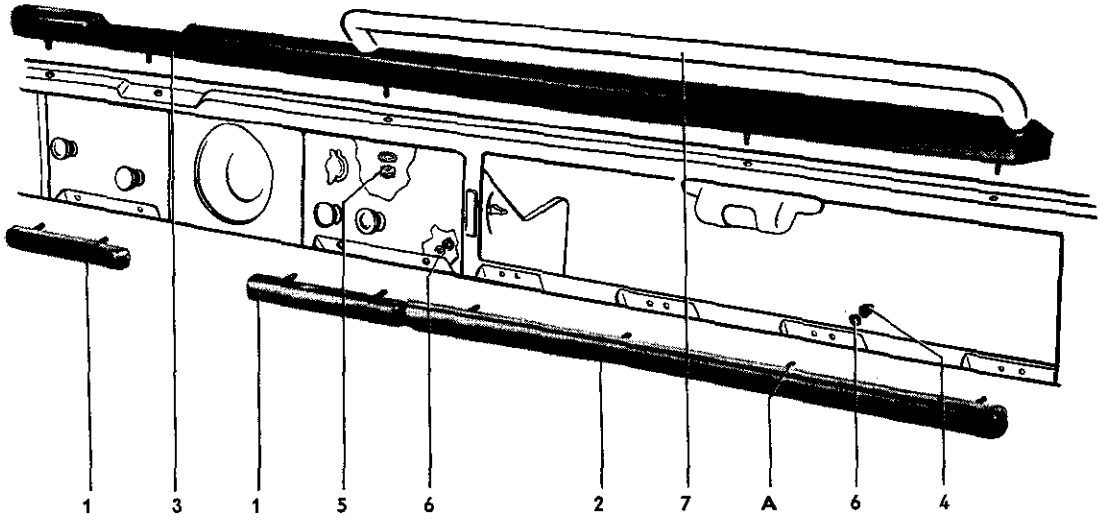

No.	Description	Qty.	Note when removing	Note when installing	Special instructions see
1	Pad	2			
2	Pad	1			
3	Pad	1			
4	Cap nut	4			
5	Nut	9			
6	Washer	13			
7	Grab handle	1			
A	Studs	13		recut threads if necessary	

Removing

1 - Fold windshield forward.

2 - Remove screws holding instrument panel clusters and swing down.

3 - Remove nuts from pad studs.
(Do not remove nuts of grab handle.)

Installing

1 - Check studs in pads.

2 - Install pads. Make sure that they are parallel to each other.
(Do not forget the washers.)

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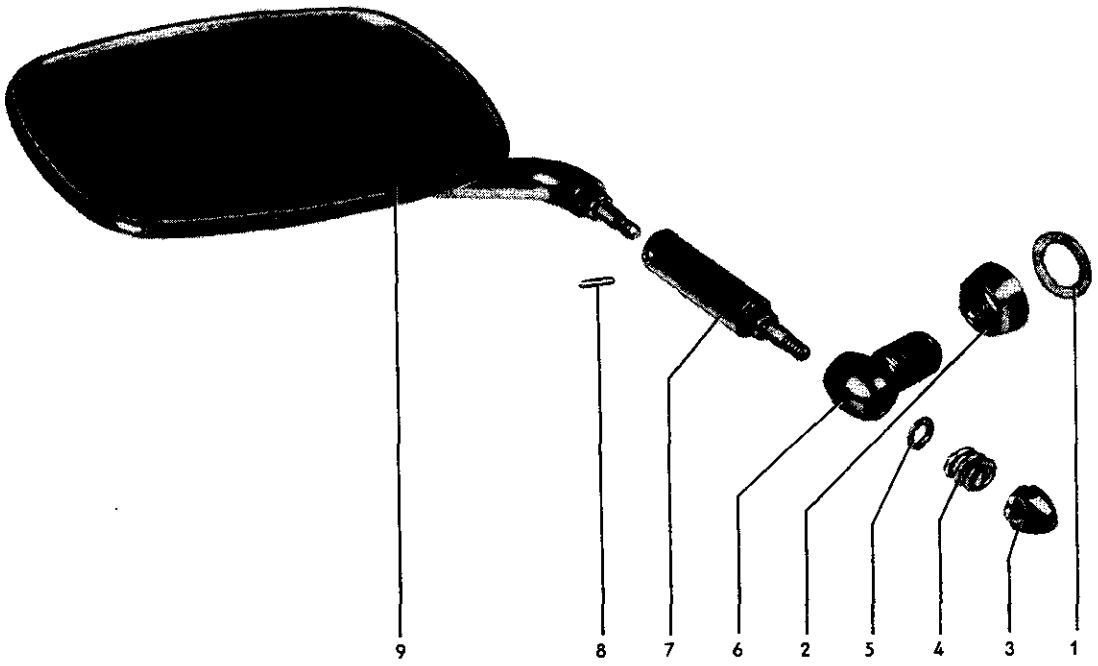


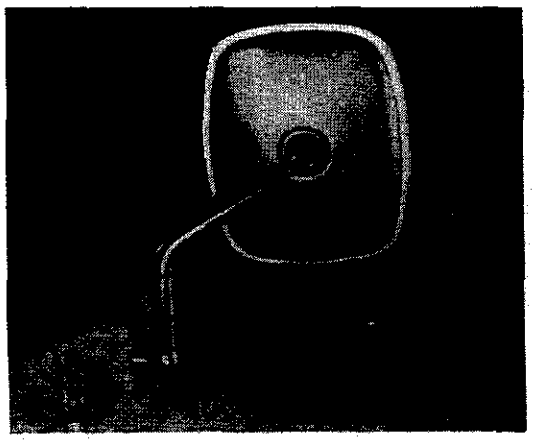
No.	Description	Qty.	Note when removing	Note when installing	Special instructions see
1	Plastic ring	1		check, replace if necessary	
2	Union nut	1			
3	Cap nut	1			
4	Spring	1		clean, grease lightly	
5	Special washer	1			
6	Mirror socket	1		clean, grease taper and thread lightly	
7	Adaptor	1		clean, grease taper lightly	
8	Pin	1			
9	Mirror	1		clean taper and thread, grease lightly	

To remove the mirror, screw the mirror socket out of the door panel.

Before installing mirror, check that the two joints move freely.

Note

Do not forget the plastic ring when installing the mirror.



Description of top

The top frame is made up of two lateral frames joined together with two transverse bows. The complete frame is attached to the rear side panels at the main hinges.

The top cover is made of durable, weather resistant vinyl (PVC) material.

At the front the cover is attached to the header with hollow rivets and at the rear it is secured by eyelets in the cover which fit over loops on the body and are held by small straps sewn to the top cover.

When down, the top can be taken off the body quickly after detaching the cover at the rear and pushing out the pins in the main hinges.

When open, the top cover should always be secured with the two end covers supplied with the vehicles. This will prevent the cover from tearing due to flapping when the vehicle is moving and stop friction marks which spoil the appearance of the cover.

Care of the top cover

The special vinyl (PVC) top cover does not require any particular care. It is however important to clean the top promptly and regularly.

After driving for a long time on dusty roads, the top should be wiped clean before being lowered otherwise the sharp dust particles will damage the surface of the vinyl (PVC) material and cause friction marks.

Lubricate the hinges if necessary.

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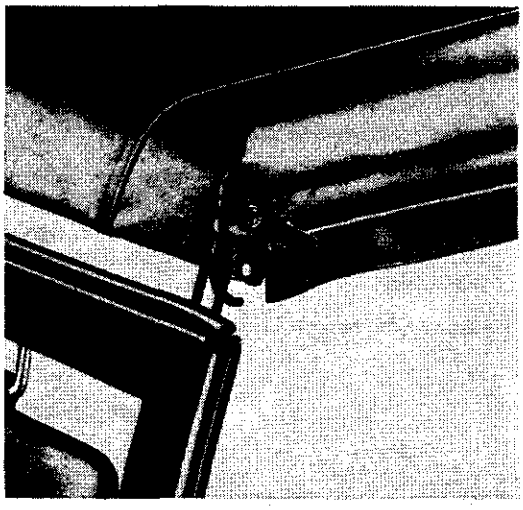
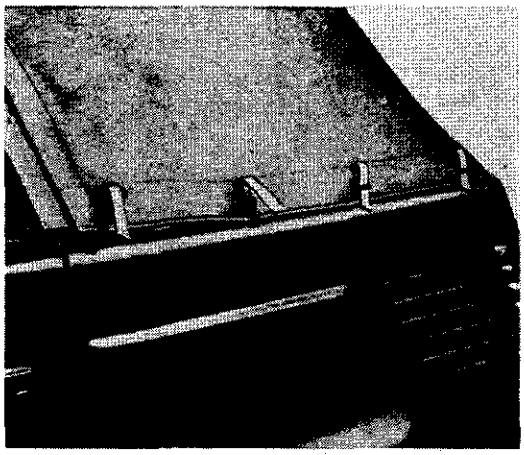


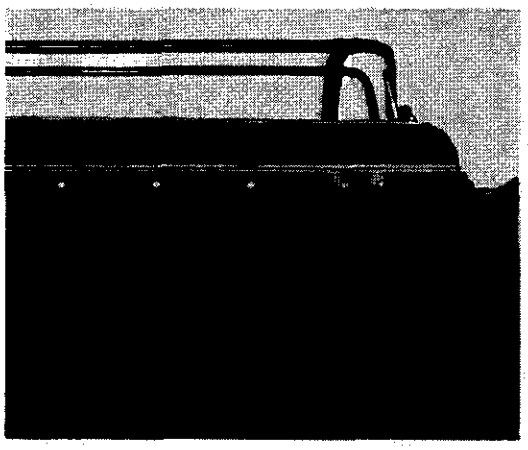
Removing

1 - Remove two chrome plated Phillips screws at the sides of the header.



2 - Detach top cover at the rear by pulling out the straps.

3 - Pull top cover forward over the frame.



4 - Grind off the rivet heads in the header.

5 - Take off top cover complete with inner plate.

6 - Take outer plate off the header with the remaining parts of the rivets.

Installing

Before installing the top cover, it is advisable to check the condition of the connecting straps. If they are damaged they should be replaced.

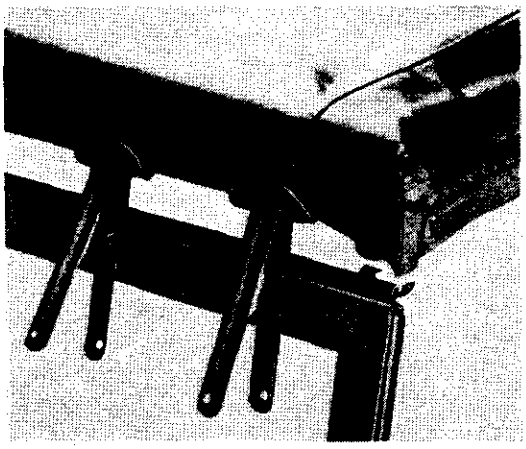
At the same time the paint on the frame should be examined, particularly on the header. The frame should be touched up with synthetic resin paint. The joints of the frame should be oiled lightly with SAE 30 oil after cleaning off all dirt and dust.

1 - Attach top cover at the rear, pull it forward firmly and secure it temporarily with clamps.

2 - Rivet the top cover to the header together with the inner and outer plates using a few hollow rivets.

Note

Use hollow rivet N 13 528 4 (head) and N 13 506 4 (rivet).



3 - Close the top and check that the top cover is uniformly tensioned and free of creases.

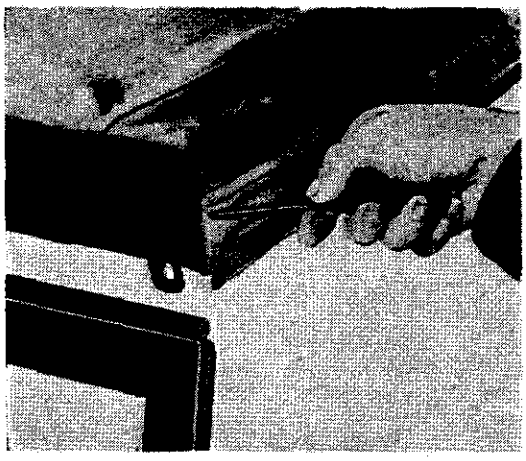
If necessary the location of top cover on the header must be rectified.

4 - Insert remainder of rivets securing top to header. Cut surplus material off.

Caution

Do not cut into the parts of the top cover which can be seen from outside. The cover cannot be glued together and would have to be discarded.

5 - Make holes in the side of the top cover at the header as shown and install two chrome-plated screws.



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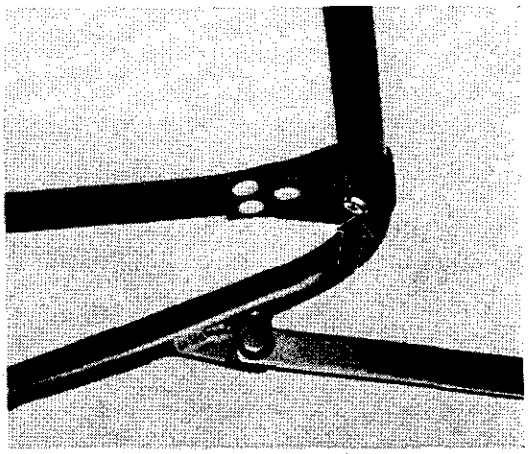
The connecting straps are made of cotton reinforced with hemp thread. Straps of synthetic materials can be used as replacements.

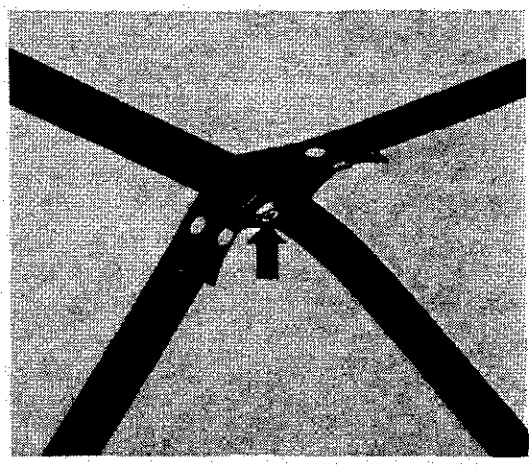
Removing

The straps are detached at the following points by cutting them or by removing Phillips screws:

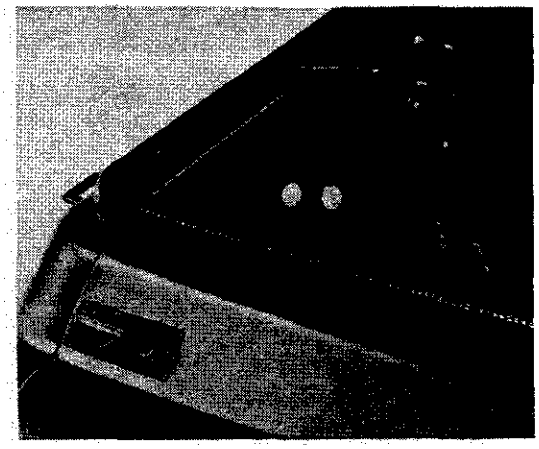
a - remove the Phillips screw (arrow) on each side of the front bow and cut the strap.



b - remove screw (arrow) on each side of the rear bow and cut the strap.



c - cut the straps at the rear of body on each side.



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Installing

Cut the straps and securing strips to size:

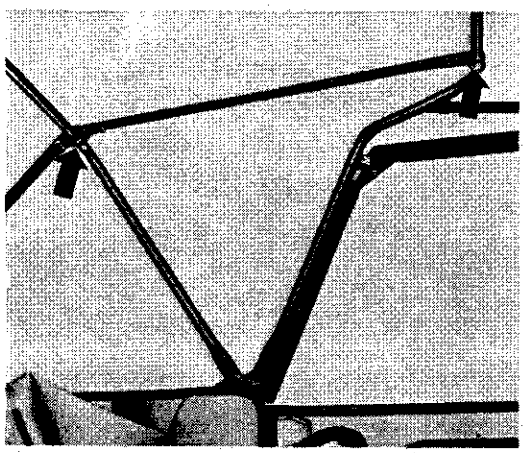
Thickness of material	3 mm	(1/8 in.)
Width of material	35 mm	(1 3/8 in.)
Length of strap	1520 mm	(59 27/32 in.)
Length of securing strips	110 mm	(4 11/32 in.)

If synthetic material is used, the cut ends should be singed to prevent the material from fraying.

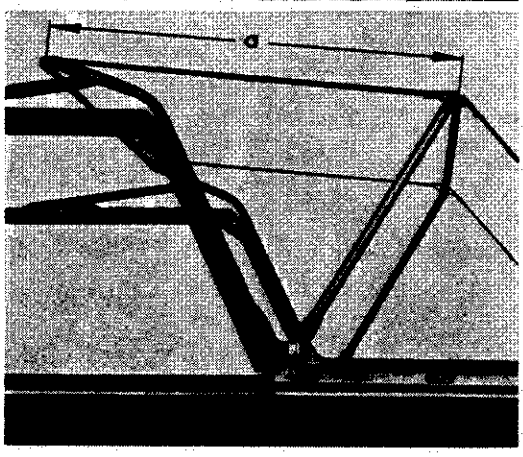
Cotton should be lightly coated with plastic adhesive.

Caution

The connecting straps and securing strips can only be installed properly with the roof closed.

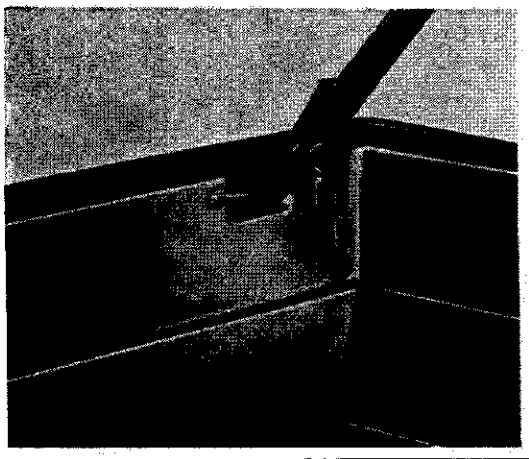


1 - Secure straps on front bow with two rivets — N 13 520 4 (head), N 13 510 4 (rivet) and a Phillips screw each (arrows).



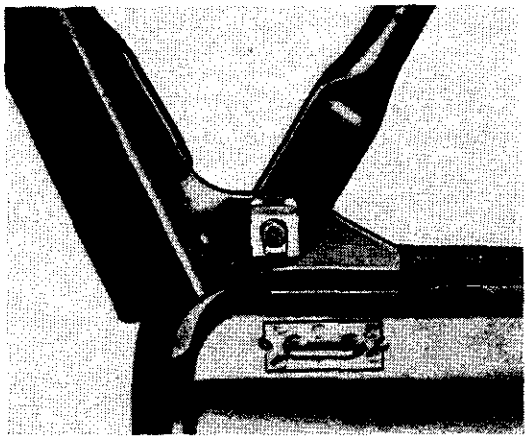
2 - Set the rear bow to the dimension given and secure the strap by riveting the short strip on with four rivets and inserting the Phillips screw.

Dimension a = 695 mm (27 3/8 in.)



3 - Pull strap tightly to the rear and attach it to the loop on the rear panel with two rivets.

The top frame is attached to the body by means of two brackets and the connecting straps.



Removing

1 - Detach top cover from body at rear.

2 - Remove the rivets securing the connecting straps to the body at the rear.

3 - Remove the clips from the pins in the brackets.

4 - Lift top frame off complete.

Installing

1 - Install frame on the pins and secure it with the clips.

2 - Rivet the connecting straps.

3 - Lubricate the frame pivots with SAE 30 oil as required after removing all dust and dirt.

Body dimensions

General instructions:

The specified basic dimensions shown on the following pages for repairing bodies sections, were obtained in a series of measurements made with a caliper gauge.

The general tolerance is ± 2 mm (1/16 in.).

Dimensional checks in the workshop can be carried out with other appropriate measuring instruments.

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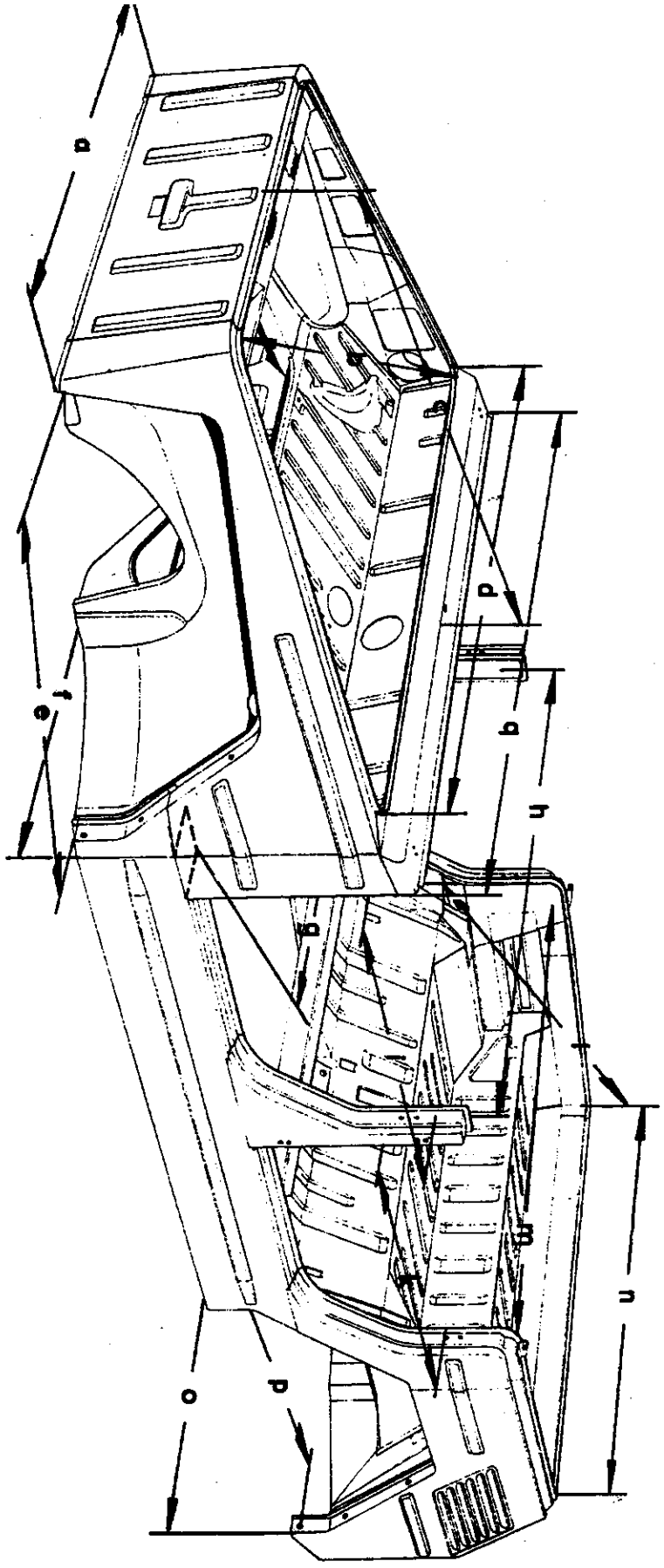
A18.5 Basic Dimensions Type 1, Model 181



Front end

	Dimension	mm (in.)	Remarks	Fig.
a	Between side panels	969 (38⁵/₃₂)	Measured in front of the fender mounting	1
b	Luggage compartment opening, between centers of flange radii	1479 (58¹/₄)	Diagonally	2
c	Between bent edge of cowl to upper edge of front apron	1103 (43³/₈)	Measured direct	3
d	Between the intersecting edges spot welded flange/cowl panel support	1371 (54)	Wide luggage compartment opening	4
e	Between the two lower securing points of the front fender	954 (37⁵/₈)		5
f	Between the side panels	1495 (59)	Measured at the profile bend	6
g	Between the hinge pillars	1349 (53¹/₈)		7

Interior

	Dimension	mm (in.)	Remarks	Fig.
h	Between center pillars	1368 (53²⁷/₃₂)	Measured between inside surfaces	8
i	Between hinge pillar and center pillar	727 (28⁵/₈)	Measured at the outer edge of the flange	9
k	Between the center pillar and rear side panel	727 (28⁵/₈)	Measured at the outer edge of the flange	10
l	Between instrument panel/hinge pillar joint and the corner of the rear shelf	2564 (100³¹/₃₂)	Measured diagonally. Measuring point: Corner 10 mm (³/₈ in.) above the flange	11/12

Rear end

	Dimension	mm (in.)	Remarks	Fig.
m	Between front of rear side panels	1365 (53³/₄)	Between inner surfaces	13
n	Between rear of rear side panels	1248 (49¹/₈)	At spot weldet flanges where radii end	14
o	Between rear of rear side panels	1302 (51¹/₄)	At the lower edge of the side panels — fender mounting point	15
p	Between the lower securing points	981 (38⁵/₈)		16
q	External distance between side panels at end of cowl panel	1495 (59)	Horizontally	17

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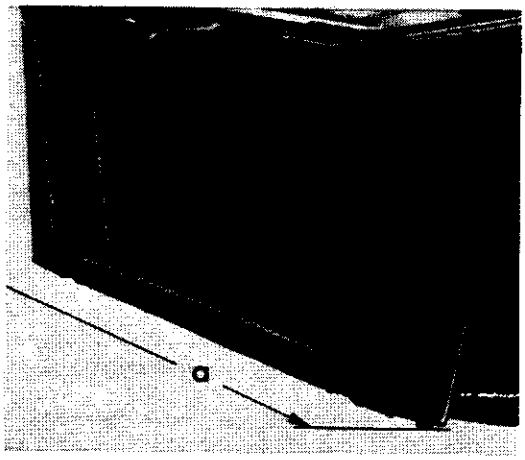

Fig. 1

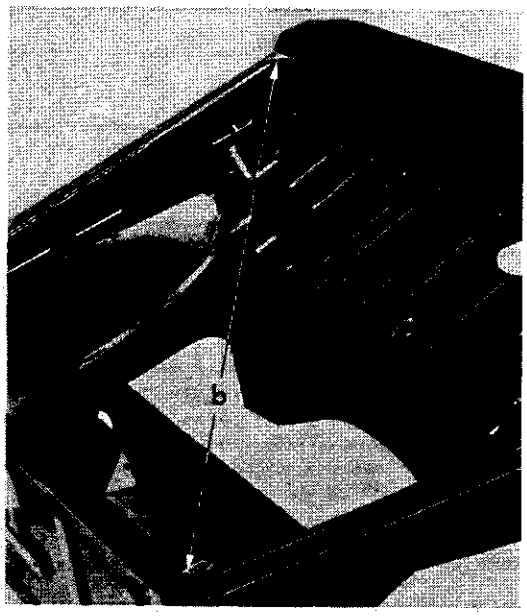

Fig. 2

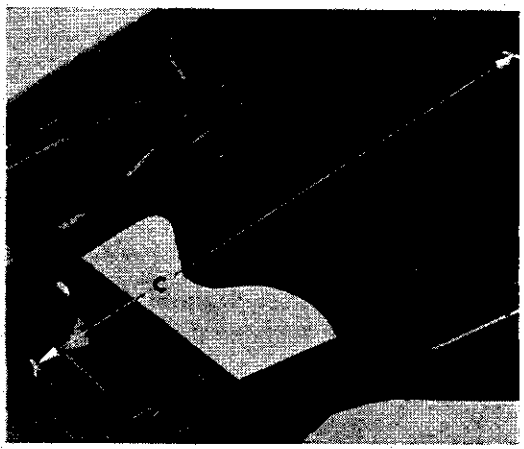

Fig. 3

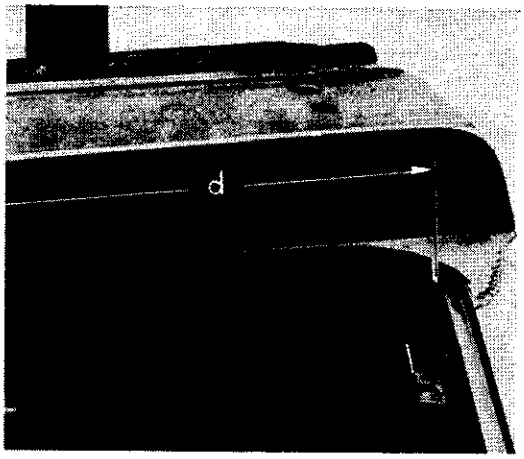

Fig. 4

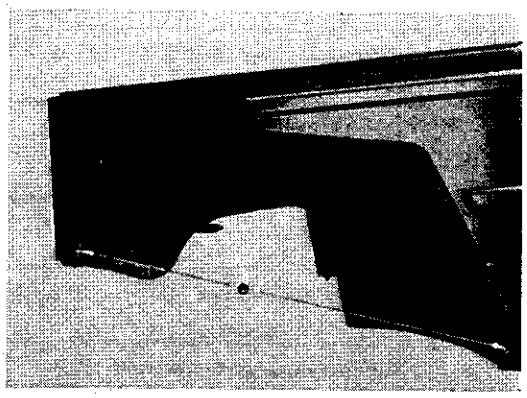

Fig. 5

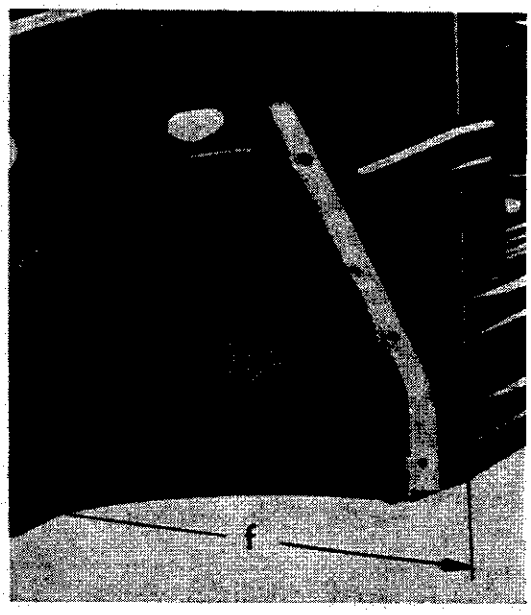

Fig. 6

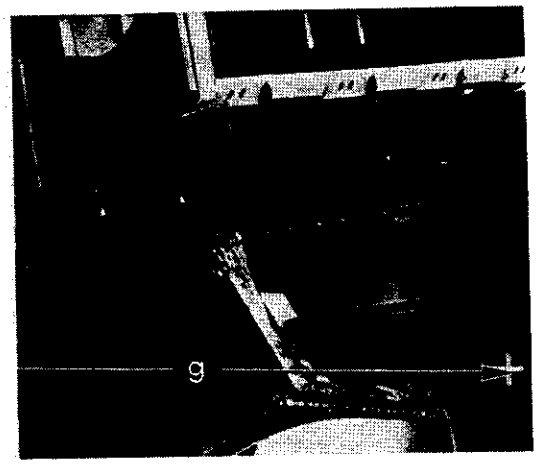

Fig. 7

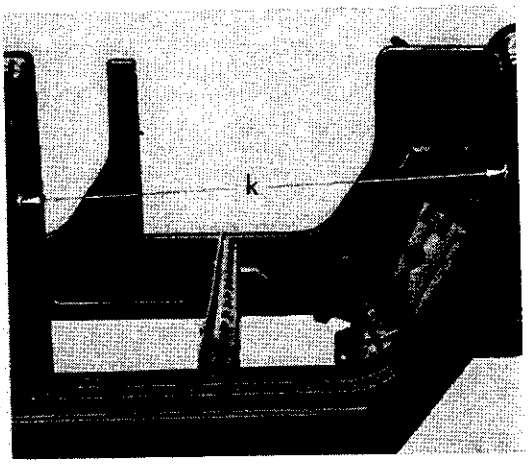

Fig. 10

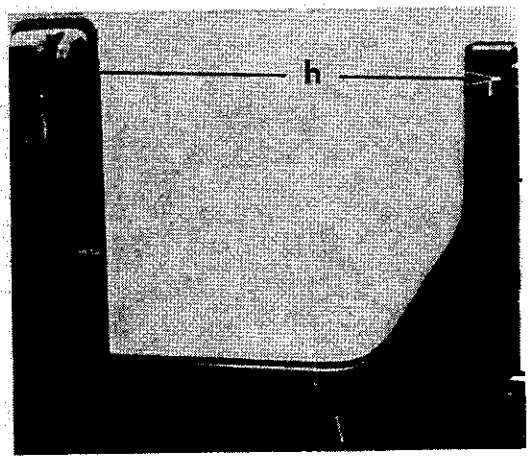

Fig. 8

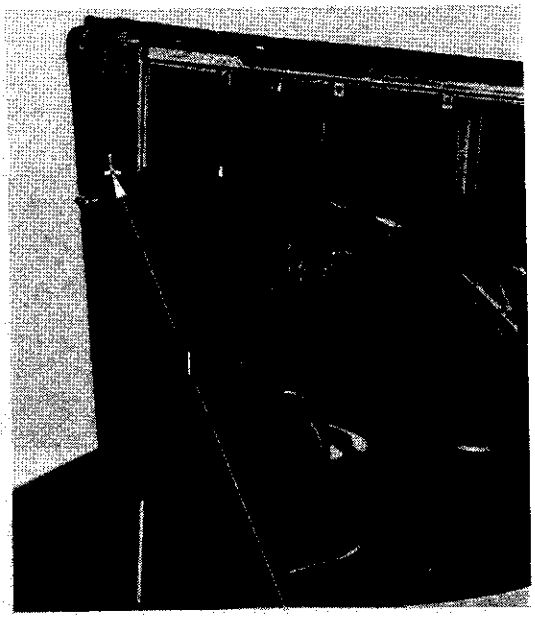

Fig. 11

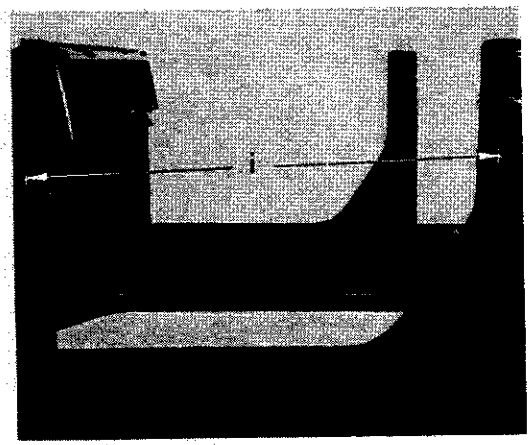

Fig. 9

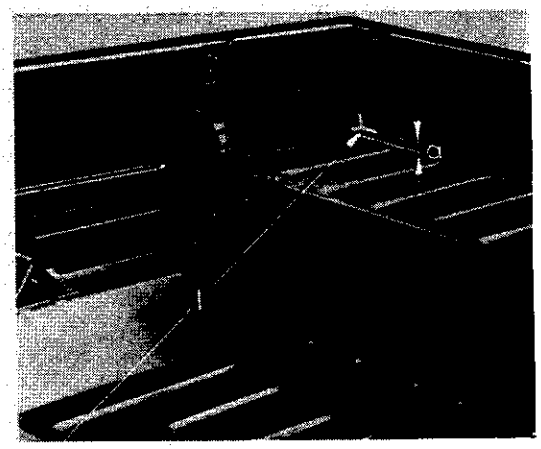

Fig. 12

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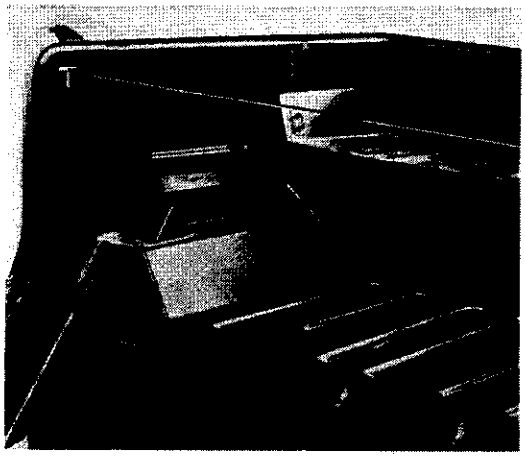


Fig. 13

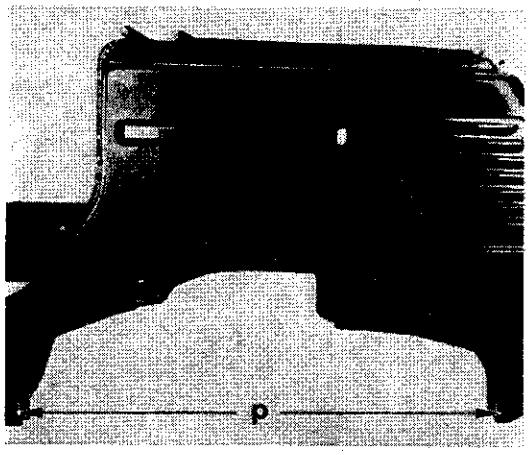


Fig. 16

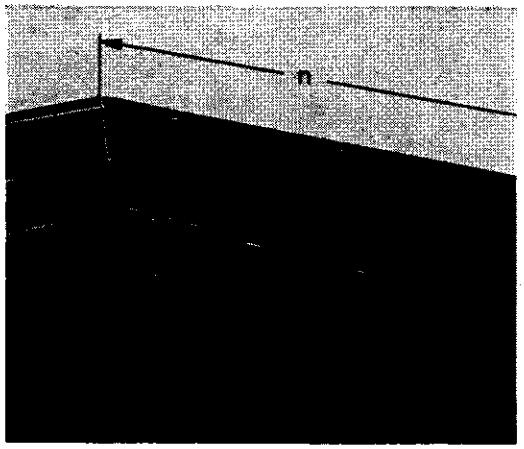


Fig. 14

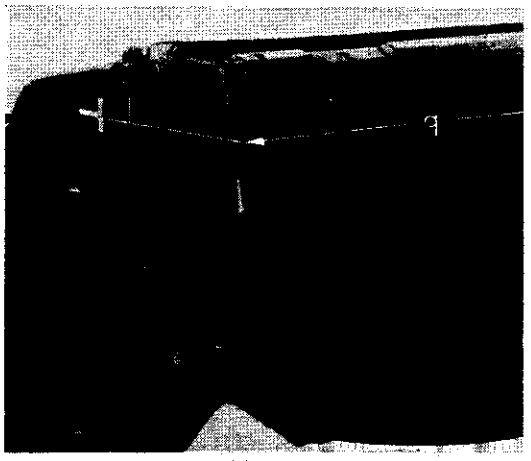


Fig. 17

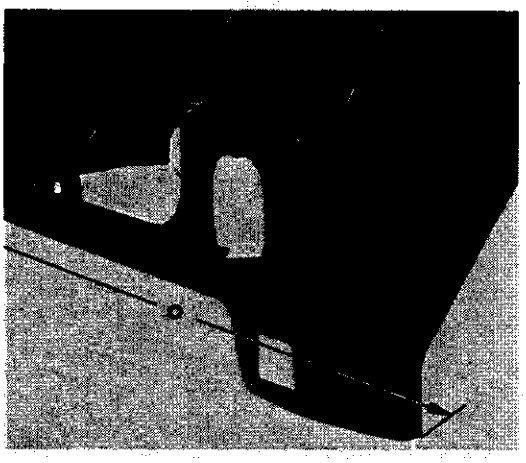


Fig. 15

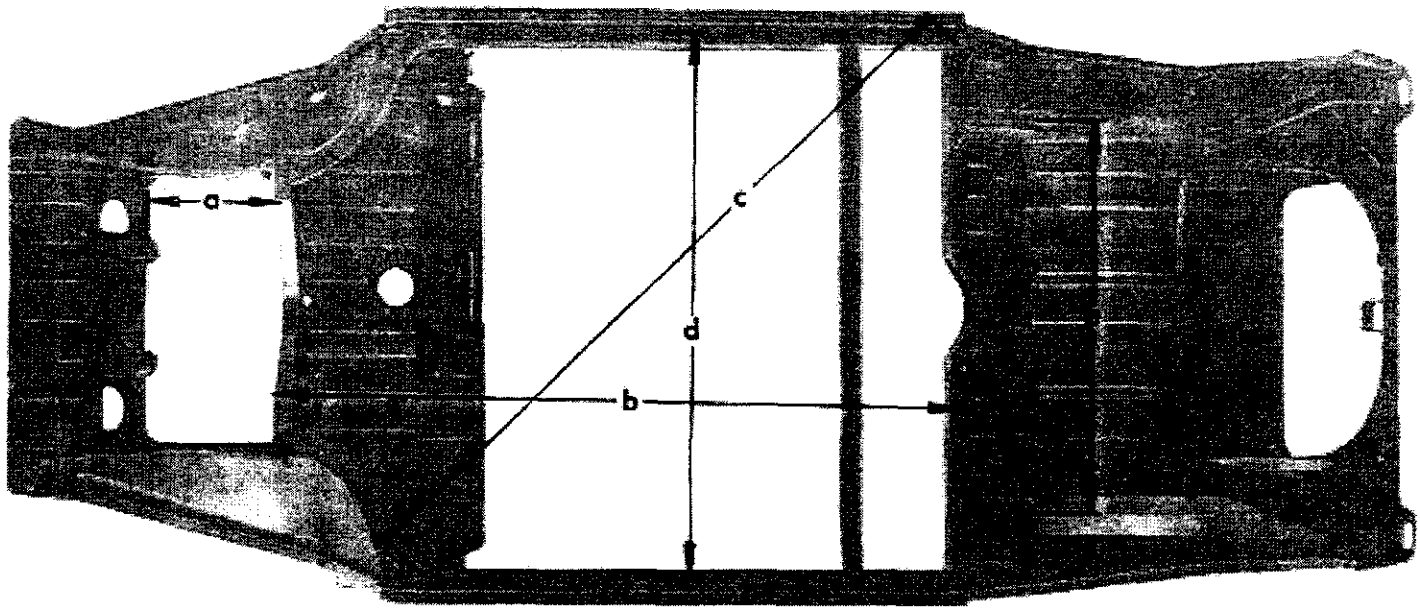
Dimensions of body / frame mounting points

General instructions:

The specified basic dimensions shown for repairing body sections were obtained in a series of measurements made with a caliper gauge.

The general tolerance is ± 2 mm ($^{5}/_{16}$ in.).

Dimensional checks in the workshop can be carried out with other appropriate measuring instruments.



	Dimension	mm (in.)	Remarks
a	Between front axle support and cross panel	350 ($13^{25}/_{32}$)	Measured at inner edge of hole
b	Between cross panel to lower part of luggage compartment floor	1765 ($65^{1}/_{2}$)	Measured from/to outside edge of flange
c	Between mounting points for the floor section to the side members	1908 ($75^{1}/_{16}$)	Diagonally measured between centers of captive nuts
d	Between mounting points for the floor section to the side members	1365 ($53^{3}/_{4}$)	Measured between centers of captive nuts
e	Between the mounting points of the cross tube	1019 ($40^{1}/_{16}$)	Measured between centers of captive nuts

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Section B
Brakes

e - **Type 2 vehicles with dual circuit brakes from August 1967:**

A larger number of pedal strokes is necessary for these vehicles as the brake fluid can only be siphoned from the refill container. The fluid in the line between refill container and reservoir and in the reservoir must be changed by "pumping".

Front, right bleeder screw open –
45 pedal strokes = approx. 270 cc of fluid
Front, left bleeder screw open –
25 pedal strokes = approx. 150 cc of fluid
Rear, right bleeder screw open –
40 pedal strokes = approx. 320 cc of fluid
Rear, left bleeder screw open –
30 pedal strokes = approx. 240 cc of fluid

f - **Type 2 vehicles with disc brakes from August 1970:**

On Type 2 vehicles with disc brakes, the entire brake system must first be emptied. Only then can new brake fluid be filled in and the brake system bled. The calipers are equipped with an additional bleeder screw on the bottom to aid the bleeding operation. To empty the system the upper as well as the lower bleeder screw should be opened and remain open until all the brake fluid has been completely removed.

Caution

Some Type 2 vehicles with disc brakes are manufactured without the second bleeder screw. On these vehicles the calipers must be removed after pumping them empty and with the bleeder screw open, tilted in such a way that the brake fluid can completely drain out.

Replace the brake fluid and bleed brake system.

Types 3 and 4 vehicles with disc brakes from August 1971:

The calipers on these vehicles have a second bleeder screw. This ensures that the system is emptied more thoroughly when changing the fluid. Proceed as follows on these vehicles:

1 - Open screws on rear wheel cylinders and pump until no more fluid emerges.

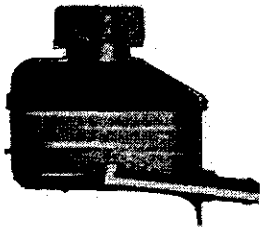
2 - Open lower screws on calipers and pump until no more fluid emerges.

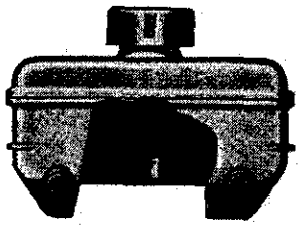
3 - Open upper screws on calipers and leave open until fluid no longer drips out of lower screws.

4 - Put fresh fluid in and bleed system either by pumping or with a pressure bleeder.

Brake fluid reservoir

Types 1, 3 and 4





On vehicles with dual circuit brakes the brake fluid reservoir is divided into two chambers so that if one brake circuit fails there is still sufficient fluid for the brake circuit that is still intact. Pipes onto which connecting hoses are pushed are cast onto the brake fluid reservoir. Inside the reservoir there is a shoulder around the exit ports that prevents deposits from entering the fluid lines. Type 4 vehicles with manual transmissions have reservoirs with two dividing walls, the third chamber serving as reservoir for the hydraulically operated clutch.

Brake fluid reservoir and tandem brake master cylinder or clutch master cylinder are connected to each other by hoses and elbows. On Types 1 and 3 vehicles 8 mm diameter lines are used.

On Types 1, 3 and 4 the fluid reservoir is in the front luggage compartment. On Type 1 / Model 181, it is in the front foot well below the instrument panel. The filler neck is accessible from the luggage compartment.

Type 2

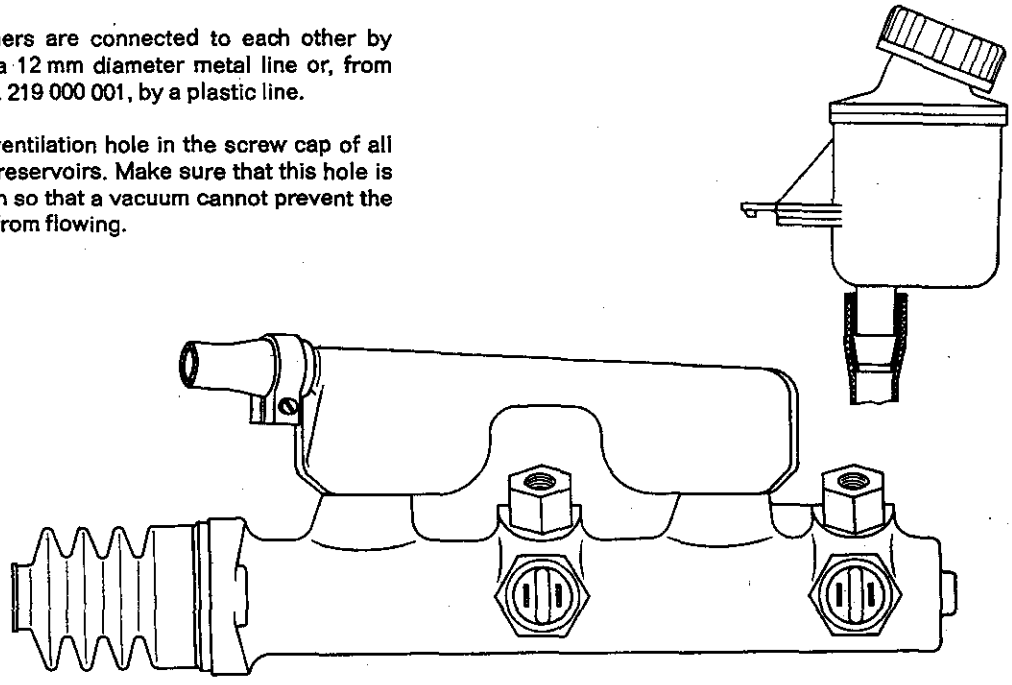
There are two containers for the brake fluid:

1 - The twin-chamber reservoir on the tandem brake master cylinder.

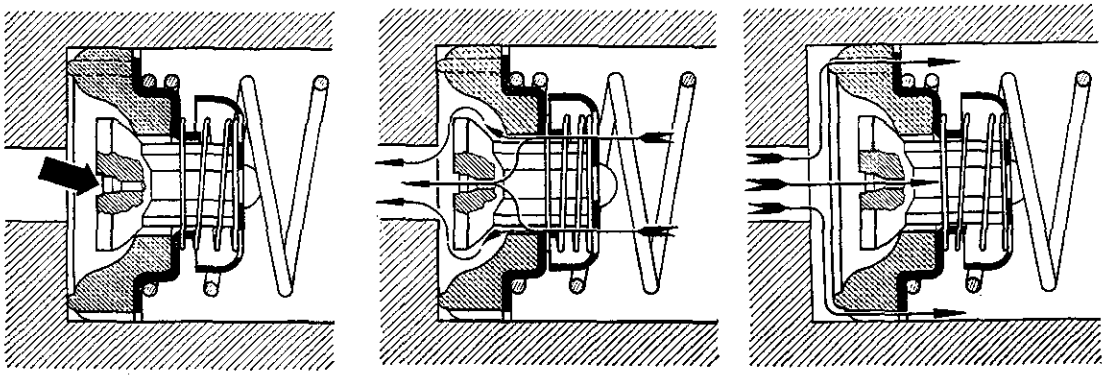
2 - The refill container on the cross panel in front of the driver's seat.

The containers are connected to each other by hoses and a 12 mm diameter metal line or, from Chassis No. 219 000 001, by a plastic line.

There is a ventilation hole in the screw cap of all brake fluid reservoirs. Make sure that this hole is always open so that a vacuum cannot prevent the brake fluid from flowing.



Important
Master cylinders with the special check valve are marked with a blue sticker bearing the words
"Anschluss mit Spezial-Bodenventil".

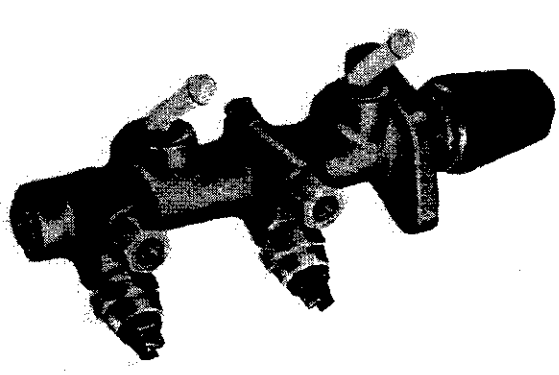


Rest position | Braking position | Return position

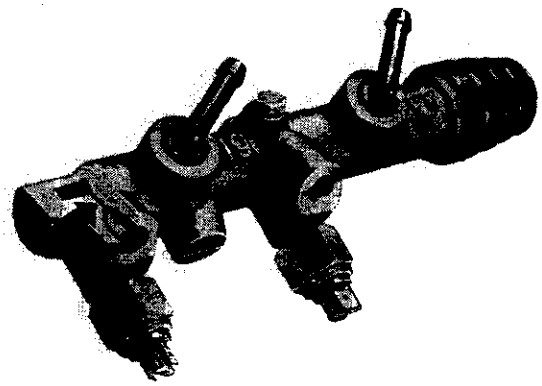
Tandem brake master cylinder

Design

The basic design of the tandem master cylinder is comparable with two normal master cylinders fitted one behind the other. The check valves, however, are replaced with residual pressure valves. They are screwed into the tandem brake master cylinder. The brake lines are connected to the residual pressure valves. Tandem brake master cylinders for vehicles with disc brakes have no residual pressure valves. The braking system of these vehicles must be free of pressure when the brakes are off as there are no return springs for the friction pads in the brake calipers. However to be able to build up a brief pressure differential for bleeding purposes, there are restriction drillings (arrow) at the outlets to the brake lines.



Tandem brake master cylinder with residual pressure valves



Tandem brake master cylinder with restriction drillings

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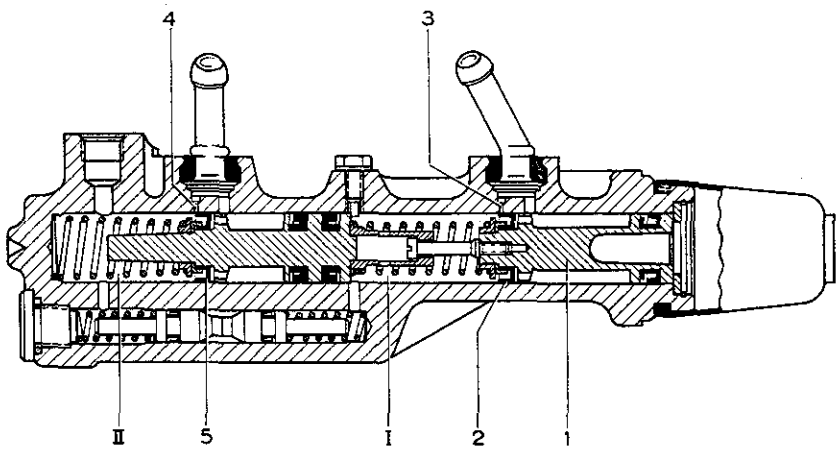
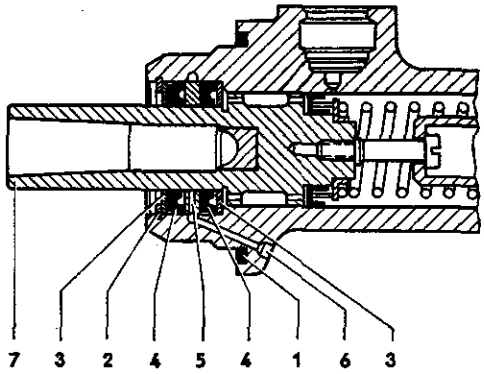
Operation

When the brake pedal is depressed the push rod moves the rear brake circuit piston (1) forward. As soon as the primary cup (2) covers the compensating port (3), pressure builds up in the closed pressure chamber (I) of the rear brake circuit. This pressure moves the piston of the front brake circuit forward. When the primary cup (5) covers the compensating port (4), and the front brake circuit pressure chamber (II) is also closed, an equal brake fluid pressure is built up in each of the pressure chambers. The brake fluid is then forced through the brake lines to the wheel brake cylinders.

The operation of the warning device is described on page B 1.1/2.





Tandem brake master cylinder for vehicles with brake servo

This tandem brake master cylinder differs from the normal tandem brake master cylinder in the following details:

1 - Modified piston for rear brake circuit.

2 - A piston housing with a cast shoulder for sealing piston chamber and vacuum chamber of brake servo.

1 - Seal
2 - Circlip
3 - Washer
4 - Cup
5 - Plastic washer
6 - Breather drilling
7 - Rear brake circuit piston

The left-hand cup seals the vacuum chamber and the right-hand cup seals the piston chamber. The space between the cups is vented to the atmosphere by a drilling. A plastic washer with radially drilled holes is used as a spacer.

Operation

If both brake circuits are intact, the same pressure exists in both brake circuits and also in both pressure chambers of the warning device due to the fact that a force applied to a fluid in an enclosed space is transferred uniformly in all directions. The pistons remain ineffective. If, for some reason or other, the pressure in one of the two brake circuits drops, the pistons of the warning device will be moved. When this occurs, the pin of the warning device switch is pushed over the angled surface of the piston and into the warning device switch thereby energizing it so that the warning lamp on the instrument panel lights up.

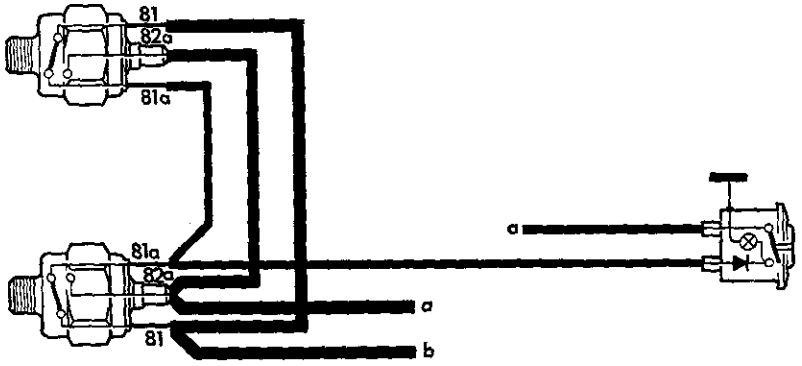
2- Combined warning device switch and brake light switch

For this type of warning device, two brake light switches with change-over contact (three-point switch) are used.

Operation

If the brake system is intact, both brake circuits and the contact pins of the brake light switches are under equal pressure. When the brake is operated and the contacts of both switches are closed, there is no circuit to contacts 81 a and the warning lamp is not energized.

Should, for some reason, the pressure in one of the two brake circuits drop, the contact pin of the brake light switch is no longer depressed. The warning lamp is energized via contact 82 a–81 of the operative brake light switch (intact brake circuit) and contact 81–81 a of the inoperative brake light switch (defective brake circuit) and lights up.



a = to terminal 15
b = to brake lights

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Front wheel brakes Types 1, 2, 3 and 4

The front wheel brakes of Type 1 vehicles have one wheel brake cylinder that operates both brake shoes (simplex brakes). The upper shoe (front shoe on Type 113) acts as leading shoe, and the lower shoe (rear shoe on Type 113) as trailing shoe. These shoes are also known as primary and secondary shoes.

The brake shoes are freely mounted and self-centering in the slots in the pistons and adjusting screws. This minimizes the tendency of the brakes to lock to a minimum. The shoe ends are angled.

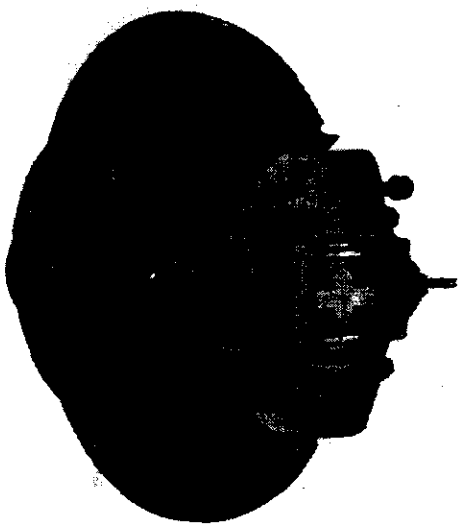
Type 1 (Karmann Ghia), Type 2 from Chassis No. 211 2 000 001, and Types 3 and 4 have disc brakes on the front wheels. The main parts of these brakes are the brake disc and the brake caliper which contains the hydraulically operated components of the brake system. A splash shield protects the inner side of the brake disc from damage caused by dirt or gravel.

The wheel cylinder and anchor block are bolted to the backing plate directly on the steering knuckle. This gives rigid and positive location to the wheel brakes. The backing plate also serves as a cover to keep out dirt and water and to give lateral support to the brake shoes. Two springs which are attached to the backing plate by cups and pins keep the brake shoes in constant contact with the backing plate. After braking, the shoes are returned to the rest position by two return springs.

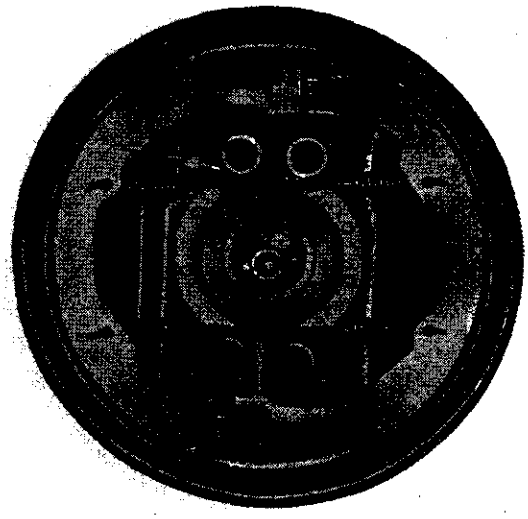
The brakes of Type 2 vehicles are of the duplex type. Due to the two wheel brake cylinders, both brake shoes act as leading shoes.

The outer side of the brake disc is protected from damage by the wheel. Viewed in driving direction, the brake caliper is positioned behind the wheel axis.

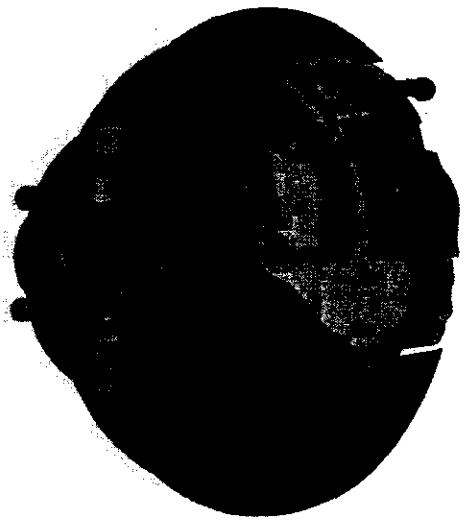
Type 1



Type 1 (Karmann Ghia) and Types 3 and 4



Type 2 up to Chassis No. 210 2 248 837



Type 2 from Chassis No. 211 2 000 001

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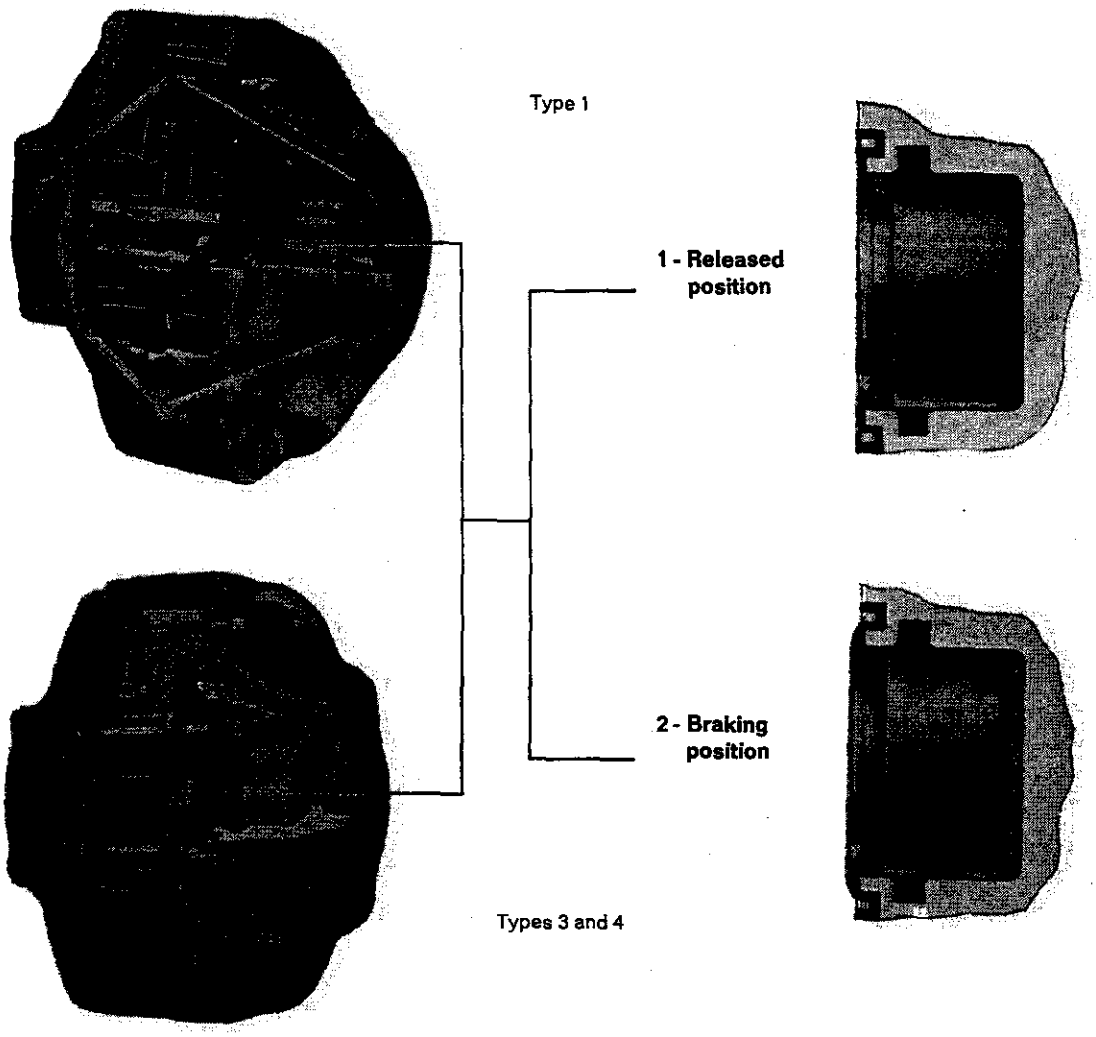
Brake caliper

The brake caliper consists of the inner and the outer housing on either side of the brake disc. The caliper is secured to the steering knuckle by two bolts. Four bolts hold the two caliper housings firmly together. A cylinder is machined into each caliper housing and each cylinder contains a piston and a rubber seal. The rubber seal, which has a square cross section, is positioned in an annular groove in each of the cylinders and prevents fluid leakage past the piston. Cylinder, piston and rubber seal are protected against moisture and dirt by a seal which is held in the recess at the front end of the cylinder by a spring ring and against the piston skirt by the inherent tension of the seal.

To prevent the pistons from rotating when braking, they are provided with retaining plates which are pushed into the piston crowns and held in the caliper recesses. The brake calipers on Type 2 vehicles are basically the same as those on Type 3 vehicles except that they do not have the run-out compensating device (see page B 1.1/ 3–3).



Operation

When the brake pedal is depressed, hydraulic pressure from the tandem master cylinder piston is transferred to the brake caliper pistons. The pistons move toward each other and press the friction pads against the friction surfaces of the disc with equal pressure on both sides. The rubber seals which bear on the skirts of the pistons are then deflected in the direction of the piston movement.

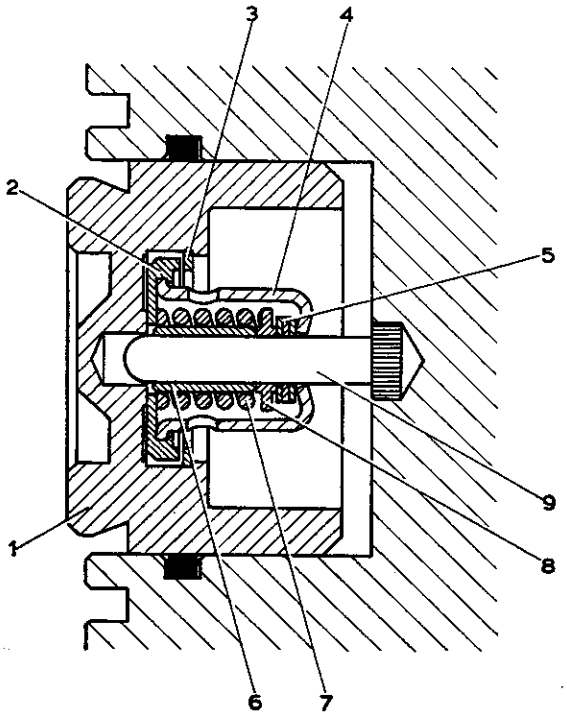
On releasing the brake pedal, the springs force the tandem master cylinder pistons back to their original positions and the complete system is relieved of pressure due to the pressure relief port in the tandem master cylinder. Simultaneously, the pistons in the brake caliper are retracted by the rubber seals resuming their normal condition.

The friction pads, which are pressed against the pistons by the spreader springs, move away from the brake disc, thus allowing the disc to rotate freely again. The amount of clearance between the friction pads and the brake disc depends upon the elasticity of the rubber seal. The clearance is approximately 0.05–0.2 mm (0.002–0.008 in.). This clearance does not increase as the friction pads wear, because the piston slip through the rubber seals when they have to move farther than the lateral deflection of the rubber seal would permit. The friction pads adjust themselves automatically according to the amount of wear.

Adjuster and brake disc deflection compensator

Type 3 only

The adjuster and brake disc deflection compensator has the task of maintaining a constant clearance between friction pads and brake disc even when the pistons have to cover a longer distance toward the brake disc as is necessary, for example, when the friction pads wear or the brake disc is deflected. The compensator consists of the spring housing, the stop ring, the spring, the spacer sleeve, the distance piece and the friction washers. The spring housing is peened to the stop ring. The compensator is so arranged that it can slide along the cylindrical pin which is firmly pressed into the base of the cylinder and it is held in the piston with a predetermined clearance between the underside of the piston crown and the retaining disc.



1 - Piston
2 - Stop ring
3 - Retaining disc
4 - Spring housing
5 - Friction washer
6 - Spacer sleeve
7 - Spring
8 - Distance piece
9 - Cylindrical pin

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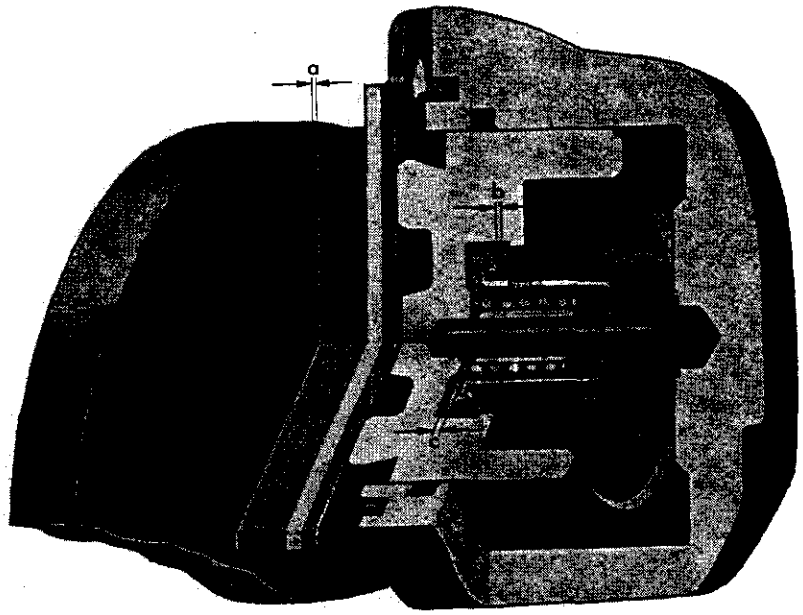
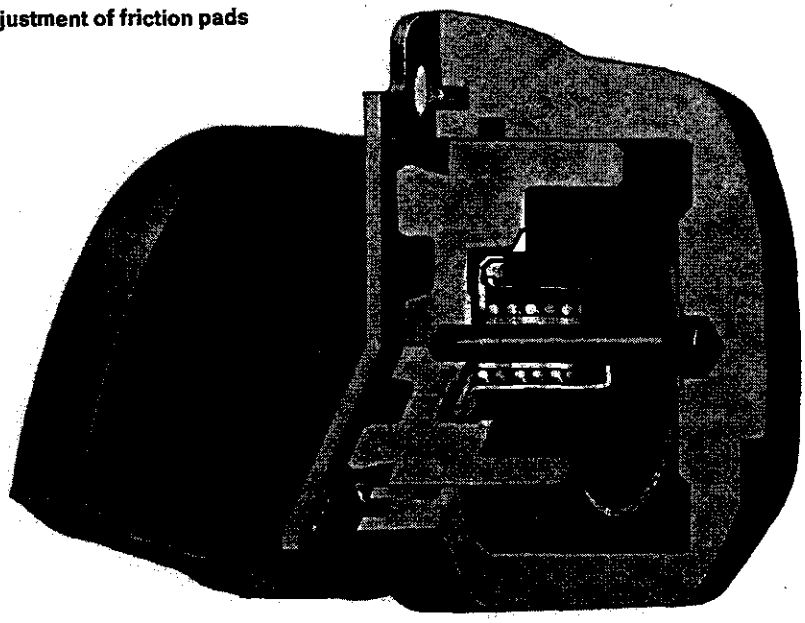


Clearance a is the clearance between friction pads and brake disc as already mentioned.

Clearance b between retaining disc and stop ring is required for the automatic adjustment of the pistons.

Clearance c between underneath of piston crown and end of spacer sleeve is required for the brake disc deflection compensator.

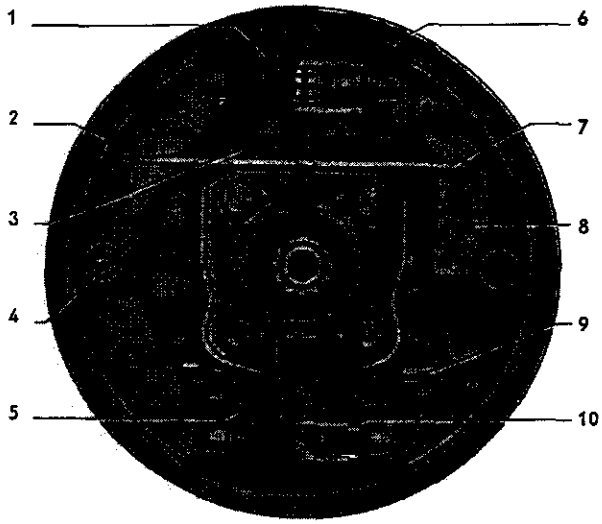
Automatic adjustment of friction pads
Type 3 only



When the brake pedal is depressed, the piston is forced toward the brake disc by the hydraulic pressure, thus eliminating clearances a and b. If, when braking hard, the friction pad wear is so great that the piston has to move farther toward the brake disc than clearance b permits, the piston slides through the laterally deflected rubber seal and, via the retaining disc, pulls the stop ring and the spring housing with it. The friction washers are forced along the cylindrical pin appropriately (arrow = direction of force).

Rear wheel brakes

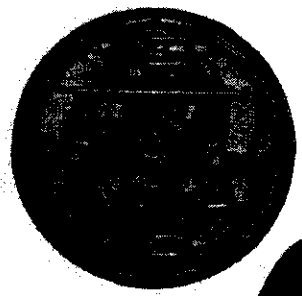
1 - Wheel brake cylinder
2 - Brake shoe and lining
3 - Upper return spring
4 - Spring with cup and pin
5 - Lower return spring
6 - Backing plate
7 - Connecting link
8 - Lever
9 - Brake cable
10 - Adjusting nut



The layout of the rear wheel brakes can be seen in the illustration. The design of the brakes is in principle the same for all vehicle types. There is a difference in the number of return springs, the attachment of the backing plates and the shape of the ends of the brake shoes. The shoe ends of Type 1, 2, 3 and 4 vehicles are angled, but on Type 2 up to Chassis No. 210 2 248 837 they are straight. In addition to this the attachment of the brake drums is also different. On Types 1 and 2 vehicles (Type 2 up to Chassis No. 210 2 248 837) the cast type brake drum is splined to the axle or wheel shaft. On Type 2 (from Chassis No. 211 2 000 001), 3 and 4 vehicles the composite type brake drums are secured to the wheel hubs by wheel bolts (or nuts as on Type 2). To prevent the brake drums from being removed unintentionally when a wheel is removed, the drums are additionally secured to the hubs with two screws,

The brake shoes are freely mounted and self-centralizing in the slots in the pistons and adjusting screws. This reduces the tendency of the brakes to lock to a minimum.

The wheel cylinder and anchor block are bolted to the backing plate. The backing plate is bolted to the rear axle bearing housing and it also serves as a cover to keep out dirt and water and to give lateral support to the brake shoes. Two springs attached to the backing plate by cups and pins, keep the brake shoes in constant contact with the backing plate. The brake shoes are returned to the rest position after braking by two return springs.
The brake linings are riveted to the brake shoes. The thickness of the brake linings can be checked during the maintenance service through the two inspection holes in the brake backing plate.
The adjusting nuts and screws are accessible through the holes in the brake backing plate. They provide a means of setting and adjusting the brake shoes.
The parking brake is adjusted at the brake lever in the vehicle after the foot brake has been adjusted. The pull of the parking brake cable is transmitted via a lever which is attached to the primary shoe and then through a connecting link to the second shoe.



Type 1

Type 3

Type 2
up to Chassis No.
210 2 248 837

Type 4

Type 2
from Chassis No.
211 2 000 001

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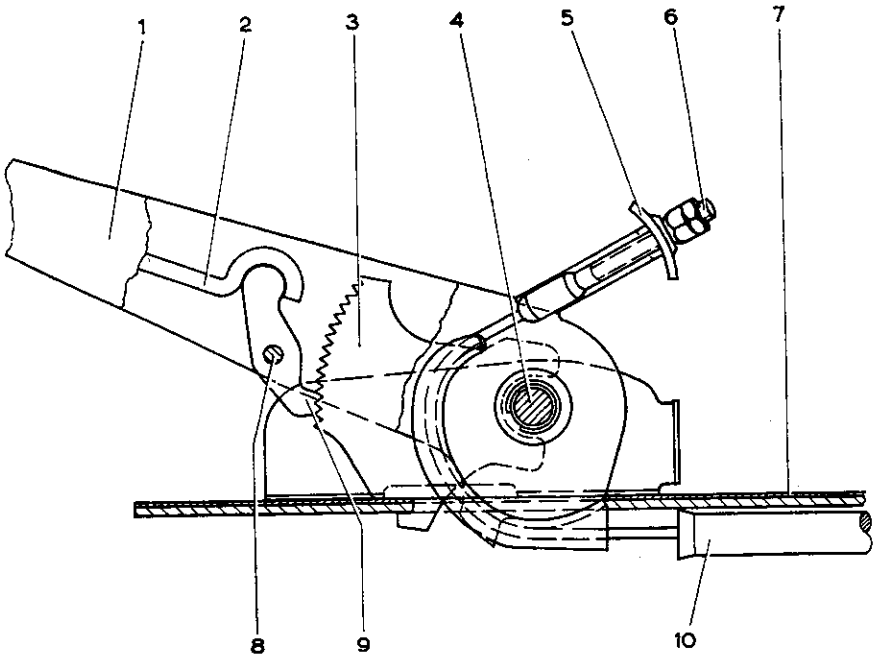
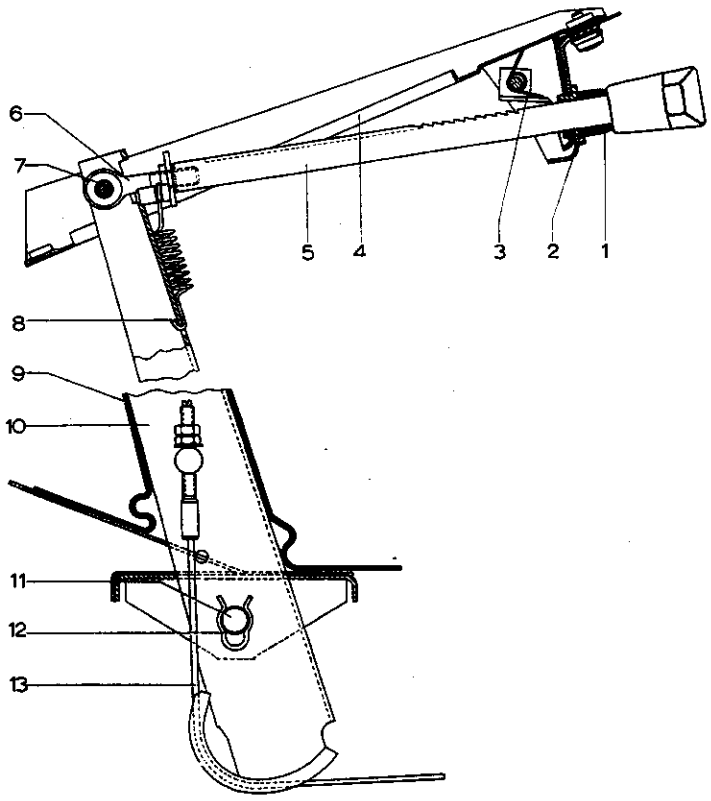


Parking brake Types 1, 3 and 4

The two brake cables are routed around two curved guides to the cable compensator on the brake lever which is held in a support on the frame. The cable compensator ensures that both brake cables are always equally tensioned when the brake is applied, resulting in even braking of both wheels. When the brake is applied it is automatically held by a ratchet segment and a pawl. The brake is released by depressing the button in the end of the parking brake lever.

1 - Parking brake lever
2 - Pawl rod
3 - Ratchet segment
4 - Lever pin
5 - Cable compensator
6 - Brake cable
7 - Frame
8 - Pawl pin
9 - Pawl
10 - Cable guide tube



Type 2

The umbrella type parking brake comprises the hand brake lever itself and also a horizontal toothed rod. A spring and pawl in the support holds the lever when the parking brake is applied.

1 - Ratchet bar stop
2 - Guide sleeve
3 - Spring and pawl
4 - Ratchet bar bracket
5 - Ratchet bar
6 - Eye bolt
7 - Pin
8 - Spring
9 - Boot
10 - Parking brake lever
11 - Pin
12 - Spring clip
13 - Parking brake cable

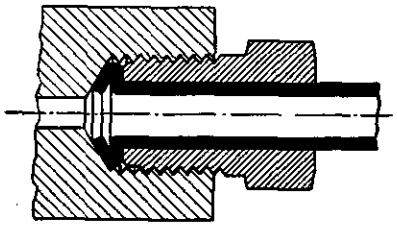
Brake lines and hoses

Brake lines

The brake lines are steel tubes electrolytically copper plated on the inside and outside. In addition, all brake lines are galvanized on the outside, thus giving increased protection against corrosion. The outside diameter of the lines is 4.75 mm, the wall thickness 0.7 mm and they can withstand all pressures developing when braking. The lines are routed so that they will not be damaged and are secured by clips to prevent vibration and chafing.

Brake line connections

The line connections are of the conical type with union nuts which grip the double flared tubing.



Brake hoses

Brake hoses are used to connect moving parts. As they must always follow all movements, they must be installed so that even at the end of the maximum possible movement of the parts concerned, the hose material does not stretch. The hoses must not be twisted.

Brake hoses must not come into contact with oil and grease. If parts of the vehicle near the hoses are to be painted or the vehicle is to be undercoated, first cover the hoses up.

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	Type 3		Type 4		Remarks
	Dimensions and adjustment data	Wear limit	Dimensions and adjustment data	Wear limit	
Tandem brake master cylinder					
Bore	19.05 mm (0.75 in.)		19.05 mm (0.75 in.)		
Intermediate piston stroke	15 mm (0.590 in.)		15 mm (0.590 in.)		
Push rod piston stroke	15 mm (0.590 in.)		15 mm (0.590 in.)		
Ratio at brake pedal	6.4 : 1		6.4 : 1		
Push rod length	adjustable		adjustable		
Pedal travel	min. 205 mm (8.0 in.)		min. 205 mm (8.0 in.)		
Clearance, push rod / piston	1 mm (0.04 in.)		1 mm (0.04 in.)		
Brake pedal free play	4–7 mm (0.016–0.28 in.)		4–7 mm (0.016–0.28 in.)		
Adjustment of stop screw	–		24.5 mm (0.96 in.)		
Differential switching pressure of warning device [1]	8–16 kg/cm² (114–227 psi)		–		
Front wheel brakes					
Brake disc diameter	281 mm (11.06 in.) [2]		281 mm (11.06 in.)		
Thickness new	11.0–0.1 mm (0.433–0.004 in.) [3]		11–0.1 mm (0.433–0.004 in.)		
Material may be removed per side, max.	0.5 mm (0.02 in.)		0.5 mm (0.02 in.)		
Min. thickness after reworking	10.0 mm (0.4 in.) [4]	9.5 mm (0.374 in.)	10 mm (0.4 in.)	9.5 mm (0.374 in.)	
Thickness tolerance, max.	0.02 mm (0.0008 in.)		0.02 mm (0.0008 in.)		
Lateral runout, max.	0.2 mm (0.008 in.)		0.2 mm (0.008 in.)		
Brake caliper (piston diameter)	42 mm (1.654 in.)		42 mm (1.654 in.)		
Friction pad thickness	10 mm (0.394 in.)	2 mm (0.08 in.)	14 mm (0.551 in.) [5]	2 mm (0.08 in.)	
Running clearance	0.05–0.2 mm (0.002–0.008 in.)		0.05–0.2 mm (0.002–0.008 in.)		
Surface area of four friction pads	100 cm² (15.5 sqin.) [6]		100 cm² (15.5 sqin.)		
Rear wheel brakes					
Brake drum diameter	248.1 +0.2 mm (9.768 +0.008 in.)	249.5 mm (9.823 in.)	248.1 +0.2 mm (9.768 +0.08 in.)	249.5 mm (9.823 in.)	
Permissible turned drum diameter	249 mm (9.803 in.)	249.5 mm (9.823 in.)	249 mm (9.803 in.)	249.5 mm (9.823 in.)	
Taper	0.1 mm (0.004 in.)		0.1 mm (0.004 in.)		
Ovality	0.1 mm (0.004 in.)		0.1 mm (0.004 in.)		
Wheel brake cylinder diameter	22.2 mm (0.874 in.)		22.2 mm (0.874 in.)		
Brake lining					
Thickness new	4–3.8 mm (0.16–0.15 in.)	2.5 mm (0.1 in.) [7]	4–3.8 mm (0.16–0.15 in.)	2.5 mm (0.1 in.) [7]	
Thickness new (oversize)	4.5–4.3 mm (0.18–0.17 in.)	2.5 mm (0.1 in.) [7]	4.5–4.3 mm (0.18–0.17 in.)	2.5 mm (0.1 in.) [7]	
Width	45 mm (1.77 in.)		45 mm (1.77 in.)		
Total lining surface, rear	450 cm² (69.8 sqin.)		450 cm² (69.8 sqin.)		

[1] Only for tandem brake master cylinders with cast on cylinders for hydraulic warning device

[2] up to Chassis No. 311 2 277 190: 277 mm (10.904 in.) diameter

[3] up to Chassis No. 311 2 277 190: 9.5–0.1 mm (0.374–0.004 in.)

[4] up to Chassis No. 311 2 277 190: 8.5 mm (0.335 in.) wear limit 8 mm (0.315 in.)

[5] up to August 1972: 10 mm (0.4 in.)

[6] up to Chassis No. 311 2 277 190: 80 cm² (12.4 sqin.)

[7] Bonded linings 1 mm (0.04 in.)

	Type 1			Type 2
	Dimensions and adjustment data			Dimensions and adjustment data
	Sedans	Karmann Ghia	Model 181	
Brake pressure regulator				
Piston diameter	–	–	–	–
Regulating commences	–	–	–	–
Test pressure				–
1st test: in front of valve/behind valve	–	–	–	100/55–65 kg/cm² [1] (1422/782–925 psi)
2nd test: in front of valve/behind valve	–	–	–	
Exit pressure must not drop when input pressure remains constant for 10 sec. minimum				
Quantity of brake fluid in brake system or brake system and clutch system with fluid reservoir correctly filled (reservoir filled to upper edge of annular welding seam)				
a - vehicles with manual transmissions	approx. 400 cc	approx. 400 cc	approx. 400 cc	approx. 500 cc
b - vehicles with automatic transmissions	–	–	–	–
Wheel and tires				
Wheel size	4½ J x 15 [2]	4½ J x 15	5 JK x 14	5½ x 14 [5]
Offset	34 mm (1.338 in.) [3]	46 mm (1.81 in.)	32.5 mm (1.27 in.)	46 mm (1.81 in.)
Bolt hole pitch circle dia.	130 mm (5.1 in.)	130 mm (5.1 in.)	205 mm (8.07 in.)	112 mm (4.4 in.) [6]
Runout				
Lateral runout max.	1.5 mm (0.06 in.)	1.5 mm (0.06 in.)	1.5 mm (0.06 in.)	1.5 mm (0.06 in.)
Radial runout max.	1.25 mm (0.05 in.)	1.25 mm (0.05 in.)	1.25 mm (0.05 in.)	1.25 mm (0.05 in.)
Wheel bolts	M 14 x 1.5 x 19	M 14 x 1.5 x 19	M 12 x 1.5 x 13	M 14 x 1.5 x 19 [7]
Wheel nuts		–	–	M 14 x 1.5
Front wheel bearing play	0.03–0.12 mm (0.001–0.004 in.)	0.03–0.12 mm (0.001–0.004 in.)	0.03–0.12 mm (0.001–0.004 in.)	0.03–0.12 mm (0.001–0.004 in.)
Conventional tires (tubeless)				
Tire size	6.00 x 15 L 4 PR [2]	6.00 x 15 L 4 PR [4]	–	7.00 x 14 8 PR
Radial runout max.	1.5 mm (0.06 in.)	1.5 mm (0.06 in.)	–	1.5 mm (0.06 in.)
Dimensions:				
Outside diameter	650±6 mm (25.6±0.23 in.)	650±6 mm (25.6±0.23 in.)	–	668±6 mm (26.3±0.23 in.)
Operating width max.	154 mm (6.06 in.)	195 mm (7.68 in.)	–	189 mm (7.44 in.)
Effective radius, static	304±3 mm (11.97±0.12 in.)	304±3 mm (11.97±0.12 in.)	–	307±3 mm (12.09±0.12 in.)
Effective radius, dynamic	309±3 mm (12.16±0.12 in.)	309±3 mm (12.16±0.12 in.)	–	313±3 mm (12.32±0.12 in.)
Radial ply tires (tubeless)				
Tire size	155 SR 15	155 SR 15	185 SR 14 M+S (with tube)	185 SR 14 C Reinforced
Radial runout, max.	– 1.5 mm (0.06 in.)	– 1.5 mm (0.06 in.)	1.5 mm (0.06 in.)	1.5 mm (0.06 in.)
Dimensions:				
Outside diameter	630±8 mm (24.8±0.31 in.)	630±8 mm (24.8±0.31 in.)	650±8 mm (25.59±0.31 in.)	654±8 mm (25.74±0.31 in.)
Operating width max.	162 mm (6.37 in.)	162 mm (6.37 in.)	190 mm (7.48 in.)	183 mm (7.20 in.)
Effective radius, static	285±4 mm (11.22±0.16 in.)	285±4 mm (11.22±0.16 in.)	296±4 mm (11.65±0.16 in.)	295±4 mm (11.61±0.16 in.)
Rolling circumference	1905±25 mm (75±0.98 in.)	1905±25 mm (75±0.98 in.)	1965±30 mm (77.36±1.18 in.)	1980±30 mm (77.94±1.18 in.)
Tire pressures				
(see list of tires, page B 1.8/1)				

Remarks:

[1] with inclined brake pressure regulator (see page B 5.2/1)
[2] up to March 1972: 4 J x 15 5.60 x 15 4 PR
[3] up to March 1972: 40 mm (1.57 in.)
[4] up to July 1972: 5.60 S x 15 4 PR
[5] up to Chassis No. 210 2 248 837: 5 JK x 14
[6] up to Chassis No. 210 2 248 837: 205 mm (8.07 in.)
[7] up to Chassis No. 210 2 248 837

Type	Model	Model year	Tire sizes (tubeless, cross ply)	Rims	Tire pressures psi to ¾ payload front	to ¾ payload rear	fully loaded front	fully loaded rear
2	Trucks	1968 1969 1970	7.00 x 14 8 PR	5 JK x 14	28	36	28	40
		1971	7.00 x 14 8 PR	5½ JK x 14				
	Wagons	1968 1969	7.00 x 14 6 PR	5 JK x 14	28	36	28	36
		1970	7.00 x 14 8 PR	5 JK x 14	28	36	28	40
		1971	7.00 x 14 8 PR	5½ JK x 14				
	Campmobile	1968 1969 1970	7.00 x 14 8 PR	5 JK x 14	28	36	28	40
		1971	7.00 x 14 8 PR	5½ JK x 14				

Note

Conventional and snow (M & S) tires: For prolonged high speed travel, increase tire pressures on vehicles with conventional (cross) ply by 3 psi. Never exceed the maximum tire inflation pressure marked on the tire.

Type	Model	Model year	Tire sizes	Rims	Tire pressures psi 1–2 persons front	1–2 persons rear	fully loaded front	fully loaded rear
1	Sedan 111	1968 1969 1970	155 SR 15	4 J x 15	18	27	18	27
		1971 1972 1973	165 SR 15	4½ J x 15 [1]				
	Sedan 113	1971	155 SR 15	4 J x 15	18	27	18	27
		1972 1973	165 SR 15	4½ J x 15 [1]				
	Convertible	1968 1969 1970	155 SR 15	4 J x 15	18	27	18	27
		1971 1972 1973	165 SR 15	4½ J x 15 [1]				
	Karmann Ghia	1968 1969 1970	155 SR 15	4½ J x 15	18	27	18	27
		1971 1972 1973	165 SR 15	4½ J x 15				
	Model 181	1973	185 SR 14 M+S (with tube)	5 JK x 14	18	27	18	27
3	Sedan	1968 1969 1970 1971 1972 1973	165 SR 15	4½ J x 15	18	28	18	28
	Squareback Sedan	1968 1969 1970 1971 1972 1973	165 SR 15	4½ J x 15	18	28	18	35

[1]) up to March 1972: 4 J x 15

Warning!

If radial tires are used, they must be mounted on all four wheels. The different handling characteristics of these tires require this uniformity.

The following operations should be carried out in accordance with the existing instructions:

Brake system

1 - **Checking brake lines**

Check brake lines in the vehicle interior from the pedal cluster to the driver's seat on Type 1 and 3 vehicles. (To do this, lift front left floor mat.) Check all visible brake lines, and connections underneath vehicle for leaks, corrosion and other damage.

Caution

Brake lines that are bent, flattened, badly corroded, chafed or show other signs of damage must be replaced. Brake hoses that are swollen, leaky or otherwise damaged are no longer safe and must also be replaced.

2 - **Foot brake**

Check clearance and pedal free play. If necessary, adjust brake shoes.

3 - **Parking brake**

Check parking brake lever free play and adjust cables if necessary.

4 - **Brake fluid reservoir**

Check brake fluid level. Use only genuine VW brake fluid and fill to 15–20 mm (.6–.8 in.) below shoulder of filler cap. If a large quantity of fluid is lost **do not only top up.** Determine the cause of the fluid loss first and, if necessary, repair the brake system.

5 - **Brake linings**

Check thickness of brake linings through inspection holes in back plates (on Type 2 vehicles to Chassis No. 218 109 823, the brake lining thickness can only be checked with VW 753 after the brakes have been adjusted).

The thickness of the linings is measured with the wheels installed with VW 774.

6 - **Brake servo unit**

To test the brake servo unit, depress the brake pedal firmly several times with engine off to remove the vacuum in the system. Then, while keeping the pedal depressed with medium foot pressure start engine. If the pedal gives slightly when the engine starts then the servo unit is working properly.

7 - **Brake fluid**

The brake fluid should be changed in accordance with the special instructions issued by the factory.

Caution

For refilling, always use fresh brake fluid. Do not use fluid which has been pumped from the system.

8 - **Brake warning light system**

The operation of the brake warning light system should be checked when changing the brake fluid (see B 2.5/1).

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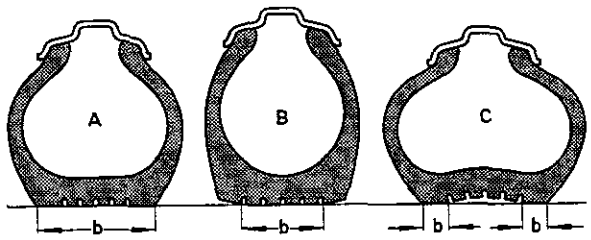
Wheels and tires

1 - Wheels

Check wheel bolts for tightness. Tighten to correct torque.

2 - Tires

Part of the maintenance and care of the tires is the regular checking of tire pressures and a visual check for tread wear and tire damage. The tread depth should be at least 1 mm (1/16 in.) across the full width of the tire.



A = normal pressure B = overinflated C = underinflated
b = road contact

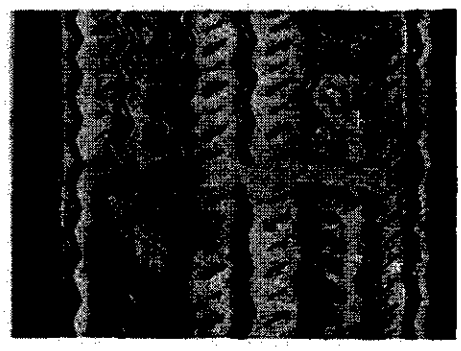
Beginning with the 1969 models, the tires are provided with tread depth indicators. These indicators are molded into the tread grooves and will appear as bands accross the tire when the tread depth reaches 1/16 of an inch.

As the tread wears, the traction of the tires is also reduced. It is therefore recommended that the tires be replaced before the molded indicators appear fully at the surface.

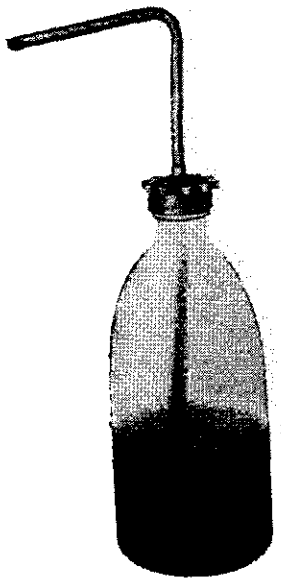
Tires should not come in contact with fuel or oil.

To reduce premature wear keep wheels balanced and the front axle aligned.

Tread good



Tread worn out



No.	Description	Tool	Remarks
	Plastic bottle		

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First empty brake fluid reservoir. To do this, use a siphon or a plastic bottle. These must be used for brake fluid only.

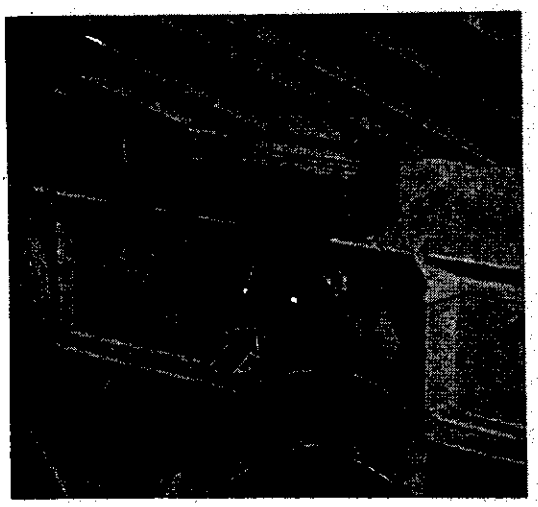
Caution

Brake fluid is poisonous. It also contains a solvent that is damaging to most paint finishes.

Removing

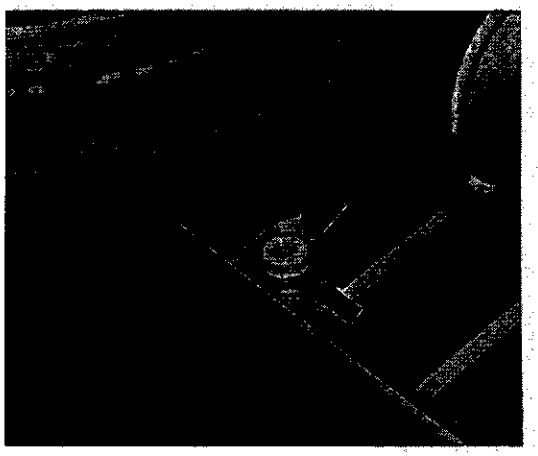
1 - Detach connecting hoses from brake fluid reservoir. Catch any escaping brake fluid in a cloth.

2 - Remove reservoir from retaining plate.



Model 181

3 - Before disconnecting hoses, remove fluid reservoir protective plate (A) (arrow).



4 - When removing brake fluid reservoir, remove cover (B) (arrow) from luggage compartment.

Installing

1 - After installing reservoir, fill with new brake fluid. Brake fluid level is 15–20 mm (0,6–0.8 in.) below shoulder of screw cap.

2 - If necessary, bleed brake system (see B 8.1/1).

Model 181

3 - When installing brake fluid reservoir, install collar (C) (arrow).

Removing and installing

Before removing brake master cylinder, drain brake fluid from reservoir. To do this use a siphon or a plastic bottle. These must only be used for draining off brake fluid.

Caution

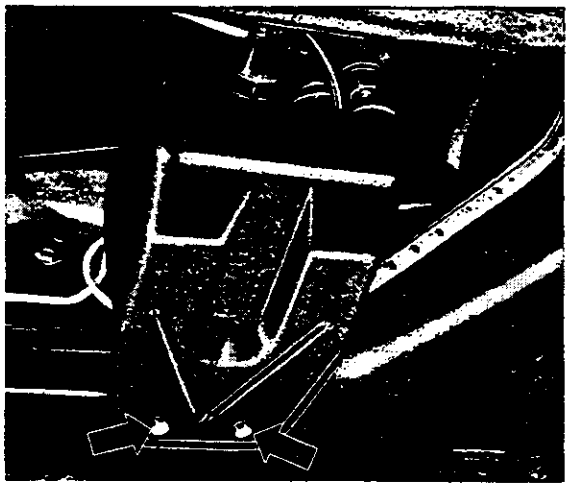
Brake fluid is poisonous. Because of its acidity it must not come into contact with paintwork.

Removing, Types 1 and 3

1 - Type 3 only: Remove cover plate.

2 - Carefully pull elbows out of sealing plugs and detach brake lines from master cylinder. Catch any escaping brake fluid. Close lines with dust caps to prevent entry of dirt.

3 - Remove brake master cylinder from frame.



Note

On Type 1 vehicles, there are spacers in the cross member. When removing the screws, ensure that the spacers (arrow) do not fall into the cavity.

Installing, Types 1 and 3

1 - Secure brake master cylinder to frame.

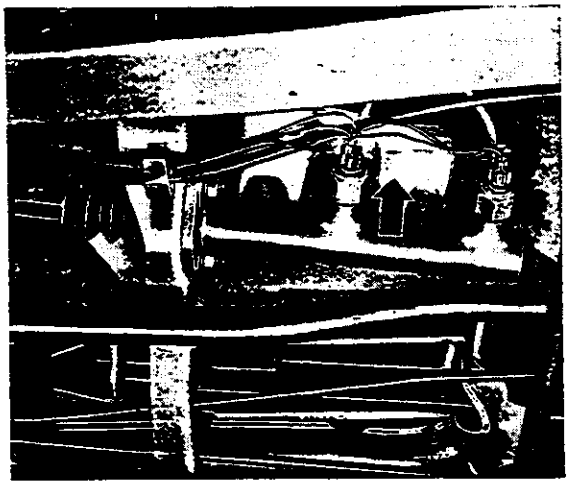
Note
Do not forget spacers on Type 1 vehicles.

2 - Moisten elbows and sealing plugs with brake fluid to facilitate installation of elbows.

3 - If necessary, adjust brake pedal free travel. See "Adjusting push rod" (B 2.6/1). Check clutch pedal play.

4 - Ensure that push rod boot is correctly installed. Dirt can damage the seal and cause brake failure. The vent hole in the boot must always face downward.

5 - Bleed brakes. See page B 8.1/1.



Removing Type 2

1 - Remove cover plate.

2 - First press brake fluid reservoir out of rear sealing plug and catch escaping brake fluid. Then pull fluid reservoir out of second sealing plug. Detach brake lines from brake master cylinder and close with dust caps to prevent entry of dirt.

3 - Remove brake master cylinder from support.

Installing Type 2

1 - Secure brake master cylinder to support and tighten screws to prescribed torque.

2 - Connect brake lines.

From chassis no. 211 2 000 001 the tandem master cylinder has only one outlet (formerly two) for the front wheel cylinders. A T-piece is installed from which brake lines lead to each front wheel.

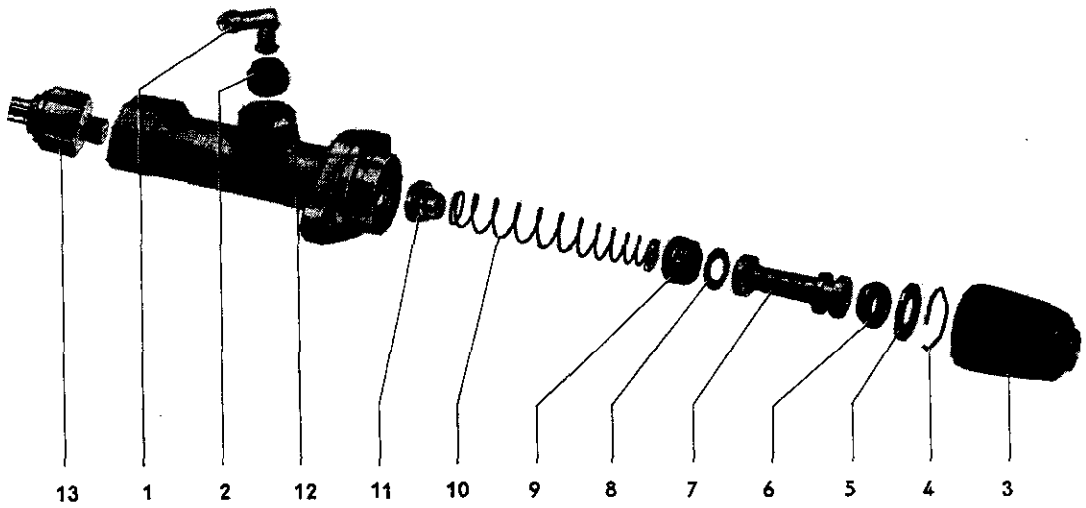
Warning

Do not install the previous type tandem master cylinder in vehicles from chassis no. 211 2 000 001 on. Even if the outlet for the second front brake line is plugged, an air cushion will form in the resultant cavity which could possibly lead to **brake failure.**

3 - Check brake pedal free travel. See "Adjusting push rod" (B 2.6/1). Ensure that boot is correctly installed. Dirt can damage the seal and can cause brake failure. The vent hole in the boot must always face downward.

4 - Moisten sealing plug with brake fluid and carefully press brake fluid reservoir connections into sealing plugs.

5 - Bleed brakes. See page B 8.1/1.



No.	Description	Qty.	When disassembling	When assembling	Detailed instructions
1	Elbow, 105°	1		moisten with brake fluid	
2	Sealing plug	2		moisten with brake fluid; ensure correct installation position	
3	Boot	1		vent hole faces downward	
4	Spring ring	1			
5	Stop washer	1			
6	Seal	1		replace; install with VW brake cylinder paste	
7	Piston	1			
8	Piston washer	1			
9	Cup	1		replace; install with VW brake cylinder paste	B 2.3/1–2
10	Spring	1			
11	Check valve	1			
12	Brake master cylinder housing	1			
13	Brake light switch	2		torque to 14–18 lb. ft. (2–2.5 mkg)	

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Important

The master cylinders are supplied by two different manufacturers. The **complete** master cylinders of the respective vehicles are interchangeable irrespective of the manufacturer, but it is not possible, however, to interchange individual parts of these master cylinders.

To avoid malfunction of the brakes use only the repair kit which contains all individual parts fitting both types of master cylinders. When carrying out repairs on the master cylinder, **all** the parts of a repair kit must be installed **together,** even if only one internal part of the master cylinder is damaged. The complete contents of the repair kit must always be used up when carrying out a repair.

Disassembling

1 - Remove internal parts of brake master cylinder.

2 - Remove brake light switch.

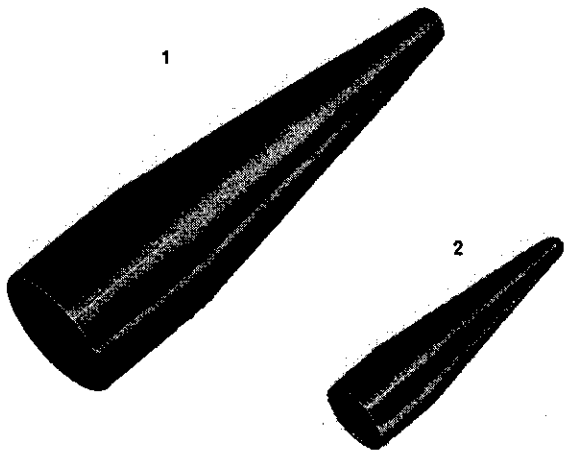
Assembling

1 - All parts must be cleaned in methylated spirits or brake fluid only.

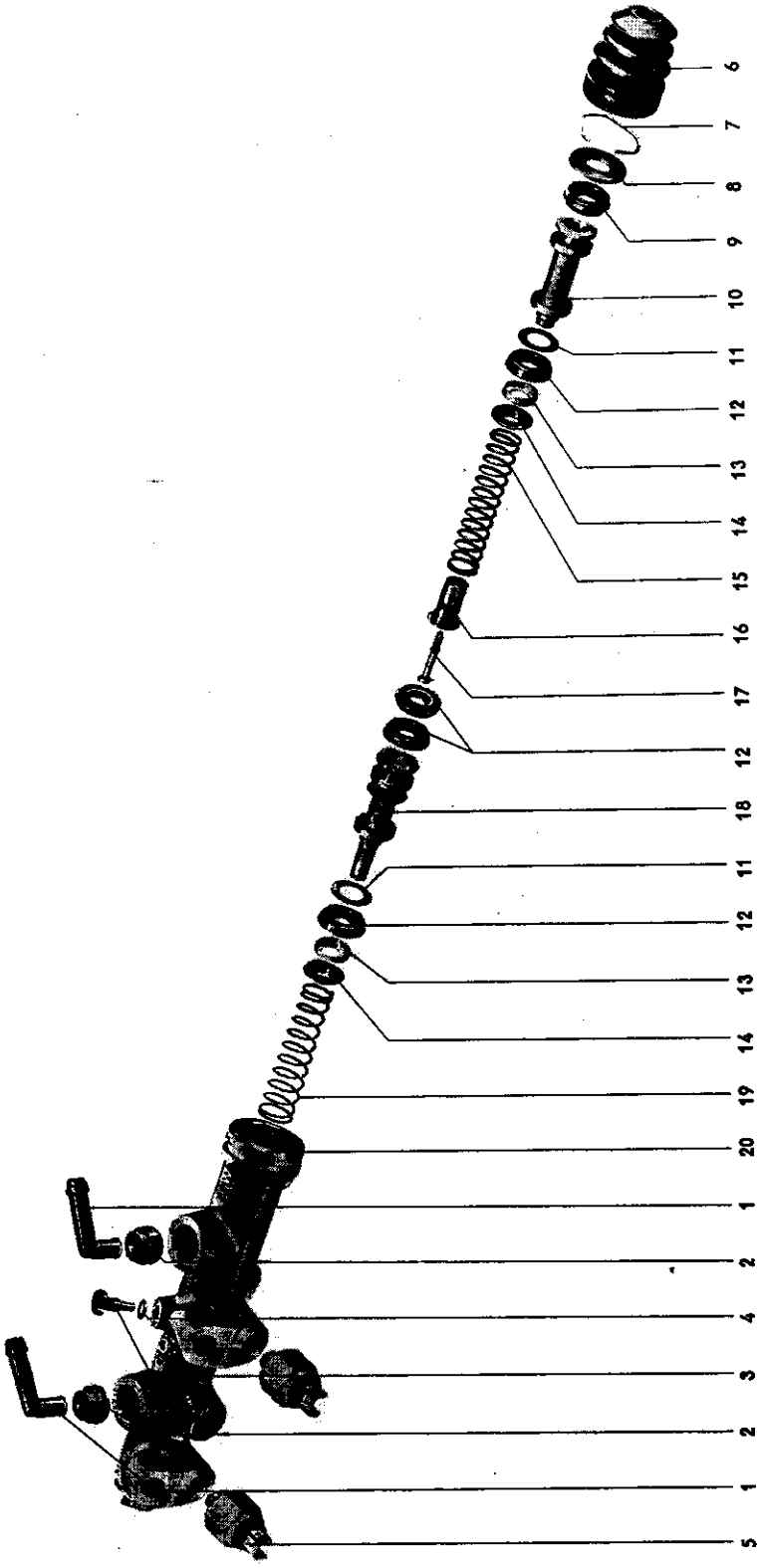
2 - Check parts for wear. The compensating ports must not be blocked or burred.

3 - Install cups with VW brake cylinder paste.

4 - Install boot so that vent hole faces downward.



No.	Description	Tool	Remarks
1	Cup installing sleeve	US 4425	Types 1, 3 and 4 19.05 mm diameter
		US 4426	Type 2 22.20 mm diameter 23.81 mm diameter
2	Warning device installing sleeve	–	Types 1, 2 and 3 10.50 mm diameter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No.	Description	Quantity	Note when disassembling	Note when assembling	Special Instructions see
1	Brake light switch	2		torque to 1.5–2 mkg (11–14 lb. ft.)	
2	Elbow	2		moisten with brake fluid; when replacing elbow, ensure prescribed angle	B 2.4/1
3	Sealing plug	2		moisten with brake fluid; ensure correct installation position	
4	Stop screw	1	unscrew before removing spring ring	if necessary, move intermediate piston in cylinder	B 2.4/1
5	Seal	1		replace	
6	Master cylinder housing	1			
7	Intermediate piston spring	1			
8	Spring retainer	2			
9	Support washer	2			
10	Primary cup	4		replace; apply VW brake cylinder paste; install with sleeve	B 2.4/1
11	Cup washer	2			
12	Intermediate piston	1		replace	
13	Stroke limiting screw	1		tighten fully	
14	Stop sleeve	1			
15	Push rod piston spring	1			
16	Push rod piston	1		replace	
17	Secondary cup	1		replace; apply VW brake cylinder paste; install with sleeve	B 2.4/1
18	Stop washer	1			
19	Lock ring	1			
20	Rubber boot	1			

Note

The master cylinders and the repair kits are supplied by two different manufacturers, Messrs. Teves and Messrs. Schäfer. They are marked "ATE" (Teves) and "S" (Schäfer). The **complete** master cylinders of the respective vehicles are interchangeable irrespective of the manufacturer. It is not possible, however, to interchange individual parts of these master cylinders.

To avoid any possibility of brake malfunction, only a repair kit supplied by the manufacturer of the particular master cylinder is to be used. When performing repairs on the master cylinder **all** the parts of the repair kit must be installed **together,** even if only one internal part of the master cylinder is damaged or worn.

Disassembling

1 - Unscrew stop screw.

2 - Remove cylinder internal parts.

Assembling

1 - All parts must be cleaned in alcohol or brake fluid only.

2 - Check parts for wear.

The compensating ports must not be blocked or burred.

Note

Teves master cylinder

With exception of the secondary cup for the push rod piston all the cups are of the same shape and size and are, therefore, interchangeable.

Schäfer master cylinder

All cups are the same size and shape.

previous

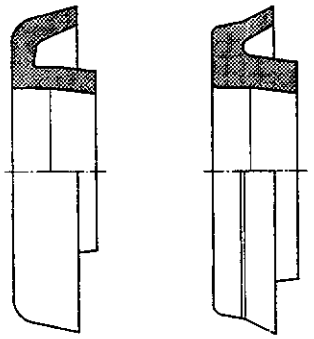
new

Modification

From August 1970, the Teves master cylinders have cups with stepped angled lips for the intermediate piston.

Repair kits contain cups with the modified lip.

They are marked on the outside with a 1 mm (0.040 in.) wide colored ring (illustration).



1 - Primary cup
2 - Cup with modified lip

3 - Install cups on pistons with installing sleeve.

4 - Place cup washer, primary cup, support washer, spring retainer and spring onto intermediate piston and insert piston vertically into master cylinder housing which should be held with the opening downward. This is necessary because if an attempt is made to put the piston in horizontally, the various parts will fall off the piston.

5 - Assemble push rod piston, cup washer, primary cup, support washer, spring retainer, stop sleeve, spring and stroke limiting screw and insert into master cylinder.

6 - Install stop washer and lock ring.

7 - Install stop screw and seal after checking that the hole for the screw is not covered by the intermediate piston. If the hole is covered, the parts inside the cylinder must be pushed farther in with the push rod as the stop screw is being screwed in.

The angles of the elbows for the lines from reservoir differ according to type and model.

In an elbow is replaced, make sure that the correct part is installed (see table).

Replacement cylinders with 135° elbows for both circuits are supplied. These cylinders can be installed in vehicles built after April 1971. When this is done, make sure that the slope of the supply lines between the reservoir and master cylinder is uniform.

The elbows of Type 3 vehicles must not be confused with each other.

Type	Brake circuit	Elbow angle 95°	105°	135°
1	Push rod piston			×
	Intermediate piston			×
1 [1])	Push rod piston		×	
	Intermediate piston			×
3	Push rod piston	×		
	Intermediate piston			×
4	Push rod piston		×	
	Intermediate piston		×	

[1]) from April 1971

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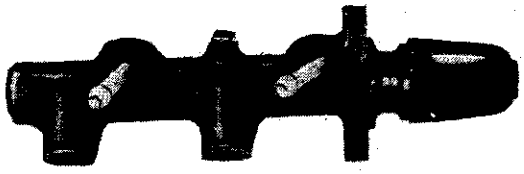


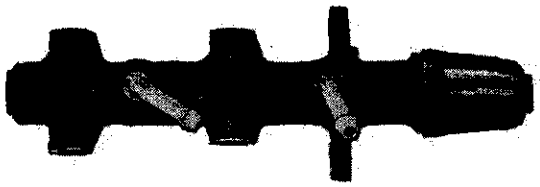
Type 1 from August 1970

Type 1 from August 1971

Note

The tandem master cylinders manufactured by Teves (marked with ATE) for Types 1 and 3 1972 model vehicles are longer and the shape and diameter of the sealing plugs have been changed. At the same time the elbows for the new plugs have been provided with a shoulder.

Type 3 from August 1970



Type 3 from August 1971

Note

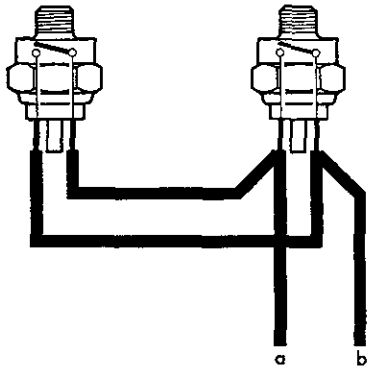
When selecting repair kits for the tandem master cylinder, check first of all, if the cylinder concerned is from model year 1971 or 1972. The correct repair kit can then be found in the Parts List.

Testing brake light switch

1 - Disconnect cables from brake light switch for front brake circuit. Switch ignition on and operate foot brake. Brake lights must light up.

2 - Connect cables and repeat test on brake light switch for rear brake circuit.

3 - If, during one of the tests, the brake lights do not light up, replace the appropriate switch with a new one.

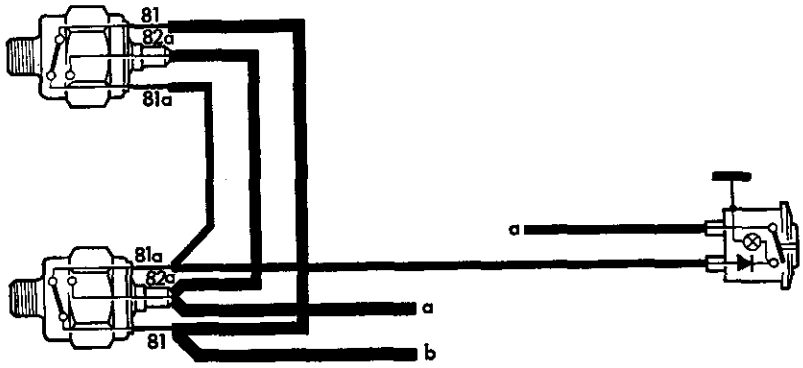


a = to terminal 15
b = to brake lights

Testing brake light switch with warning device

A - Contact for brake light

1 - Disconnect cables from brake light switch for front brake circuit (contacts 81–82 a, black-red and black cable).



a = to terminal 15
b = to brake lights

2 - Switch ignition on and depress brake pedal. Brake lights must light up.

3 - Connect cables and repeat test on rear brake circuit switch.

4 - If, during one of the tests, the brake lights do not light up, replace the appropriate switch with a new one.

B - Contact for warning lamp

1 - Switch ignition on and test warning lamp by pressing push button in. Warning lamp must light up.

2 - Open a bleeder valve in the front brake circuit. Catch escaping fluid.

3 - Switch ignition on and depress brake pedal. Warning lamp must light up.

Important
Release brake pedal only after bleeder valve has been closed.

4 - Repeat test on rear brake circuit.

5 - Check fluid level in brake fluid reservoir.

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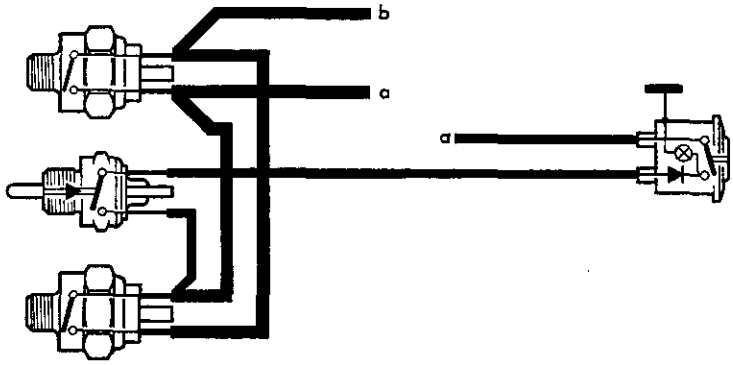
Removing and installing brake light switch/ warning device switch

1 - Disconnect cables from brake light switch or warning device switch and unscrew switch. Catch any escaping fluid with a cloth.

2 - Install new brake light switch / warning device switch and connect cables according to wiring diagram.

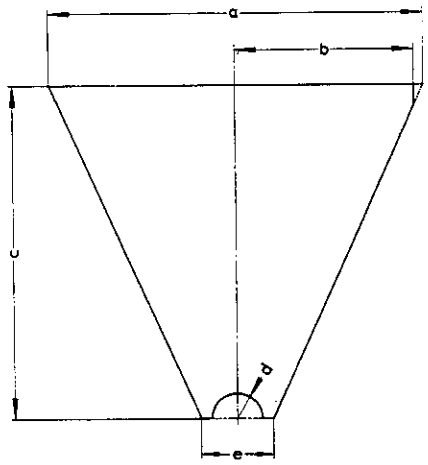
3 - After installing switch, bleed appropriate brake circuit. This is not necessary for the warning device switch.



a = to terminal 15

b = to brake lights

Tools



Type 1
a = 8.27 in. (210 mm)
b = 3.94 in. (100 mm)
c = 7.48 in. (190 mm)
d = .55 in. (14 mm)
e = 1.57 in. (40 mm)
Sheet metal thickness = .06 in. (1.5 mm)

Type 1 from Chassis No. 119 480 130 / Type 3
a = 8.86 in. (225 mm)
b = 4.23 in. (107.5 mm)
c = 7.48 in. (190 mm)
d = .55 in. (14 mm)
e = 1.57 in. (40 mm)
Sheet metal thickness = .06 in. (1.5 mm)

Important

The templates for Types 1 and 3 must not be confused when carrying out the adjustment. For this reason, the Type 1 template should be marked with yellow paint and the Type 3 template with violet paint.

No.	Description	Tool	Remarks
	Template		

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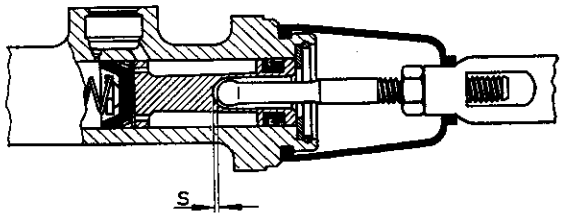
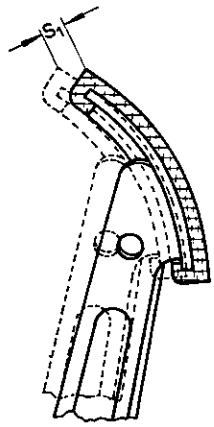
Adjusting push rod

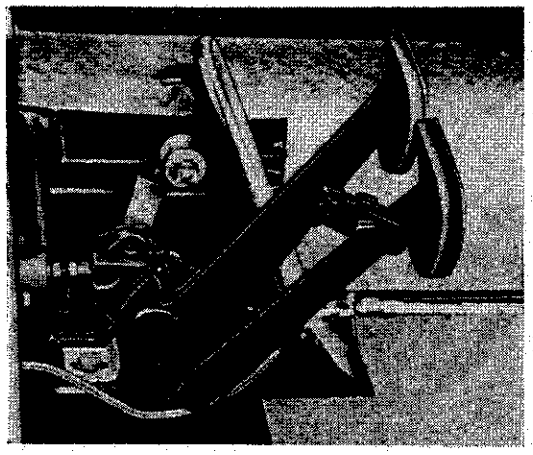
The push rod must always be adjusted so that there is a clearance of s = .04 in. (1 mm) between push rod and bottom of piston. This play can also be measured as free play at the brake plate. The free play is s_1 = .20–.28 in. (5–7 mm).



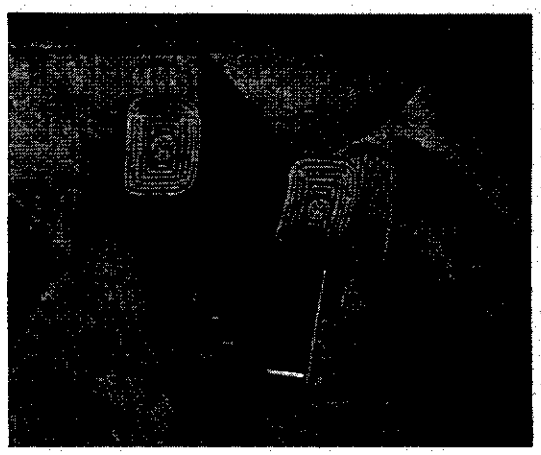


Types 1 and 3

1 - Adjust pedal free play at pedal stop.



Important
The pedal free play must be large enough so that when one brake circuit fails sufficient retardation can be attained with the intact brake circuit without the brake pedal touching the cross panel. A template enables the pedal play to be determined quickly and accurately.



2 - Adjust push rod until the necessary play "s" is attained.

3 - Tighten locknut and push boot over hexagon.

Types 1 and 3

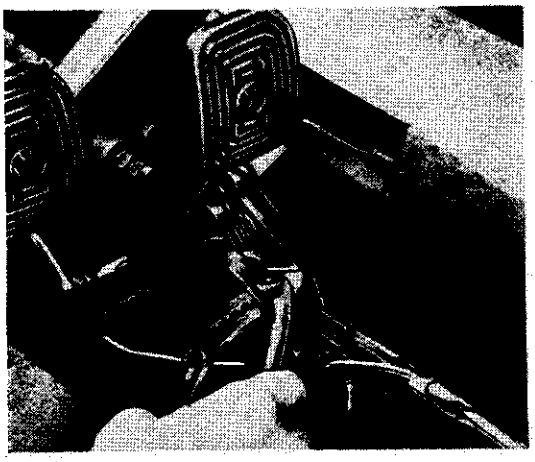
Removing

1 - Remove accelerator pedal (see K 4.1/1).

2 - Remove push rod lock plate.

3 - Detach brake pedal return spring.

4 - Detach pedal cluster from frame and remove push rod.



Installing

1 - Install push rod, tighten pedal cluster bolts and attach return spring. Install lock plate on push rod pin.

2 - Install accelerator pedal (see K 4.1/1).

3 - Check pedal free travel with template and, if necessary, adjust.

Type 2

Removing

1 - Remove cover plate.

2 - Pull cotter pin out of retaining pin and remove push rod.

Installing

1 - Make sure that pin is locked with **new** cotter pin.

2 - If necessary, align brake pedal stop.

Type 2 with brake servo

Removing

1 - Remove cover plate.

2 - Back off locknut of servo push rod.

3 - Disconnect push rod from brake pedal by twisting fork clear of pedal. Unscrew out of threaded part of servo.

Installing

When installing, make sure that the length of the push rod is set accurately (see B 2.6/1).

Type 4

Removing and installing

To remove the push rod it is necessary first to remove the complete pedal support (see B 2.7/1).

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Removing

1 - Detach clutch cable at clutch lever.

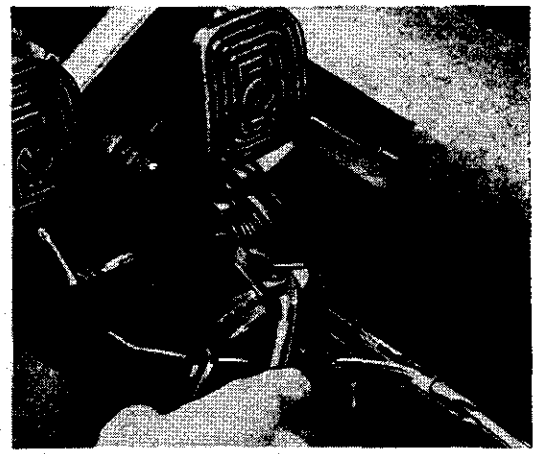
2 - Remove accelerator pedal.

3 - Detach accelerator cable.

4 - Remove push rod lock plate.

5 - Detach brake pedal return spring at push rod pin.

6 - Remove pedal cluster mounting bolts. Carefully pull out pedal cluster together with clutch cable so that cable is not detached. At the same time take master cylinder push rod off pin. Detach clutch cable.



Installing

1 - After attaching clutch cable, hold clutch pedal as vertical as possible, otherwise the cable will easily come off again.

2 - Insert both pedal cluster attaching bolts.

3 - Position push rod on brake pedal pin, then tighten both bolts to prescribed torque.

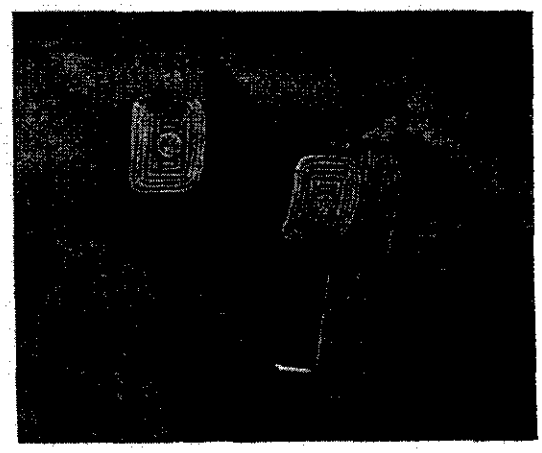
4 - Make sure that the brake pedal return spring is correctly positioned.

5 - Attach brake pedal return spring. Install master cylinder push rod lock plate.

6 - Check brake pedal free play with template. If necessary, adjust pedal play and length of push rod (see B 2.6/1).

Note

From August 1970 the angle of the clutch and brake pedals on Type 1/Sedan 113 vehicles was altered to bring the brake pedal more into line with the accelerator pedal. The pedal travel is still limited by a depression in the front partition.

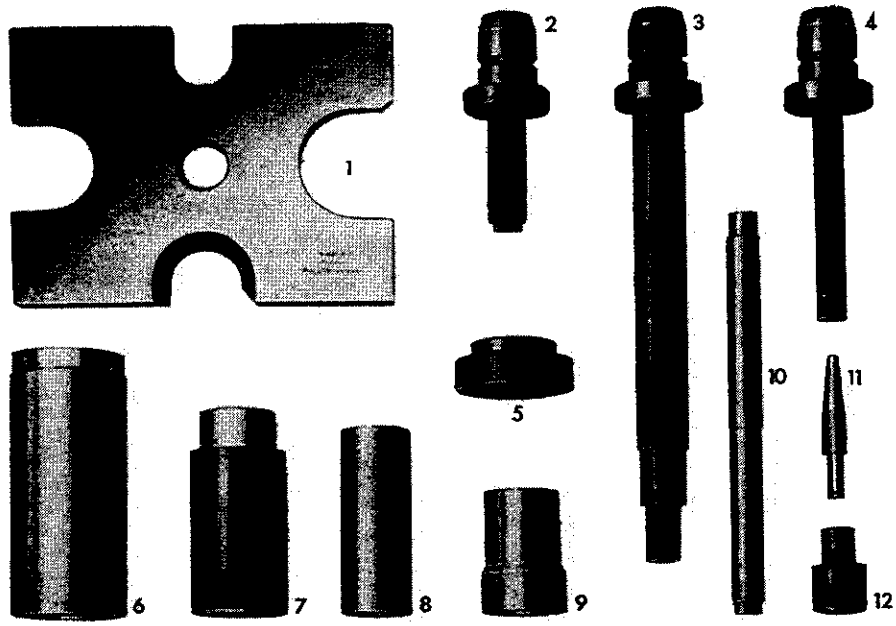


7 - Attach accelerator cable to connecting lever.

8 - Install accelerator pedal.

9 - Adjust clutch play (see M 8.3/4).

Removing and installing pedal cluster Types 1 and 3 **1-1**



No.	Description	Tool	Remarks
1	Thrust plate	VW 401	
2	Punch	VW 409	
3	Punch	VW 408 a	
4	Punch	VW 411	
5	Thrust pad	VW 433	
6	Tube	VW 415 a	
7	Arbor	VW 432	
8	Tube	VW 416 b	
9	Tube	VW 454	
10	Guide pin, shouldered	VW 439	
11	Guide pin, conical	VW 437 a	
12	Thrust pad	VW 431	

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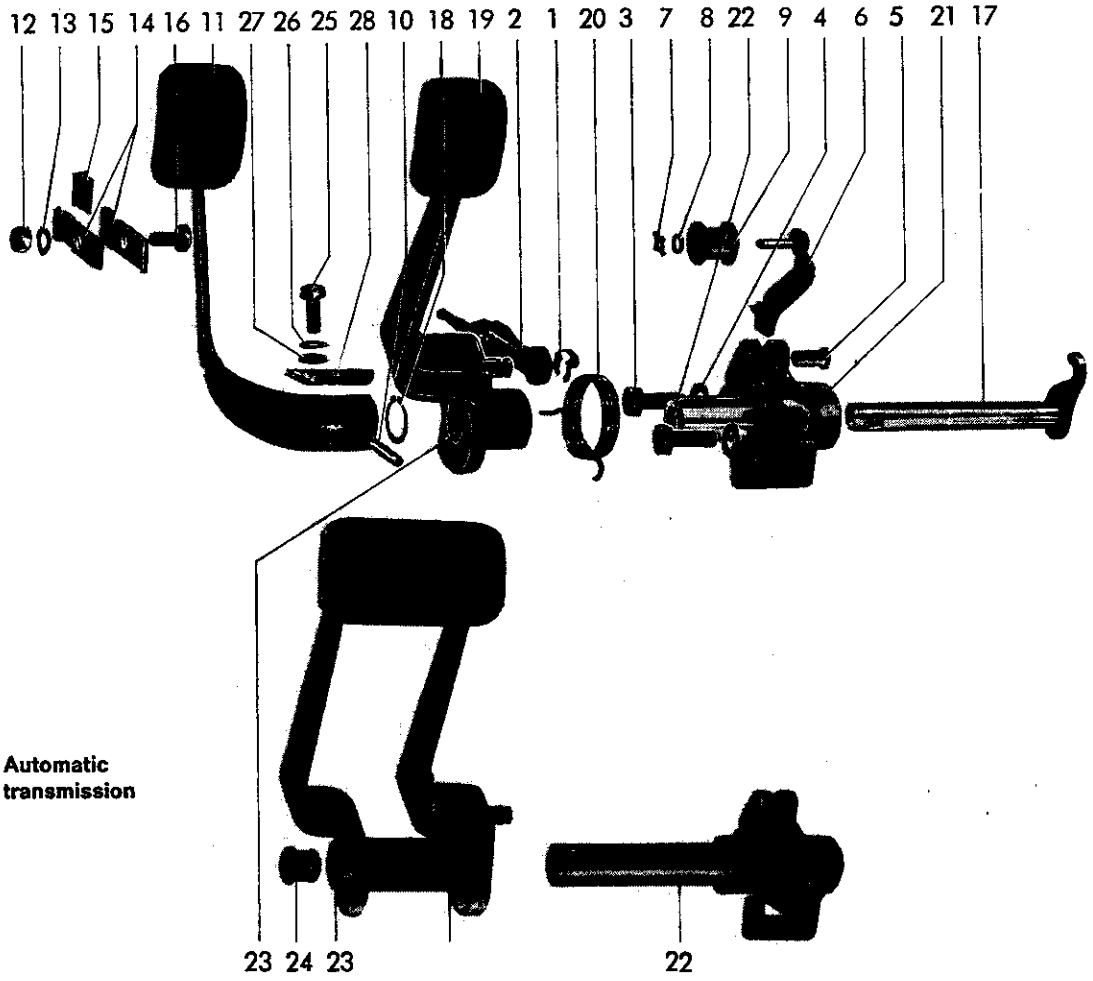
Manual transmission



Automatic transmission

No.	Description	Qty.	Note when removing	Note when installing	Special-instruc-tions see:
1	Clip	1	detach return spring at same time		
2	Push rod	1		adjust	B 2.6/1
3	Bolt	2			
4	Spring washer	2			
5	Pin	1		lubricate	
6	Accelerator pedal lever	1			
7	Lock plate	1			
8	Washer	1			
9	Roller	1			
10	Spring pin	1			
11	Clutch pedal	1	with VW 401, VW 411 and VW 437 a	with VW 401 and VW 411	B 2.7/3
12	Nut	1			
13	Spring washer	1			
14	Clamp	2			
15	Rubber stop	1			
16	Bolt	1			
17	Clutch pedal shaft	1		install with grease	
18	Circlip	1			
19	Brake pedal	1		check bushings for wear	
20	Return spring	1			
21	Mounting and brake pedal shaft	1		check bushings for wear install with grease	
22	Bushing	2		with VW 401, VW 409, VW 431 and VW 432	B 2.7/3
23	Bushing	2		with VW 401, VW 409 and VW 416 b	B 2.7/3
24	Plug	1			
25	Bolt	1			
26	Spring washer	1			
27	Washer	1			
28	Stop plate	1			

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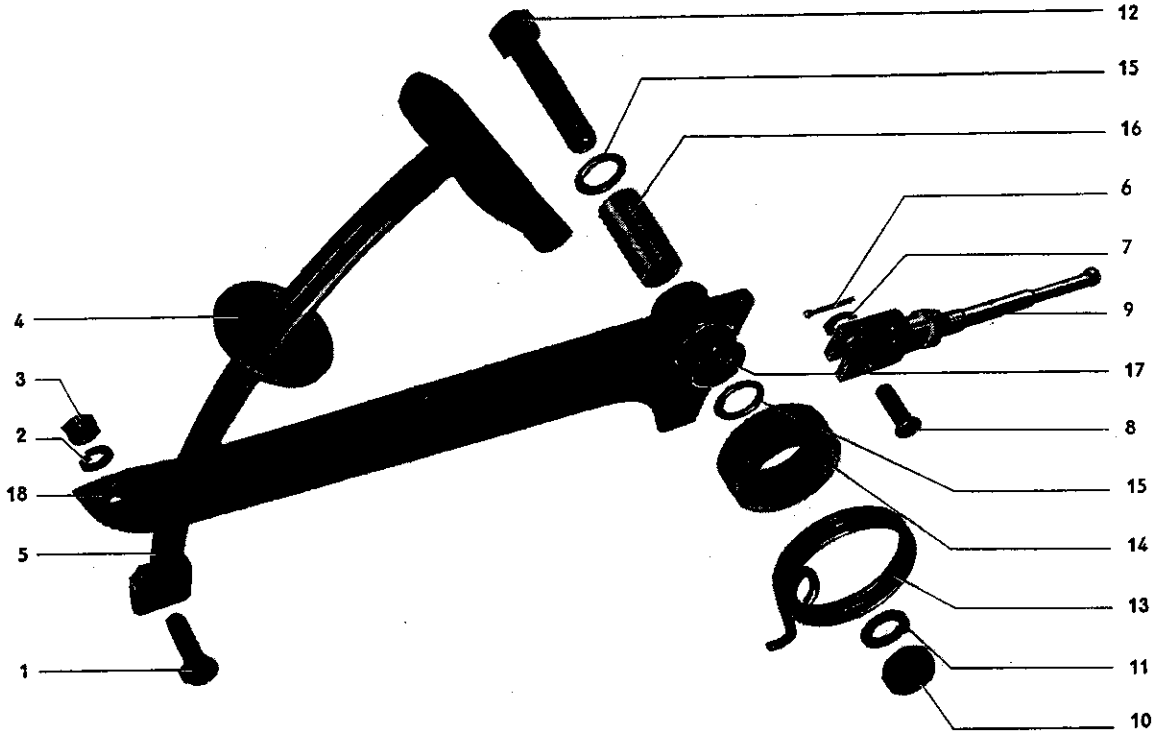
B 2.7 Pedal Cluster



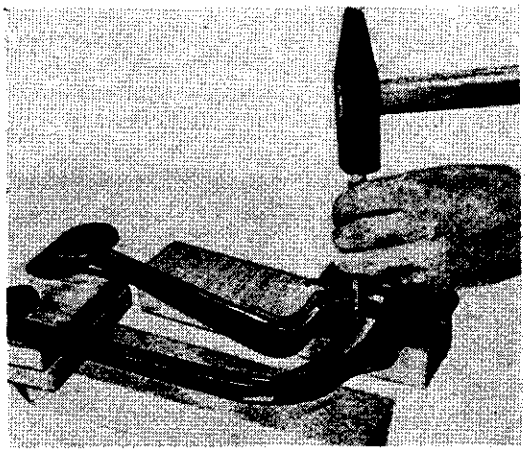
No.	Description	Qty.	Note when disassembling	Note when assembling	Special-instruc-tions see:
1	Bolt	1			
2	Lock washer	1			
3	Nut	1			
4	Seal	1			
5	Brake pedal	1			
6	Cotter pin	1		replace	
7	Washer	1			
8	Pin	1		lubricate sparingly	
9	Push rod	1		check play	B 2.6/1
10	Nut	1		tighten to 2.5–3 mkg (18–22 lb. ft.)	
11	Lock washer	1			
12	Bolt	1			
13	Return spring	1			
14	Plastic ring	1			
15	Seal	2			
16	Mounting tube	1		lubricate sparingly	
17	Bushing	1		check for wear press old bushing out with new bushing and VW 401, VW 409, VW 415 a and VW 433	B 2.7/3
18	Brake pedal lever	1		check bushing	

2-4 **Disassembling and assembling pedal cluster Type 2**

Disassembling

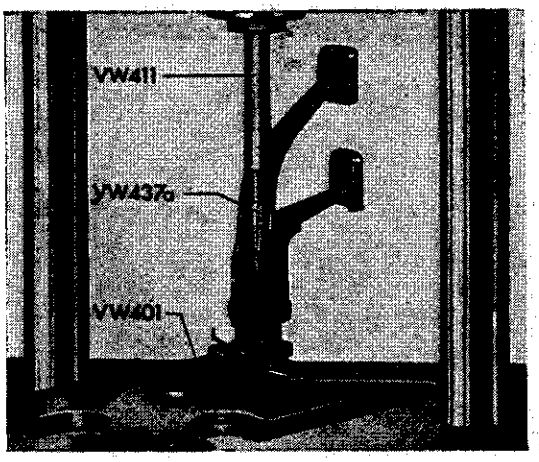
1 - Press pin for accelerator cable connecting lever out of pedal cluster mounting and remove accelerator cable connecting lever.

2 - Drive spring pin out of clutch pedal and clutch pedal shaft.



3 - Press clutch pedal shaft out of clutch pedal on repair press, using VW 411, VW 437a and VW 401.

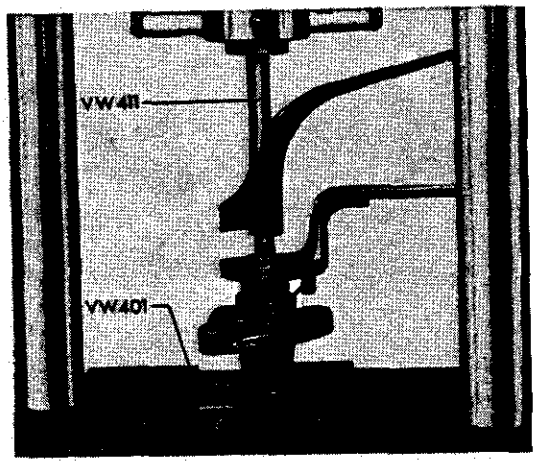
4 - Pull clutch pedal shaft out of pedal cluster mounting.

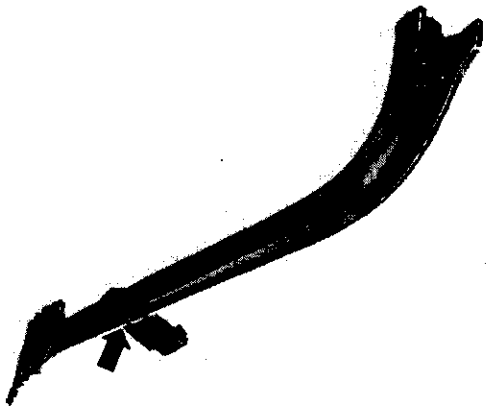


5 - Using circlip pliers, remove circlip from mounting tube.

6 - Remove brake pedal and return spring from mounting tube by turning them by hand.

7 - Check bushing for wear and, if necessary, replace (see page B 2.7/3).





Assembling

1 - Push brake pedal onto mounting tube, ensuring that brake pedal return spring is correctly positioned.

2 - Do not forget brake pedal circlip.

3 - Press clutch pedal onto clutch pedal shaft on repair press, using VW 411 and VW 401.

4 - Use new spring pin for clutch pedal.

5 - Install accelerator cable connecting lever correctly.

Note

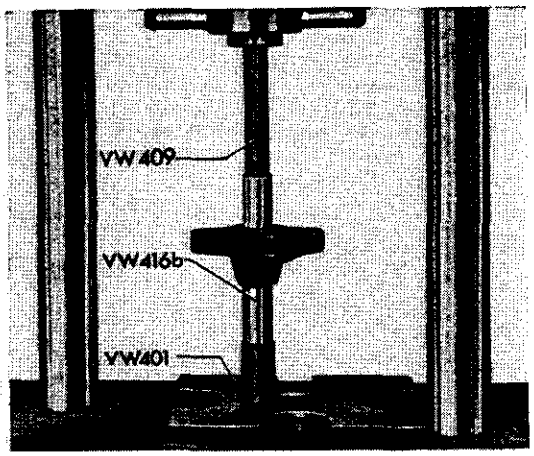
From August 1970, Types 1 and 3 vehicles are equipped with clutch pedals which only differ in the welded-on pedal travel stop (Type 1).

As a spare part only the Type 1 pedal with stop is supplied for both vehicles. When installing the pedal to a Type 3 vehicle, cut the stop off as shown (arrow).

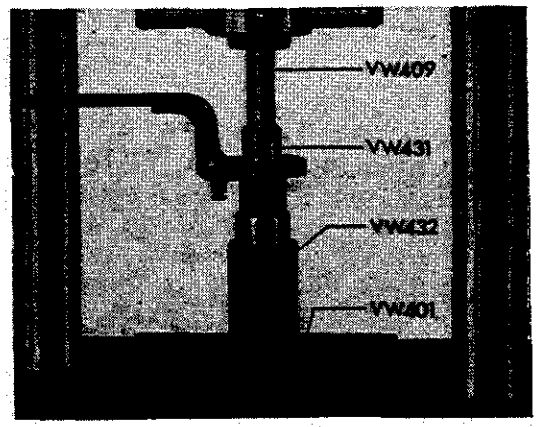
The rest of the stop should be deburred and painted black.

Types 1 and 3

1 - If necessary, drive clutch pedal shaft bushings out of mounting tube. Press new bushings in with tools VW 401, VW 416 b and VW 409.

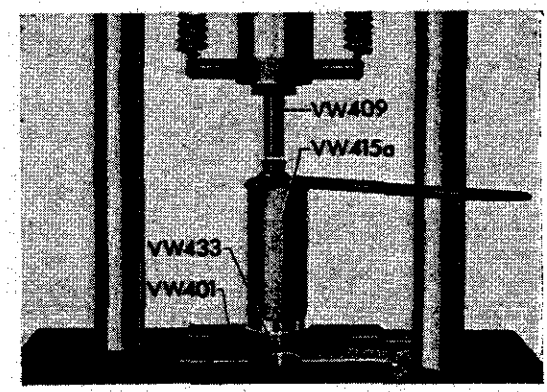


2 - If necessary, drive bushings out of brake pedal. Press new bushings in with tools VW 409, VW 431, VW 432 and VW 401.



Type 2

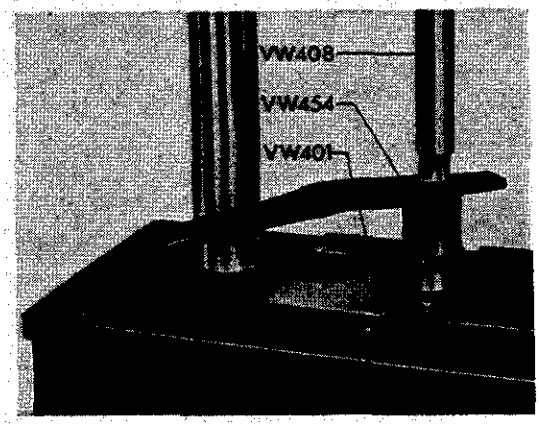
Press old metal bushing out with new bushing using tools VW 401, VW 409, VW 415 a and VW 433.



Type 4

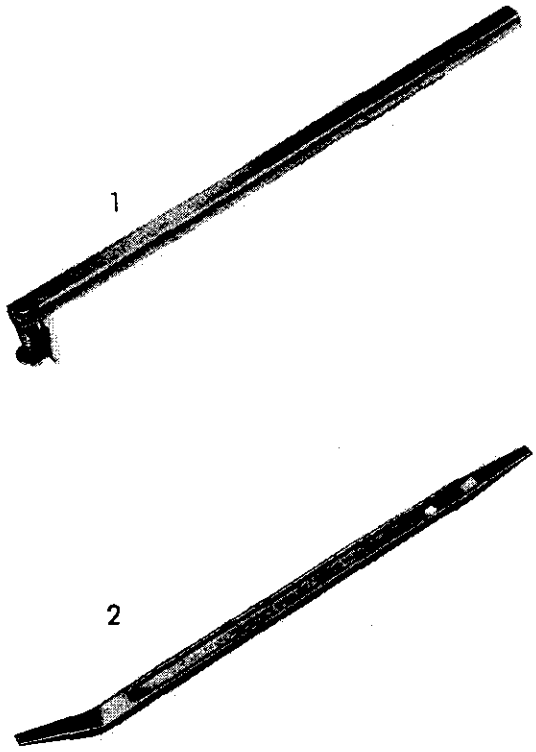
Press old metal bushing out with new bushing and tools VW 408 a, VW 454 and VW 401.

When doing this, the longer end of the pedal tube into which the bushing is pressed must face downward. The bushing must be flush at the shorter end of the pedal tube.



Pressing bushings out and in pedal cluster Types 1, 2, 3 and 4 **3-3**

Tools



No.	Description	Tool	Remarks
1	Appliance for checking brake lining wear	VW 753	
2	Brake shoe adjuster		

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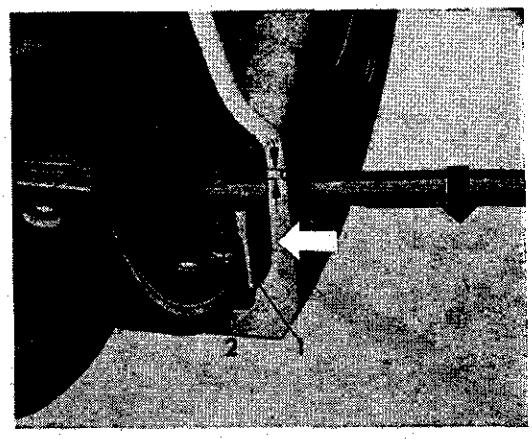
Checking brake linings



The thickness of the brake linings can be checked with the brake drums installed. For this purpose there are inspection holes in the backing plates that are closed with plugs.

The brake backing plates of Type 2 vehicles to chassis no. 218 109 823 have no inspection holes. The thickness of the brake linings can be checked with tool VW 753 through the adjusting hole in the brake drum. Before checking, the brake shoes must be adjusted as prescribed.

Press tool outwards (black arrow) so that the fixed pin (1) is located on the friction surface of the brake drum. The pin (1) must also be pressed against the brake shoe (white arrow) so that the turning radius of the drum is not included in the measurement in error. The measurement "a", by which the moving pin (2) is lifted, is equal to the existing lining thickness left to wear.

Example: If measurement "a" = 1 mm it means that the linings can be worn down a further 1 mm before they reach the wear limit of 2.5 mm.

The linings are completely worn out if the pin (2) does not lift at all.

Adjusting brakes

With an adjusting lever or using a screwdriver as a lever, turn the adjusting nuts until a slight drag is noticed when the wheel is turned by hand. Back off adjusting nuts 3 to 4 teeth to allow the wheel to turn freely.

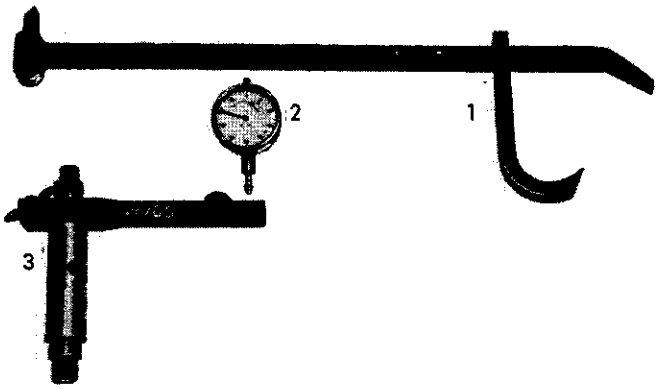
The adjusting nuts on Type 1 vehicles are accessible from the backing plate. The holes are closed with plugs.

Repeat the procedure on the other adjusting nuts. Note that the two nuts turn in opposite directions.

Note:

On the front wheels of Type 2 vehicles, the adjusting nuts are opposite each other.

Tools



No.	Description	Special tool	Remarks
1	Hub cap puller	VW 637/2	
2	Dial gauge		Local purchase item
3	Dial gauge bracket	VW 769	

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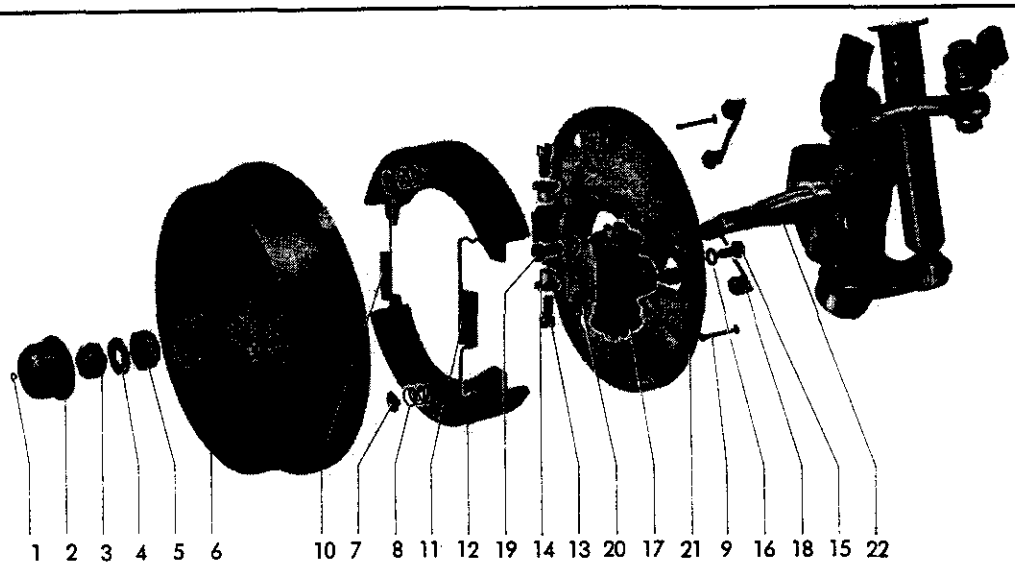


No.	Description	Quantity	Note when disassembling	Note when assembling	Special instructions see
1	C-washer	1			
2	Hub cap	1	pull off with VW 637/2		
3	Clamp nut	1		torque to 1–max. 1.3 mkg (7–max. 9 lb. ft.)	B 3.1/2
4	Thrust washer	1			
5	Wheel bearing	1		adjust play (0.03–0.12 mm / .001–.005 in.)	B 3.1/2
6	Brake drum Sedan, Convertible Coupé 4 hole	1	check for wear; if necessary, turn down or replace		B 3.1/2
7	Spring plate	2			
8	Spring	2			
9	Retaining pin	2			
10	Return spring	1			
11	Return spring	1			
12	Brake shoe	2	check brake lining thickness; if necessary, replace		B 3.1/2
13	Adjusting screw	2		lubricate lightly	
14	Adjusting nut	2		lubricate lightly	
15	Bolt	1		torque to 2.5 mkg (18 lb. ft.)	
16	Lock washer	1			
17	Wheel brake cylinder	1	check dust seals and cups for wear		B 3.1/3
18	Sealing bridge	2			
19	Bolt	3		torque to 5 mkg (36 lb. ft.)	
20	Lock washer	3			
21	Back plate	1			
22	Steering knuckle	1			

Removing and installing brake drums

Removing

1 - Remove C-washer for speedo cable (left only) and pull hub cap off with VW 637/2.

2 - Remove clamp nut and take drum off.

Installing

When installing, it is important that the wheel bearing is correctly adjusted.

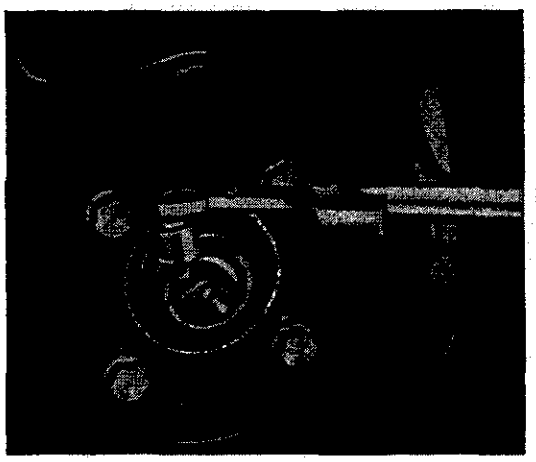
1 - Install brake drum, bearing and clamp nut. Install wheel. When tightening clamp nut, rotate wheel.

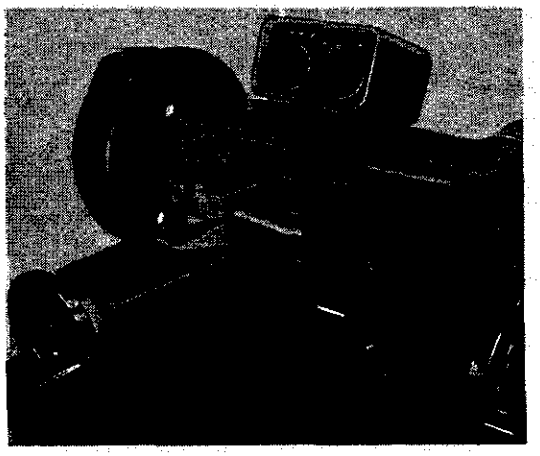
2 - Position dial indicator and adjust bearing play.

Nominal play: 0.03–0.12 mm (.001–.005 in.).

Note:
The play should be measured at several locations on the circumference.

3 - Tighten socket head screw to prescribed torque.





Reconditioning brake drums

Brake drums that are worn, scored or out-of-round can often be made serviceable by turning. The turning dimensions as well as all other tolerances are given in the technical data on page B 1.8/1.

Caution
Oversize linings must be used on brake shoes for reconditioned drums as these are matched with the radius of the turned drums.

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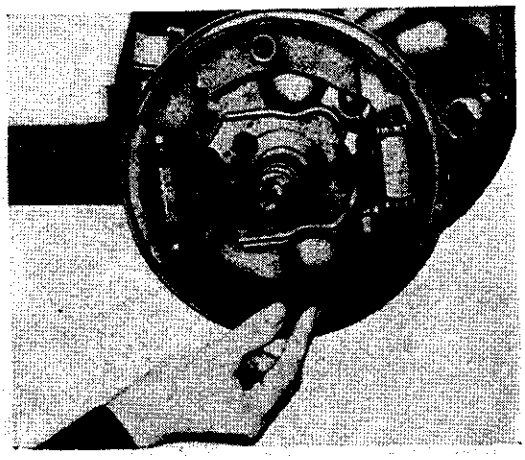
Removing and installing brake shoes



Type 1

Removing

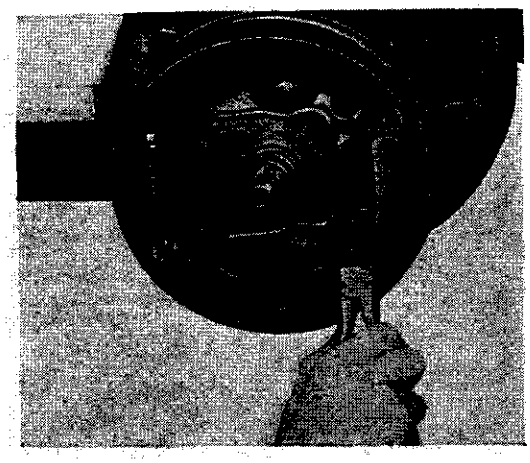
1 - Remove brake drum.

Note

Before removing brake shoes, the wheel brake cylinder should be checked for proper operation.

To do this, a mechanic depresses the brake pedal carefully while a second mechanic watches to see that the pistons press the brake shoes apart evenly. To prevent the shoes from opening too far, insert two screwdrivers between the backplate flange and brake shoes. If necessary, repair wheel brake cylinder. At the same time, check bleeder valve for freeness.

2 - Remove spring plates, springs and retaining pins for brake shoes.



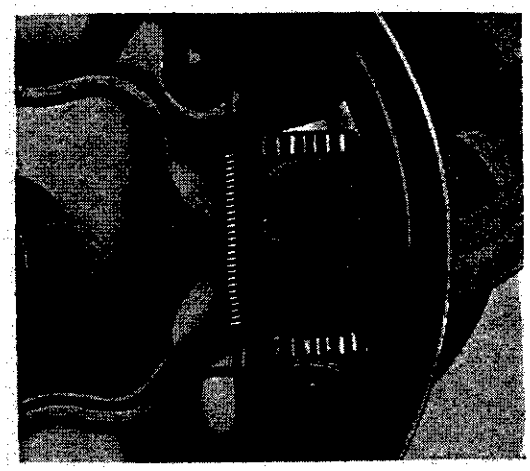
3 - Detach return springs and take brake shoes off.

4 - Check that adjusting screws and nuts are free. Free up if necessary.

Installing

Note:

When replacing brake shoes, make sure that the same type of lining is used for both wheels of one axle.



1 - Install brake shoes correctly. The stronger return spring and the cut-out for the push rod in the brake shoe web should be near the wheel cylinder.

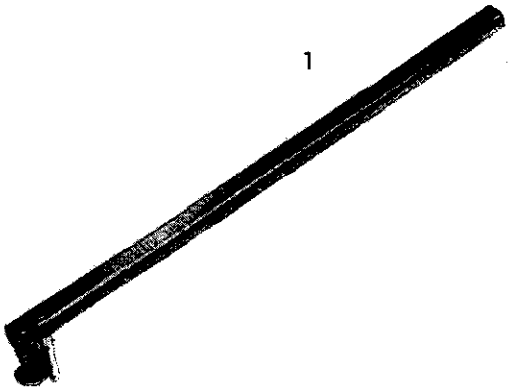
Caution

Make sure that the slots in the adjusting screws are properly seated **on the angled shoe ends.**

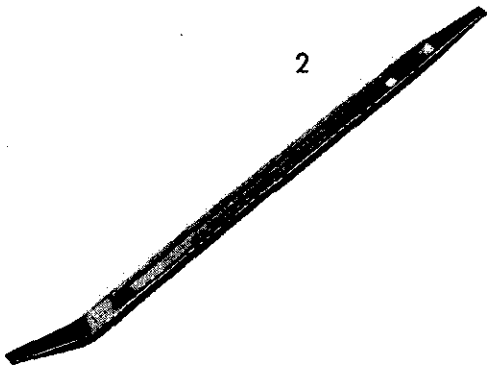
2 - Install brake drum and adjust bearings (see B 3.1/2).

Tools

1



2



No.	Description	Tool	Remarks
1	Appliance for checking brake lining wear	VW 753	
2	Brake shoe adjuster		

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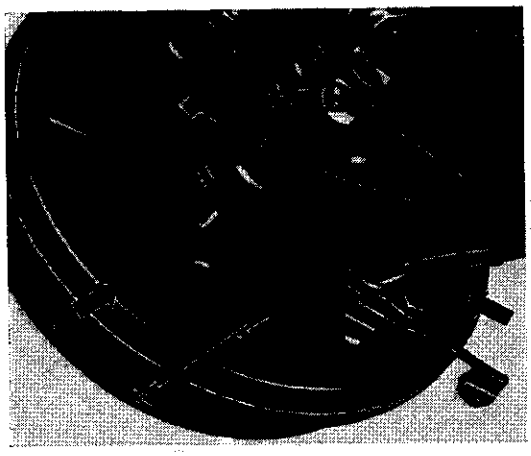
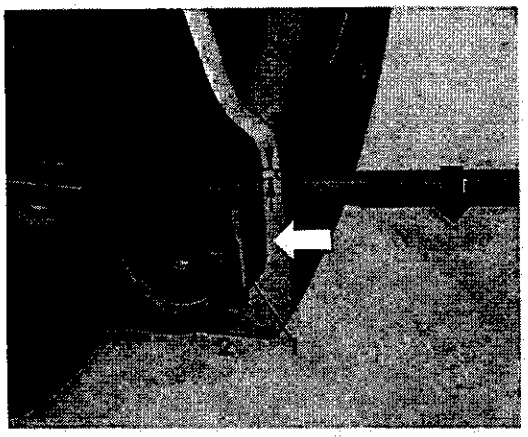
Checking brake linings

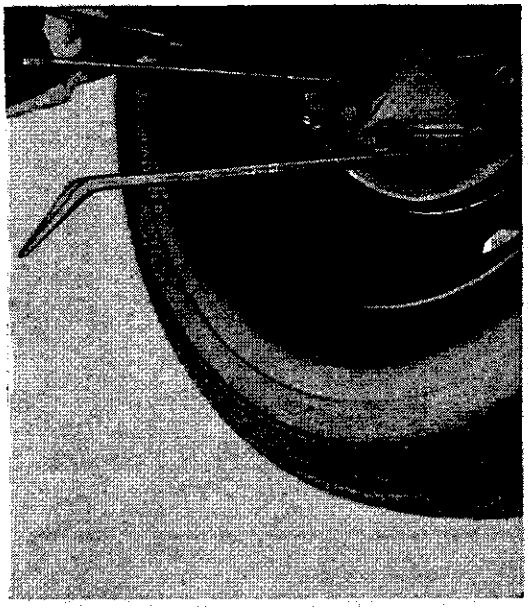


The thickness of the brake linings can be checked with the brake drums installed. For this purpose there are inspection holes in the backing plates that are closed with plugs.



The brake backing plates of Type 2 vehicles to Chassis No. 218 109 823 have no inspection holes. The thickness of the brake linings can be checked with tool VW 753. This tool is inserted into the adjusting hole in the brake drum. Before checking, the brake shoes must be adjusted as prescribed. (The use of tool VW 753 is shown on page 3.1/1–2.)

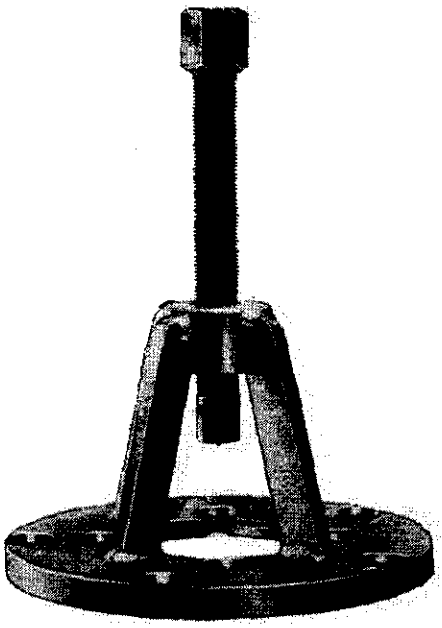
Adjusting brakes



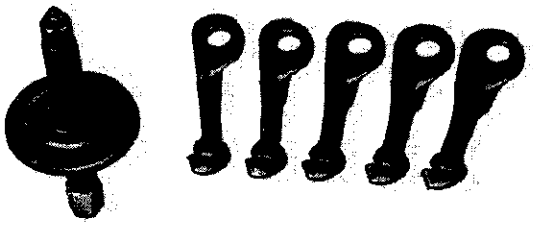
Before adjusting the brake shoes, back off the hand brake completely.

With an adjusting lever, or using a screwdriver as a lever, turn the adjusting nuts until a slight drag is noticed when the wheel is turned by hand. Back off adjusting nuts 3 to 4 teeth to allow the wheel to turn freely.

Repeat the procedure on the other adjusting nuts. Note that the two nuts turn in opposite directions.



1



2

No.	Description	Special tool	Remarks
1	Brake drum puller	VW 202 BZ	
2	Brake drum puller		local purchase item

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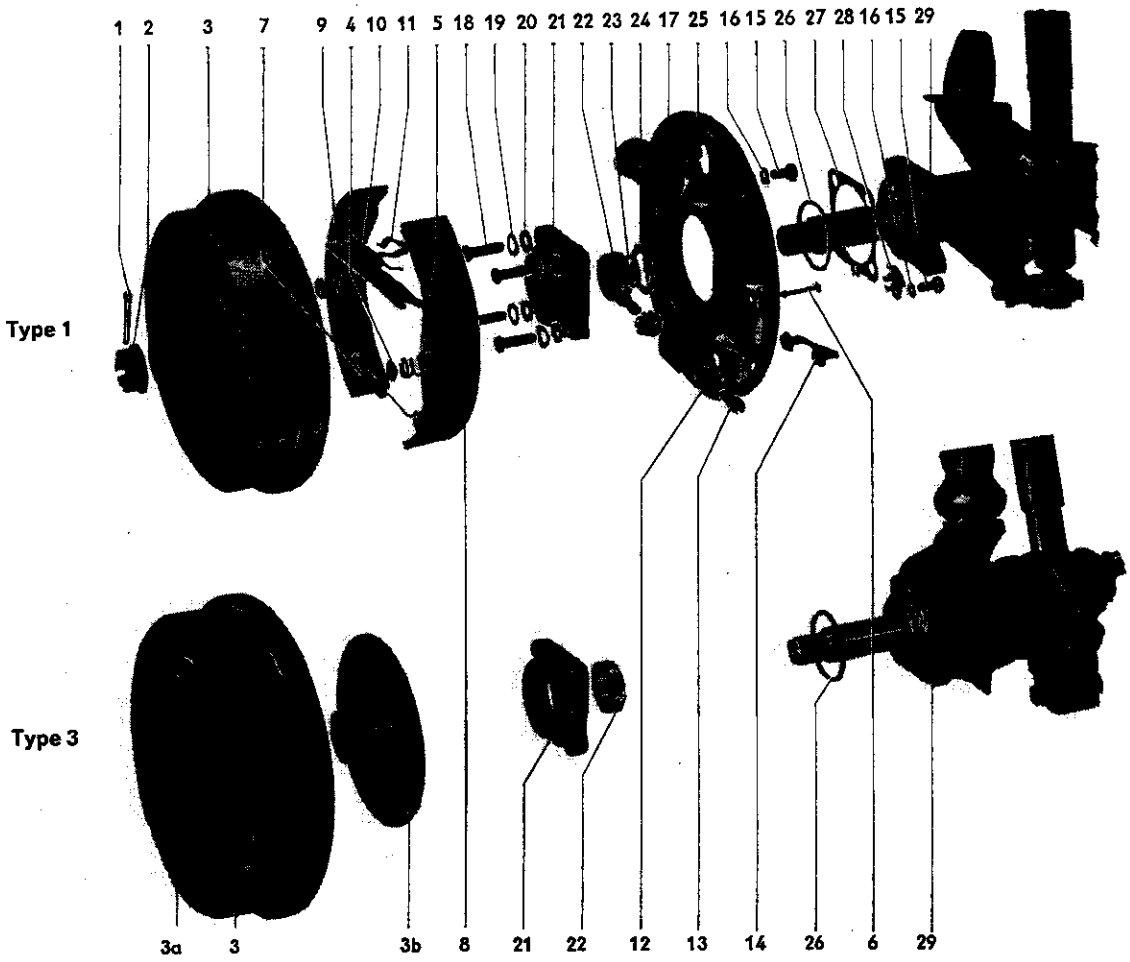


No.	Description	Quantity	Note when disassembling	Note when assembling	Special instructions see
1	Cotter pin	1		use new cotter pin	
2	Slotted nut	1		torque to 35 mkg (253 lb ft) [1]	
3	Brake drum Model 181: five bolt brake drum	1	if necessary use puller; back off brake shoes	check for wear	B 4.1/2
3a	Bolt	2			
3b	Rear wheel hub	1			
4	Spring cup	2			
5	Spring	2			
6	Retaining pin	2			
7	Return spring	2			
8	Brake shoe (one with brake lever)	2		check brake linings; if necessary, replace use only brake linings of the same type on one axle; install lever correctly	B 4.1/2 B 4.1/2

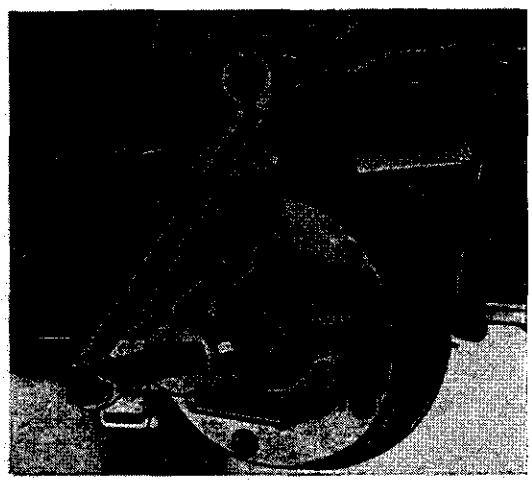
Removing

Warning

It is dangerous to remove and install slotted nut with the vehicle on a hoist. Lower vehicle to perform this work.

Before removing brake drums, back off brake shoe adjustment.

On older Type 1 and 3 vehicles the brake drum, or on later Type 3 vehicles the wheel hub, is sometimes corroded on the splines of the axle shaft. In such cases it can be removed with a puller.



Note

On Type 2 vehicles from August 1970, Chassis No. 211 2 000 001, the rear wheel hub complete with brake drum is pulled off the axle shaft splines with a five-arm puller.

Installing

1 - Before installing brake drum, lubricate splines lightly.

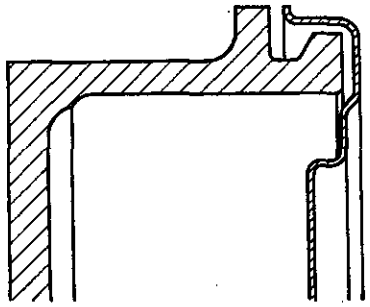
2 - Tighten slotted nut to correct torque. If necessary, turn farther to align cotter pin with hole.

3 - Insert cotter pin.

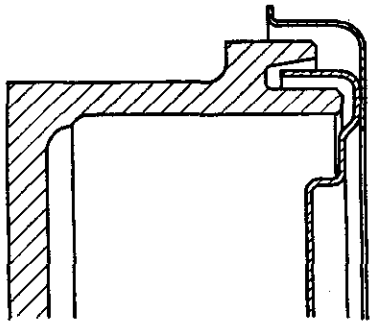
Note

All Type 2 vehicles from Chassis No. 218 109 824 have brake drums and backing plates installed on the rear axle with a double labyrinth type of sealing.

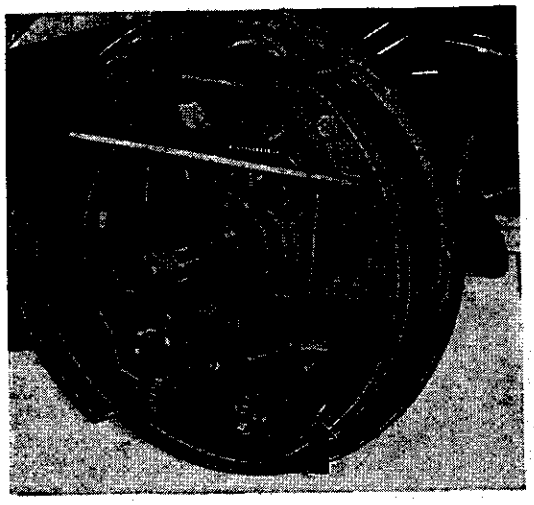
When these parts are being service installed the brake drums and backing plates of both sides must be exchanged together.

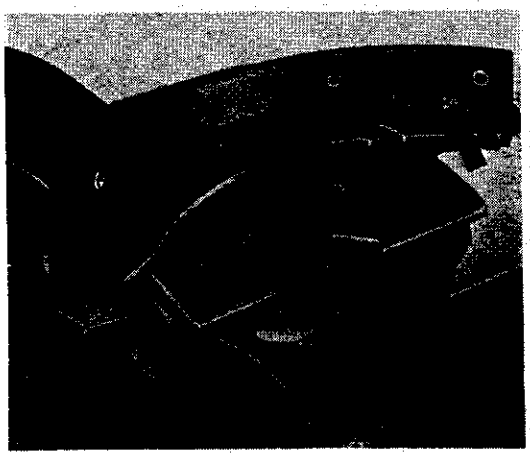


up to Chassis No. 218 109 823



from Chassis No. 218 109 824





1 - Pin
2 - Spring washer
3 - Lever
4 - Shoe
5 - Clip

Removing

1 - Remove both shoe retaining springs.

2 - Disconnect lower return springs.

3 - Disconnect parking brake cable from lever (arrow).

4 - Remove brake shoes, connecting link, upper return spring and clip.

5 - Detach brake lever from shoe (arrow).

Installing

When installing new brake shoes, make sure that the same type of linings is used for both wheels on one axle.

Caution

On vehicles equipped with a brake servo, only TEXTAR brake linings are to be used on the front axle. Both TEXTAR and ENERGIT linings can be installed on the rear axle.

1 - Install brake lever correctly.

2 - Lubricate adjusting nuts and screws lightly and back them off.

3 - Install brake shoes, connecting link and upper return spring as well as clip.

Caution

Make sure that the brake shoes are correctly positioned in the adjusting screws.

Angled brake shoe ends, Type 1 and 3

Straight brake shoe ends, Type 2

Angled brake shoe ends, Type 2 from Chassis No. 211 2 000 001

4 - Install lower return springs and retaining springs.

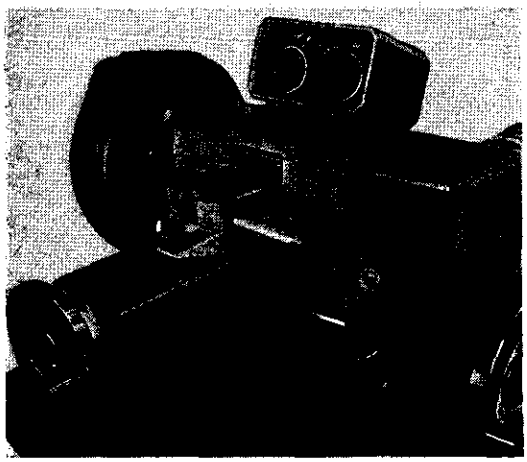
5 - Attach parking brake cable.

6 - Install brake drum

Turning brake drums

Brake drums that are out-of-round or worn or scored can often be made serviceable by machine turning or grinding.

The turning dimensions as well as all other tolerances are given in the technical data on page B 8.1/1.



Note

Brake shoes for reconditioned drums must be installed with oversize linings. These linings are ground to match the turned drum.

For this purpose, the brake drums of Type 3 vehicles should be removed together with the rear wheel hub. Brake drums of Type 4 vehicles must be bolted to the rear wheel hub of a Type 3 vehicle for turning.

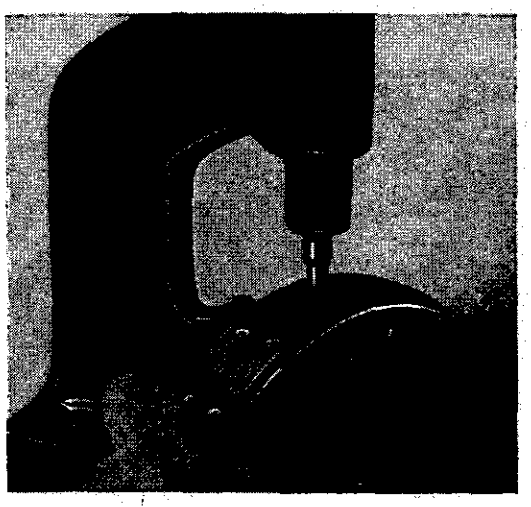
Relining brake shoes

When removing brake shoe linings from brake shoes, the linings on both rear wheels should be replaced at the same time to ensure uniform braking. Linings of the same type should also be used on both sides of each axle for the same reason. Oil soaked linings must be replaced.

1 - Carefully remove linings to avoid damage and distortion to shoes .

2 - Clean brake shoes and remove burrs from rivet holes.

3 - Rivet new linings from the center outward.



The linings must not overhang at the sides. They must also properly contact the shoe over the entire area, otherwise noises will occur as well as a loss in braking efficiency.

Press rivets in vertically to avoid tension in linings.

Removing

1 - Remove brake drum, brake shoes and wheel brake cylinder. Then take brake shoe adjusting nuts out of support on backing plate.

2 - Remove brake cable bracket.

3 - Remove rear wheel bearing cover and take brake backing plate off.

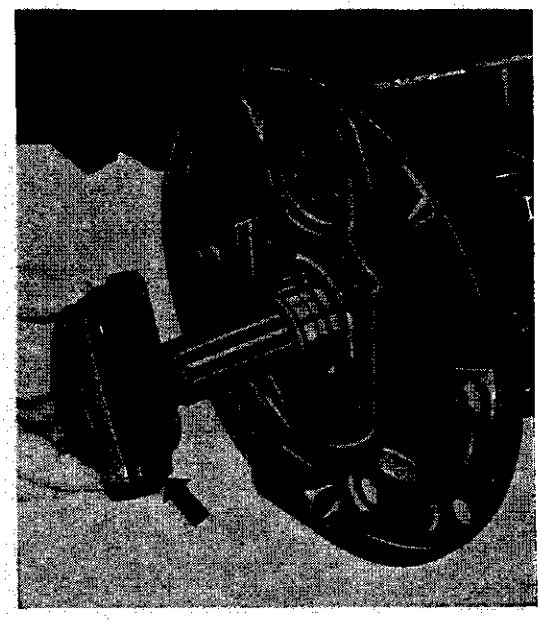
Installing

A - Vehicles with swing axle

1 - Clean dirt and traces of old sealing compound off contacting surfaces of backing plate, bearing flange and bearing cover.

2 - Position back plate, gasket and large seal on bearing flange. Then push washer and small seal onto axle shaft.

3 - Install spacer.



4 - Install bearing cover. Make sure that hole (arrow) faces downward.

5 - Tighten bearing cover bolts to correct torque.

6 - Install other parts and bleed brake system (see page B 8.1/1).

B - Vehicles with double joint rear axle

1 - Push spacer onto axle shaft.

2 - Install brake backing plate.

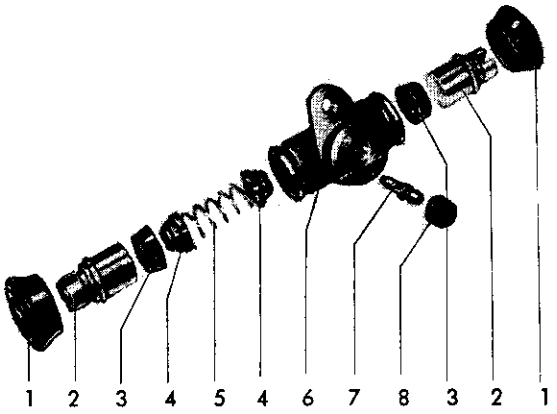
3 - Push seal against backing plate and install bearing cover.

4 - Tighten bearing cover bolts to torque.

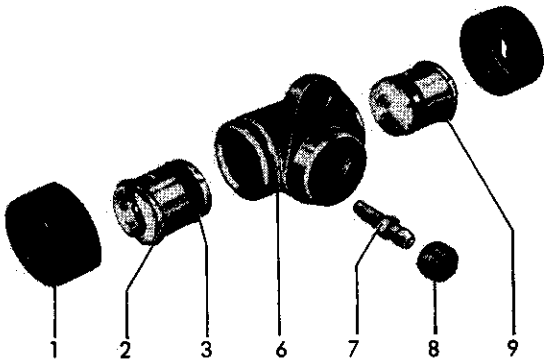
5 - Install other parts and bleed brake system (see page B 8.1/1).

Disassembling and assembling wheel brake cylinders

Types 1 and 3



Type 2



No.	Description	Quantity	Note when disassembling	Note when assembling	Special instructions see
1	Boot	2		install new	
2	Piston	2		apply VW brake cylinder paste	
3	Cup	2		install new; apply VW brake cylinder paste	
4	Cup expander	2			
5	Spring	1			
6	Housing	1			
7	Bleeder valve	1			
8	Dust cap	1			
9	Circlip	2			

When assembling note the following:

1 - Only alcohol or brake fluid may be used to clean all parts.

2 - Check parts for wear. The sliding surfaces of the pistons and cylinder must not be machined.

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Removing and installing brake hoses

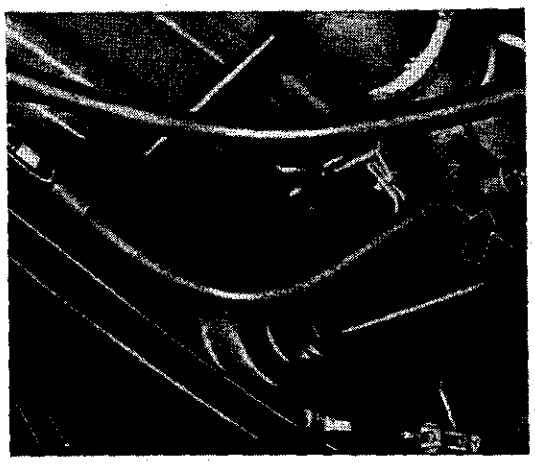
Removing

1 - Unscrew union nut and remove hose bracket.

2 - Take brake hose off.

Installing

Do not twist hoses when installing.



Note:

All Type 1 and Type 3 vehicles with double joint rear axles have shorter brake hoses.

When fitting new brake hoses ensure that only the correct type is used. Longer brake hoses (for vehicles with swing axle) can chafe on the vehicle body when the suspension bottoms on vehicles with double joint rear axle.

Removing and installing brake lines

As stocks were kept to a minimum, some brake lines can no longer be supplied as replacement parts in the original length. In such cases, use a brake line of the same or approximate length and, if necessary, bend it slightly to suit. When doing this, ensure that the line is not routed in tight bends and that it cannot chafe on the vehicle chassis or body when the suspension bottoms.

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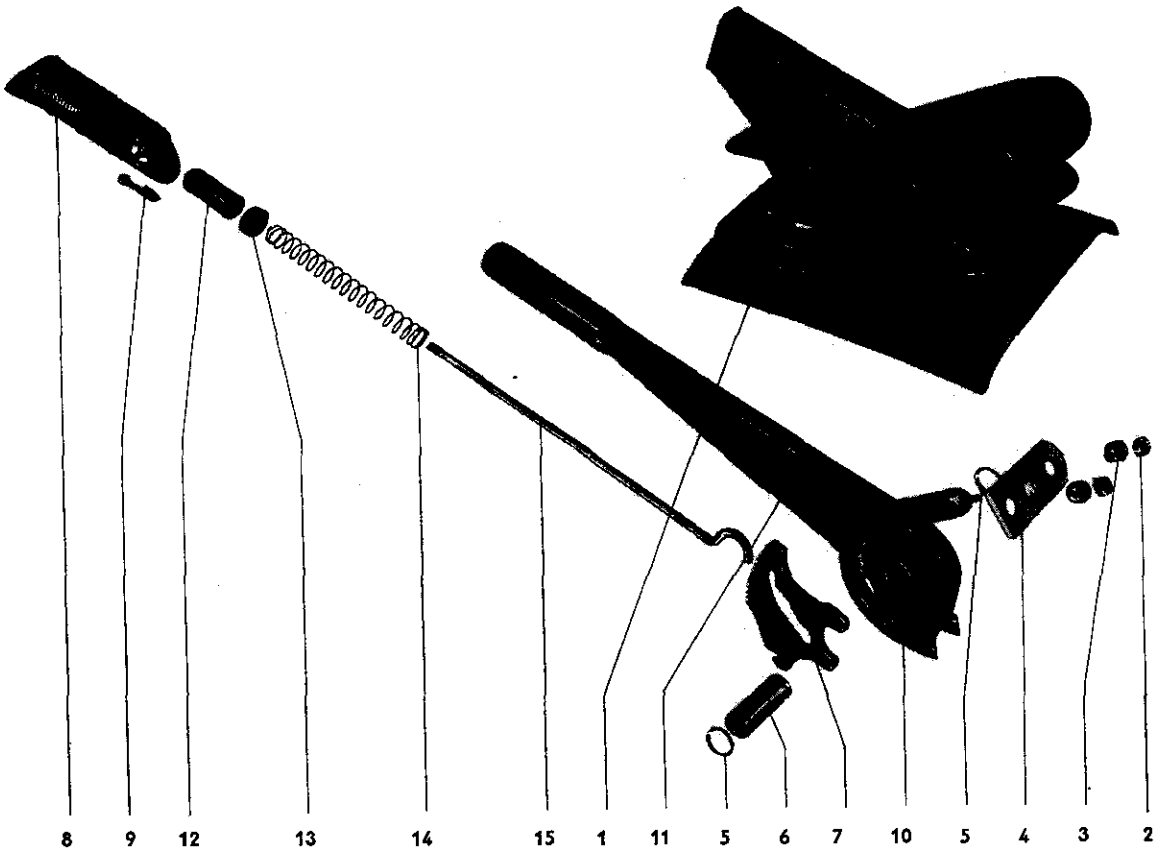
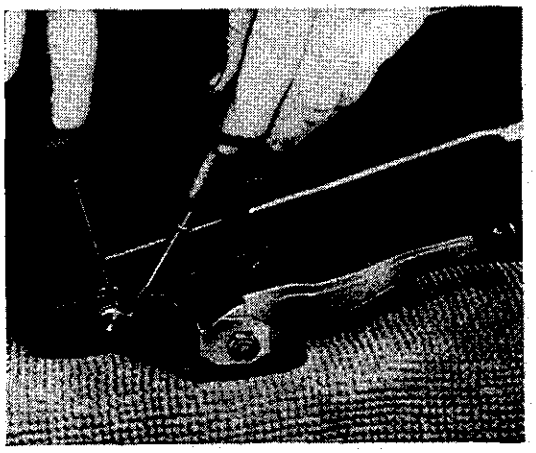


No.	Description	Qty.	Note when disassembling	Note when assembling	Special instructions see
1	Parking brake lever boot	1			
2	Nut M 6	2			
3	Brake cable adjusting nut M 6	2		prevent cable from turning with a screwdriver	
4	Compensator	1			
5	Circlip	2			
6	Pin	1		lubricate sparingly	
7	Ratchet	1			
8	Parking brake lever handle	1	press handle retainer in	install retainer in handle	
9	Handle retainer	1			
10	Parking brake lever	1		lubricate curved guides sparingly	
11	Pawl	1			
12	Release button	1			
13	Rubber washer	1			
14	Spring	1			
15	Pawl rod	1		connect to pawl	

Disassembling and assembling parking brake lever Types 1, 3 and 4 **1-1**

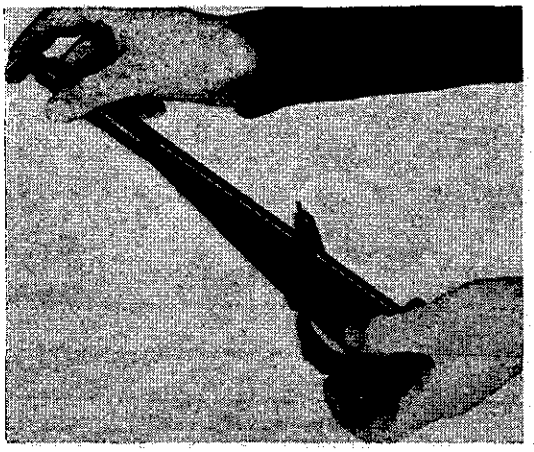


Removing

1 - Remove locknuts and adjusting nuts from cables.

2 - Remove circlip from lever pin and take pin out.

3 - Press lever toward rear until it can be lifted out with the ratchet segment. Do not press the release button when doing this.



4 - Press button and take ratchet segment out.

Installing

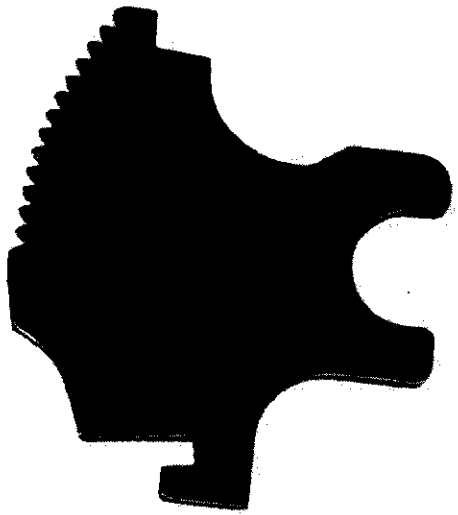
1 - Insert ratchet segment so that the recess fits over the tube in the lever and the teeth engage in the pawl. Ensure that the rounded end of pawl is positioned correctly.

From August 1972

The parking brake lever has a modified ratchet. The ratchet has 3 teeth less at the bottom and 2 more at the top. The back of the parking brake lever has a slot for the ratchet.

Note

The slot in the ratchet segment must engage the frame edge when the lever is inserted.



2 - Insert lever from above, guiding threaded ends of cables laterally.

3 - Lubricate lever pin with universal grease and install.

Do not forget circlips.

4 - Attach cables and adjust parking brake.

Note

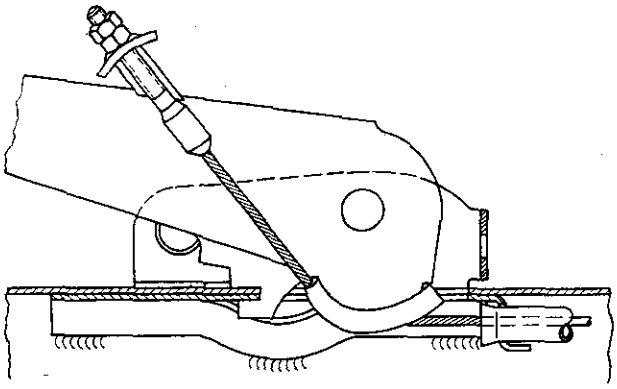
From April 1972.

Types 1, 3 and 4 vehicles are equipped with a parking brake lever with a different leverage. The reinforcement plate welded to the frame tunnel or floor plate for the parking brake mounting has also been modified. The reinforcement plate now has a lip (cable guide "A") which locates the cable properly in the guide tube.

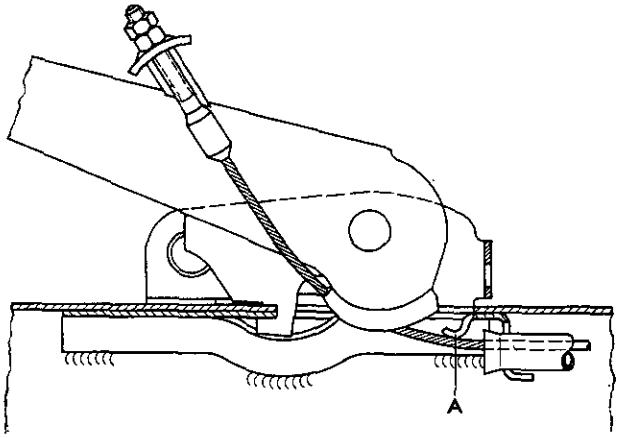
The two modifications were not introduced at the same time. On a number of Types 1, 3 and 4 vehicles, the new parking brake lever was installed in old type frames or floor plates. In a few cases the parking brake cable was too long and as a temporary solution 1–2 washers were installed between cable and guide tube.

Service installation

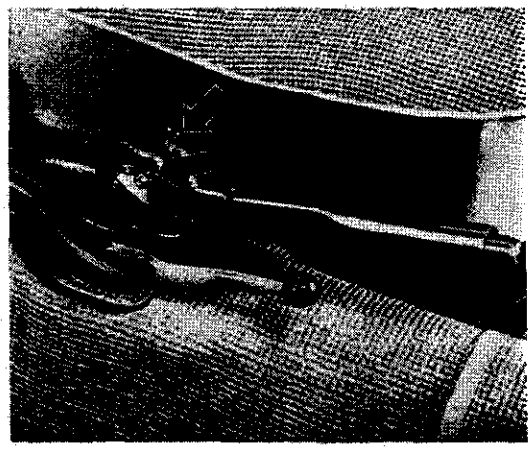
When stocks of the previous type parking brake lever have been used up, only the new type lever will be supplied. The previous type lever will not fit in new frames or floor plates. When replacing the frame on Type 1 and 3 or the floor plate on Type 4, check if a new reinforcement plate with cable guide is installed. On parts with the cable guide, a new parking brake lever should be used, otherwise the previous type levers can be used up.



previous version



new version (A = cable guide)



Removing

1 - Detach cable from parking brake lever and pull out of guide toward rear.

2 - Remove brake drum, detach cable at lever and remove brake cable bracket from brake backing plate.

Installing

1 - Position brake cable and bracket correctly and secure to brake backing plate. The curved guide must face upward at an angle, toward vehicle center.

2 - Attach brake cable to lever and install brake drum.

Caution

Lower vehicle onto wheels when tightening the slotted nuts.

3 - Route brake cable around curved guides on parking brake lever and screw adjusting screw onto cable. Apply screwdriver to slotted end of cable to prevent cable from turning.

4 - Adjust parking brake (see B 4.1/1).

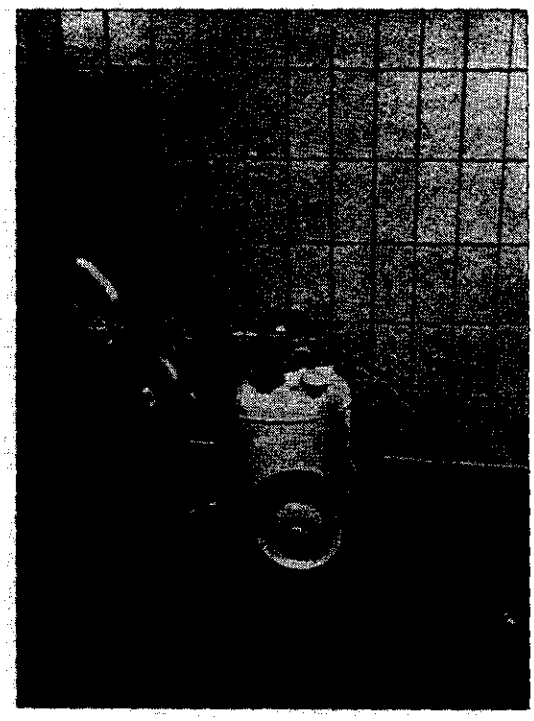
Warning

Always note the following when dealing with brake fluid:

1 - Brake fluid is poisonous. It is also damaging painted surfaces.

2 - Brake fluid must always be stored in air-tight containers.

3 - Used brake fluid must never be re-used.



1

2

No.	Description	Special tool	Remarks
1	Hydro brake tester		Local purchase item
2	Bleeder bottle		Local purchase item

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Bleeding the brake system

The brake system must be bled each time any repair requires opening of the system. When working on only one brake circuit, you only have to bleed the circuit (front or rear) that is being worked on.

Caution

Only use fresh and unused brake fluid. Do not re-use fluid pumped from the system.

Bleeding with pressure bleeder

If possible, brake bleeding should be done with a pneumatic device similar to the one shown on the left side of page B 8.1/1. A pressure of 3 kg/cm² (43 psi.) is pushed through a connector attached to the brake fluid reservoir. While the bleeder valve is open, depress brake pedal firmly and quickly several times. The brake pedal is released slowly each time. This makes sure that no air is left in the system.

Bleeding by "pumping"

If the brake system is bled by "pumping" with a bleeder bottle, (shown on the right side of page B 8.1/1) a second mechanic is needed to operate the brake pedal. This will build up the necessary pressure in the system.

When bleeding brakes note the following:

1 - If the complete brake system has to be bled, bleed and fill each wheel cylinder first. Start with the front brake circuit.

2 - The procedure should be repeated to make sure that there is no air in the system.

3 - Pressurize the system by "pumping" several times. With a hose and bleeder bottle installed, open valve on wheel cylinder. Close valve while pedal is depressed. Repeat this procedure until no more air comes out.

4 - When bleeding brakes make sure that the brake fluid reservoir is not emptied completely. If this happens air will be drawn into the system.

5 - After bleeding, fill reservoir to upper edge of circular welding seam.

Caution

Used brake fluid must never be re-used.

Note

On Type 2 vehicles, the bleeder valve on the brake pressure regulator must not be opened. This bleeder valve is used only during production, and requires a special bleeder and filler.

When bleeding Type 2 vehicles, it is possible that under certain conditions an air bubble can form in the line between the refill container and the brake fluid reservoir. In this instance and when the vehicle is level, the brake fluid flows into the reservoir at a very slow rate.

It is therefore very important to keep the refill container full when bleeding the brake system to prevent air from entering the brake fluid reservoir.

When replacing the brake fluid reservoir, first fill up the refill container and raise the vehicle at the front so that any trapped air can escape. After having done this, start bleeding the brake system.

If a pressure bleeder is used, this operation is not necessary.

When bleeding the hydraulically operated clutch system, Type 4 note the following:

Basically the same procedure applies for the bleeding of the clutch hydraulic system as applies for the brake system.

1 - With the vehicle raised, bleed from underneath. The bleeder valve is located on top of the slave cylinder and faces forward.

2 - As the pressure line has a diameter of 6 mm (0.236 in.), the bleeder valve must be opened wide, if no pneumatic appliance is used.

Changing brake fluid

Heat generated while braking is not only transferred to the brake drums or brake discs, but also to the wheel cylinders or calipers and thus to the brake fluid.

Brake fluid is hygroscopic, meaning that it has a tendency to absorb moisture from the atmosphere. Brake fluid used over an extended period of time may accumulate a high enough water content to reduce the boiling point of the brake fluid. This condition influences the viscosity of the fluid at low outside temperatures. It also may promote corrosion in the brake system.

It is therefore necessary to change the brake fluid in accordance with the special instructions issued by the factory.

1 - Drain as much brake fluid as possible from the reservoir with a siphon or plastic bottle. After this add fresh brake fluid. (A siphon or a plastic bottle should be used for brake fluid only.)

2 - Change fluid in cylinders and lines. To do this the pedal has to be depressed quite a number of times and the bleeder screws opened and closed each time.

Caution

A brake fluid change can be carried out with a pressure bleeder on all Volkswagens except Type 2 vehicles with disc brakes.

Make sure that the fluid level in the refill container never reaches the bottom during bleeding operation.

When replacing the brake fluid, the used brake fluid should be caught in a measuring glass. The quantity that must be pumped from the various bleeder screws is given after the number of pedal strokes to ensure that new brake fluid fills the entire system.

a - **Type 1 vehicles with single circuit brakes:**

Rear, right bleeder screw open –
12 pedal strokes = approx. 80 cc of fluid

Rear, left bleeder screw open –
8 pedal strokes = approx. 70 cc of fluid

Front, right bleeder screw open –
8 pedal strokes = approx. 70 cc of fluid

Front, left bleeder screw open –
8 pedal strokes = approx. 70 cc of fluid

b - **Types 1, 3 and 4 vehicles with dual circuit brakes:**

Front, right bleeder screw open –
30 pedal strokes = approx. 100 cc of fluid

Front, left bleeder screw open –
15 pedal strokes = approx. 50 cc of fluid

Rear, right bleeder screw open –
25 pedal strokes = approx. 80 cc of fluid

Rear, left bleeder screw open –
10 pedal strokes = approx. 30 cc of fluid

c - **Type 2 vehicles with single circuit brakes:**

Rear, right bleeder screw open –
20 pedal strokes = approx. 260 cc of fluid

Rear, left bleeder screw open –
10 pedal strokes = approx. 130 cc of fluid

Front, right bleeder screw open –
10 pedal strokes = approx. 130 cc of fluid

Front, left bleeder screw open –
10 pedal strokes = approx. 130 cc of fluid

d - **Type 2 vehicles with dual circuit brakes up to July 1967:**

Front, right bleeder screw open –
20 pedal strokes = approx. 160 cc of fluid

Front, left bleeder screw open –
20 pedal strokes = approx. 160 cc of fluid

Rear, right bleeder screw open –
40 pedal strokes = approx. 240 cc of fluid

Rear, left bleeder screw open –
15 pedal strokes = approx. 90 cc of fluid

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Section E

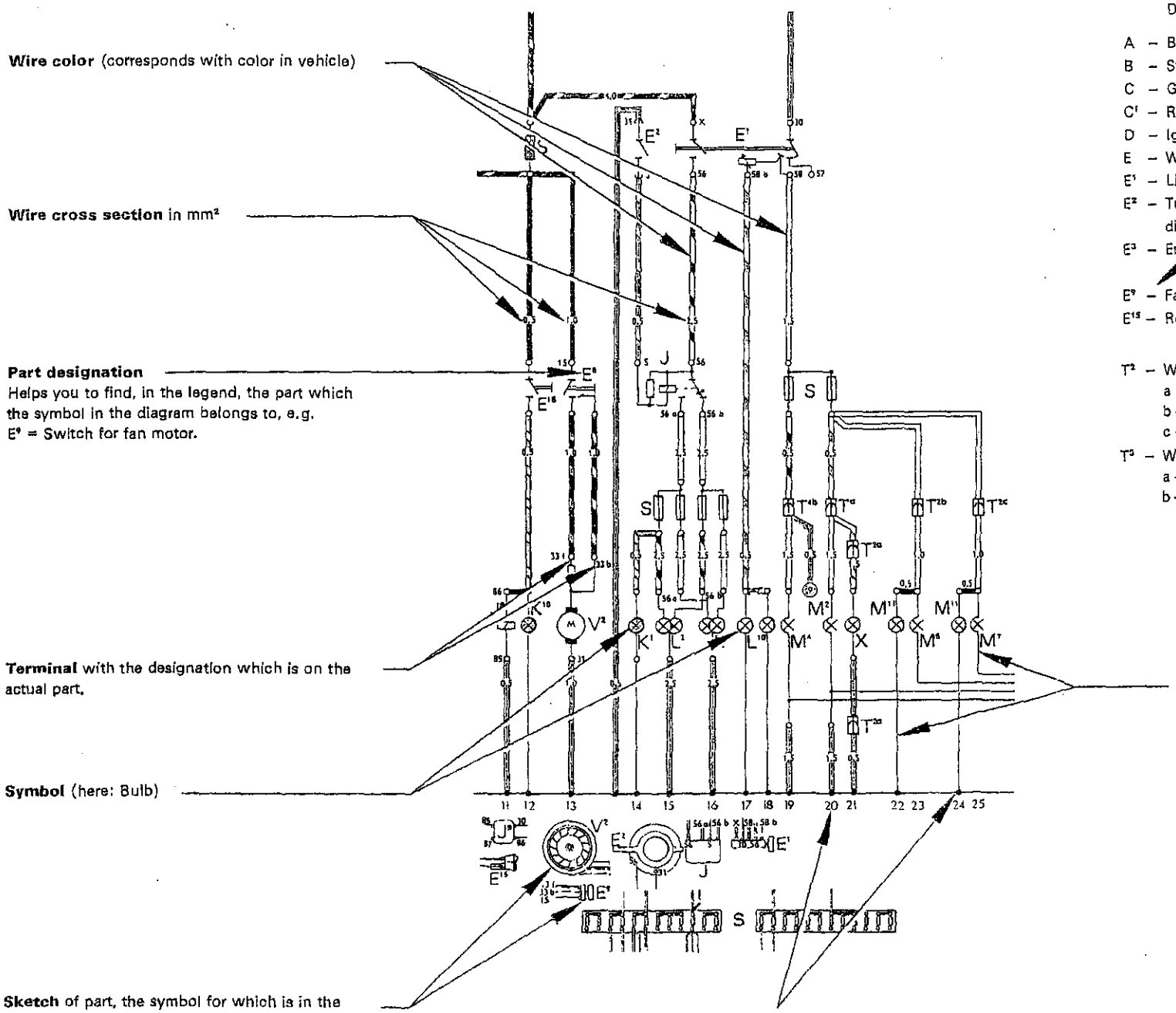
Electrical

	Description	Current track
A	– Battery	23
B	– Starter	24, 25
C	– Generator	20, 21, 22
C^1	– Regulator	20, 21, 22
D	– Ignition/starter switch	8, 24, 25, 26
E	– Windshield wiper switch	44, 45
E^1	– Light switch	8, 12, 13, 16
E^2	– Turn signal and headlight dimmer switch	3, 37, 38
E^3	– Emergency flasher switch	32, 36, 37, 38, 39, 41
F	– Brake light switch	47, 48
F^1	– Oil pressure switch	29
F^4	– Backup light switch	49
G	– Fuel gauge sending unit	27
G^1	– Fuel gauge	27
G^4	– Ignition timing sensor	54
H	– Horn button	46
H^1	– Horn	46
J	– Dimmer relay	3, 6, 8
J^2	– Emergency flasher relay	31, 32, 33
J^6	– Fuel gauge vibrator	27
K^1	– High beam warning light	4
K^2	– Generator charging warning light	28
K^3	– Oil pressure warning light	29
K^5	– Turn signal warning light	30
K^6	– Emergency flasher warning light	35
K^7	– Dual circuit brake warning light	47, 48
L^1	– Sealed beam unit, left headlight	6
L^2	– Sealed beam unit, right headlight	8
L^6	– Speedometer illumination light	10, 11
L^{16}	– Heater switch light	12
L^{21}	– Light for heater lever illumination	41
M^2	– Tail light, right	16
M^4	– Tail light, left	19
M^5	– Turn signal and parking light, front left	17, 37
M^6	– Turn signal, rear left	36
M^7	– Turn signal and turning light, front right	18, 38
M^8	– Turn signal, rear right	39
M^9	– Brake light, left	48
M^{10}	– Brake light, right	47
M^{11}	– Side marker light, front left and right	17, 18
M^{16}	– Backup light, left	49
M^{17}	– Backup light, right	50
N	– Ignition coil	53
N^1	– Automatic choke	55
N^3	– Electromagnetic pilot jet	56
O	– Distributor	53, 54
P	– Spark plug connectors	54
Q	– Spark plugs	54
S^1 to S^{10}	– Fuse box	2, 6, 7, 8, 17, 19, 42, 46
S^{13}	– Fuse for backup lights (8 amp.)	49
T	– Wire adapter; behind dashboard	
T^1	– Wire connector, single;	
	– behind the dashboard	
	– in engine compartment, right side	
T^{1b}	– in luggage compartment	
T^{1c}	– in engine compartment	
T^2	Wire connector, double; in engine compartment lid	
T^3	– Wire connector, three connections in headlight housing, left and right	
T^4	– Wire connector, four connections in engine compartment	
T^{20}	– Test network, test socket	51
U	– Socket, accessory	2
V	– Windshield wiper motor	43, 45
W	– Interior light	1
X	– License plate light	14, 15
Y^1	– Terminal 58b of heater switch	11
Z	– Connection of heater	1

①	– Ground strap battery-frame	23
②	– Ground strap transmission-frame	20
④	– Ground strap steering coupling	
⑩	– Ground connection, dashboard	
⑪	– Ground connectionn, speedeometer	

Test network

the orange colored spots are the connections in the test network which are wired to the test socket – T^{20} –.
The numbers in the spots correspond to the terminals in the test socket.


Wire color (corresponds with color in vehicle)
Wire cross section in mm²
Part designation
Helps you to find, in the legend, the part which the symbol in the diagram belongs to, e.g. E⁹ = Switch for fan motor.
Terminal with the designation which is on the actual part.
Symbol (here: Bulb)
Sketch of part, the symbol for which is in the current track above it. Also shows how wires are connected.
Current tracks with track numbers to facilitate finding of part in diagram (see legend).
Des
A – Batt
B – Star
C – Gen
C¹ – Reg
D – Igni
E – Wln
E¹ – Ligh
E² – Turn
dim
E³ – Eme
E⁹ – Fan
E¹⁵ – Rea
T² – Wir
a –
b –
c –
T³ – Wir
a –
b –

	Description	current track
A	– Battery	4
B	– Starter	5, 6
C	– Generator	1, 2, 3
C¹	– Regulator	1, 2, 3
D	– Ignition / starter switch	6, 7, 12
E	– Windshield wiper switch	8, 9, 10
E¹	– Light switch	16, 17, 19
E²	– Turn signal and headlight dimmer switch	14, 38, 39
E³	– Emergency flasher switch	38, 39, 42, 43, 44
E⁹	– Fan motor switch	13
E¹⁸	– Rear window defogger switch	12

Legend, consisting of:

Part designation,

Current track number, with the aid of which you can find the part in the diagram, e.g. turn signal switch E², current track 14.

T² – Wire connector, double
a – in engine compartment lid
b – in luggage compartment, front, left
c – in luggage compartment, front, right

T³ – Wire connector, triple
a – in luggage compartment, front, left
b – behind the engine compartment insulation, right

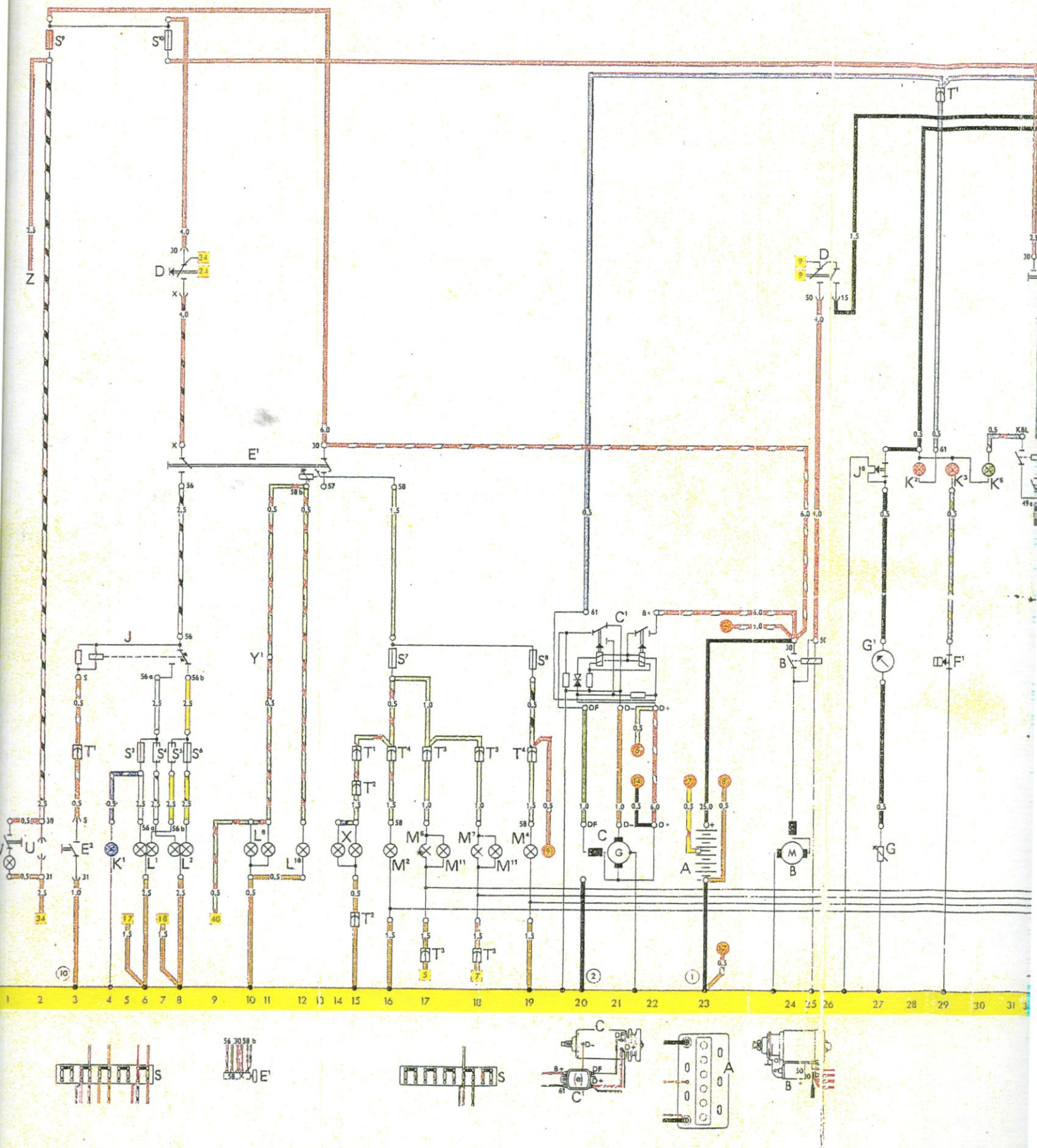
Explanation (where you can find a wire connector, for example, on the vehicle).

T¹ᶜ

M⁷

Internal connections (thin lines). These are **not** actual wires but ground connections which go through parts such as bulb holders for example.

Please note:
All switches and contacts are in a mechanically neutral position.
The various contacts in switches are shown in the current track in which they operate.


S'
S°
Z
D
E'
J
Y'
S'
S°
T'
C'
B
G'
F'
J°
K²
K³
K⁵
U
E²
K'
L'
L²
L⁹
L¹⁰
X
M²
M⁶
M¹¹
M⁷
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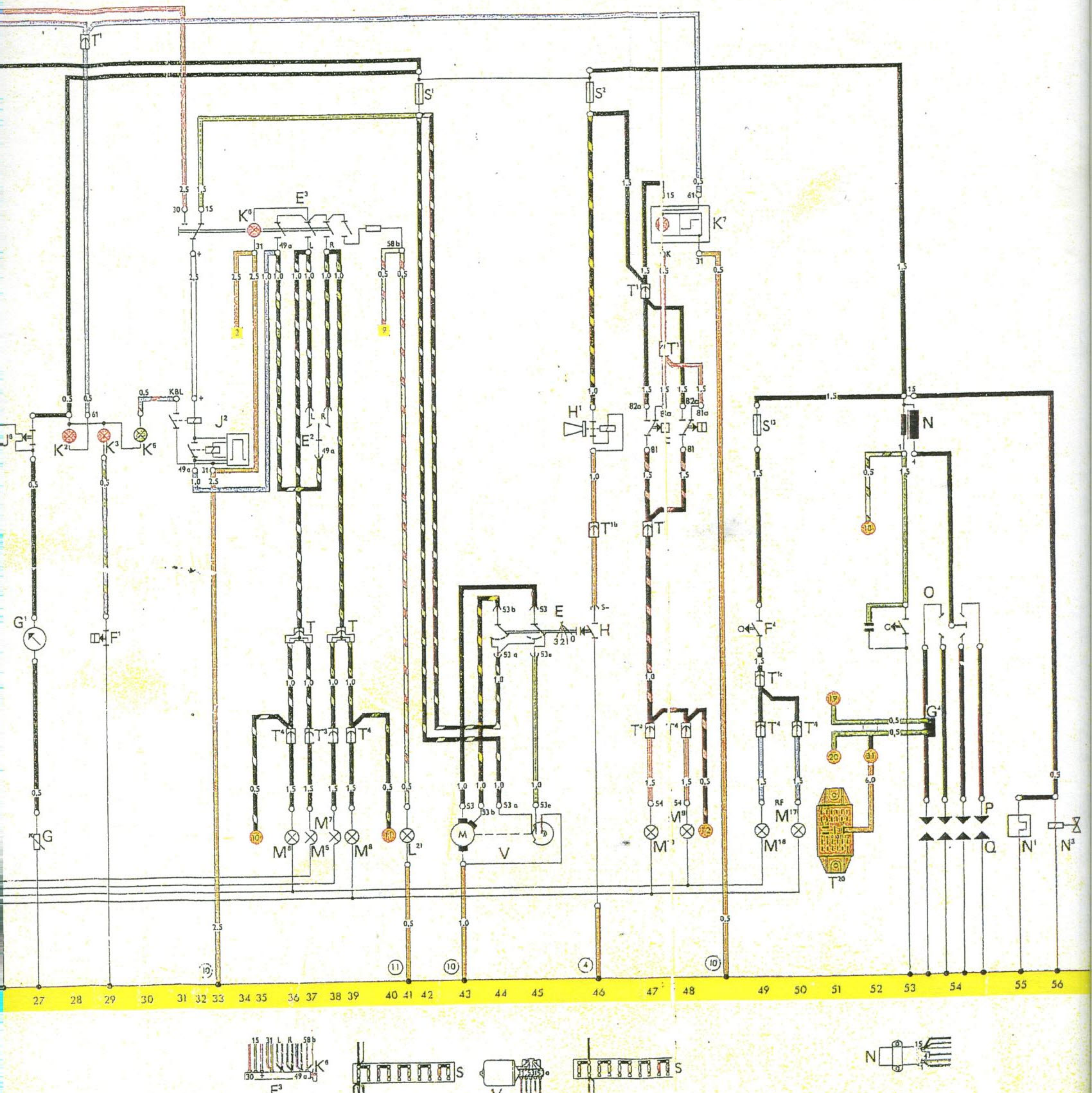
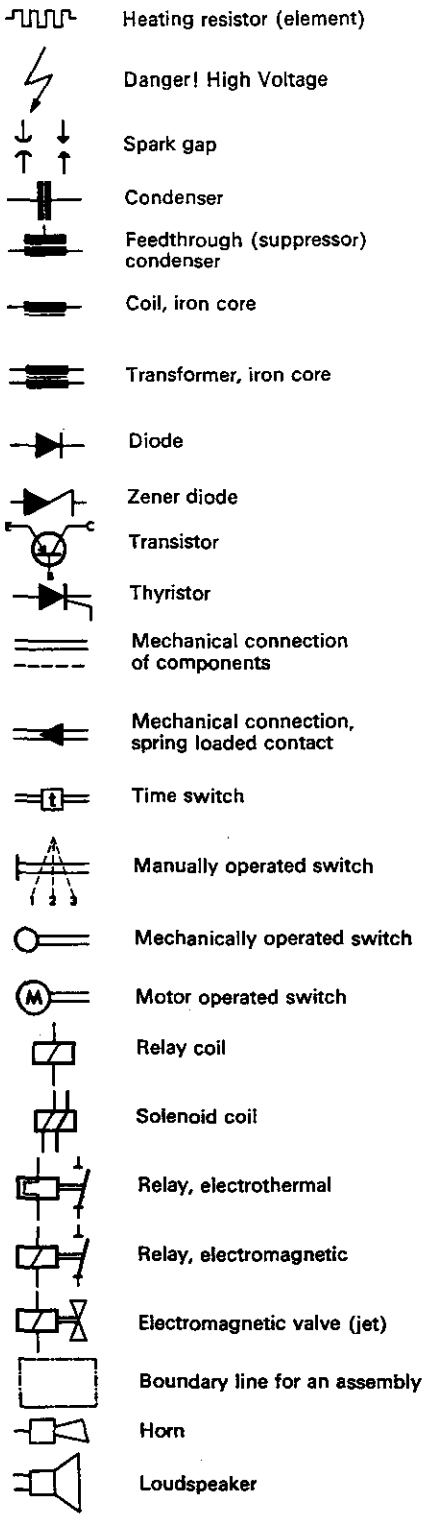
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31



T¹
S¹
S²
E³
K⁶
K⁷
J²
K²
K³
K⁵
E²
G¹
F¹
H¹
H
E
V
N
S¹³
F⁴
O
G⁴
P
Q
N¹
N³
T²⁰
G
L²¹
M
27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56


Antenna
Dipole antenna
Direct current
Alternating current
Three-phase current
Generator
Battery cell
Motor
Measuring gauge
Voltmeter
Ammeter
Wiring
2.5
Wire cross section in mm²
Wire junction, fixed
Wire connector, separable
Wire junction, separable
Suppression wire
Wire crossing
Ground
Switch position, open
Switch position, closed
Multiple contact switch
Fuse
Light bulb
Glow lamp
Resistor
Potentiometer
Tapped resistor
Thermal resistor, automatically regulating


Heating resistor (element)
Danger! High Voltage
Spark gap
Condenser
Feedthrough (suppressor) condenser
Coil, iron core
Transformer, iron core
Diode
Zener diode
Transistor
Thyristor
Mechanical connection of components
Mechanical connection, spring loaded contact
Time switch
Manually operated switch
Mechanically operated switch
Motor operated switch
Relay coil
Solenoid coil
Relay, electrothermal
Relay, electromagnetic
Electromagnetic valve (jet)
Boundary line for an assembly
Horn
Loudspeaker

Description	Type 1	Type 2	Type 3	Type 4
Generator				Alternator
Maximum current	30 amp	30 amp 38 amp	30 amp	55 amp
Mean regulating voltage	14 V	14 V	14 V	14 V
Nominal output speed	2000 rpm	2000; 2400 rpm	2000 rpm	2000 rpm
Cut-in speed	1450 rpm	1450; 1300 rpm	1450 rpm	1000 rpm
Ratio	1.8:1; 1.9:1	1.9:1	2.3:1	2.26:1
Battery	12 V; 45 Ah	12 V; 45 Ah	12 V; 45 Ah	12 V; 45 Ah
Starter	12 V; 0.7 hp (Automatic Stick Shift 0.8 hp)	12 V; 0.7 hp	12 V; 0.7 hp (Automatic 0.8 hp)	12 V; 0.7 hp (Automatic 0.8 hp)
Windshield wiper motor	12 V	12 V	12 V	12 V
Current draw	low speed approx. 2 amp high speed approx. 3 amp	low speed approx. 2.5 amp high speed approx. 3.5 amp	low speed approx. 2.5 amp high speed approx. 3.5 amp	low speed approx. 2.5 amp. high speed approx. 3.5 amp
Windshield washer	pneumatic	pneumatic	pneumatic	pneumatic
Maximum pressure	3 kg/cm² (43 psi)	3 kg/cm² (43 psi)	Sedan: 3 kg/cm² (43 psi) Wagon: 4 kg/cm² (56 psi)	Sedan: 3 kg/cm² (43 psi) Wagon: 4 kg/cm² (56 psi)
Capacities	2.1 US pts	3.2 US pts	2.1 US pts	3.2 US pts
Sealed beam unit	12.8 V; 50/40 W	12.8 V; 50/40 W	12.8 V; 50/40 W	12.8 V; 50/37.5 W
Turn signal/parking light bulb	12 V; 21 W	12 V; 21 W	12 V; 21 W	12 V; 21 W
Stop/tail light bulb	12 V; 21/5 W	12 V; 21/5 W	12 V; 21/5 W	12 V; 21/5 W
License plate light bulb	12 V; 10 W	12 V; 10 W	12 V; 5 W Sqareback Sedan 12 V; 10 W	12 V; 10 W Wagon: 12 V; 5 W (two)
Back-up light bulb	12 V; 25 W	12 V; 25 W	12 V; 25 W	12 V; 25 W
Interior light bulb	12 V; 10 W	12 V; 10 W	12 V; 10 W	12 V; 10 W
Side marker light bulb	12 V; 4 W	12 V; 4 W	12 V; 4 W	12 V; 4 W
Warning light bulb	12 V; 2 W 12 V; 1.2 W	12 V; 1.2 W	12 V; 2 W 12 V; 1.2 W	12 V; 1.2 W
Speedometer range	0–90 mph	10–90 mph	0–90 mph	0–110 mph
Clock	–	electric	electric	electric
Fuel gauge	thermo-electric	electric	electric	electric
Heated rear window	12 V; 60 W	12 V; 60 W	12 V; 60 W	12 V; 80 W
Fresh air fan low speed	2 amp	2 amp	2 amp	2 amp
Current draw high speed	2 amp	3 amp	3 amp	3 amp
Fuse box	10 fuses	10 fuses	12 fuses	12 fuses

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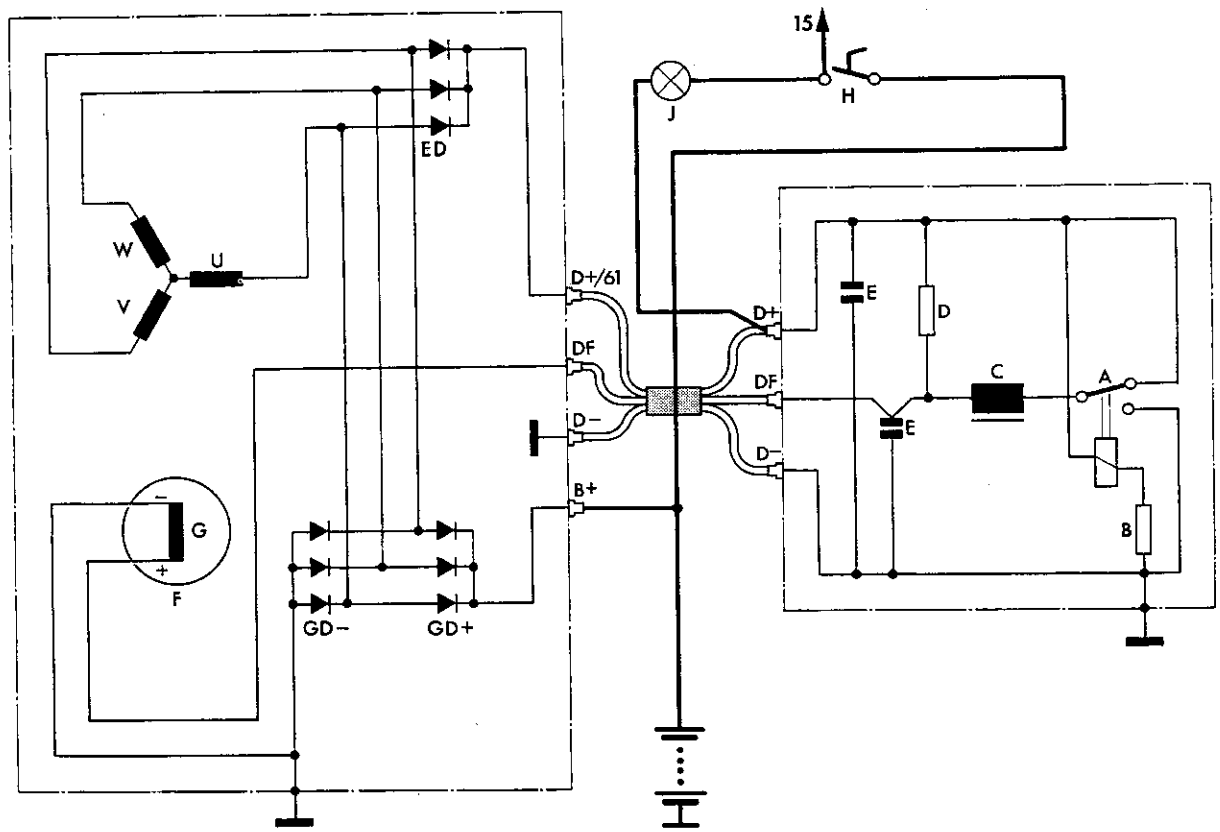

A – Regulator contact
B – Compensating resistance
C – Choke
D – Resistance
E – Condensers
ED – Exciter diodes

F – Rotor
G – Exciter winding
GD – Rectifier diodes
H – Ignition switch
I – Generator charging warning lamp
K – Battery
U, V, W – Stator windings

The terminals on the regulator and alternator are plug combinations that cannot be mistaken.

A mechanical, single-contact voltage regulator (Bosch type ADN) is installed. The reverse current relay necessary for regulators of direct current generators is not required for alternators because the rectifier diodes prevent the battery from being discharged through the alternator windings.

One peculiarity of the alternator must be mentioned at this point: For weight reasons, the rotor (field winding) contains less iron than the pole shoes of a comparable direct current generator. When the alternator starts, the residual magnetism is often not sufficient to induce exciter voltage in the stator windings. For this reason, the field winding is provided with voltage from the positive battery terminal through the ignition switch, charging warning light, terminal B+/61, regulator, and alternator terminal DF. This voltage is sufficient to excite the stator winding. As the alternator rpm increases, the voltage at terminal D+ increases to the voltage of the battery. At this moment, the charging warning light goes out. It is important the charging warning light have an input of 1.2 Watt.

DC generators, regulators

Vehicle Type	Generator VW Part No.	Regulator VW Part No.	Installed Chassis No. from to	Nominal Data Maximum current A	Mean regulating voltage V	Nominal output speed rpm
1	211 903 031	211 903 803	117 000 001 – 117 844 902	30	14	2000
	211 903 031 A	211 903 803 B	118 000 001 – 118 857 871	30	14	2000
	113 903 031 G	113 903 803 E	118 857 872 –	30	14	2000
2	211 903 031	211 903 803	216 052 244 – 217 148 459	30	14	2000
	211 903 031 A	211 903 803 B	218 000 001 – 218 163 485	30	14	2000
	113 903 031 G	113 903 803 E	218 163 486 – 218 202 251	30	14	2000
	211 903 031 D	211 903 803 E	219 000 001 – 2112 276 560	38	14	2400
3	311 903 031 E	211 903 803 and B	317 000 001 – 318 191 403	30	14	2000
	311 903 031 F	113 903 803 E	318 191 404 –	30	14	2000

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General testing instructions

To determine the condition of the generator, the following tests must be made:

1 – No-load voltage

2 – Regulating current (load current given in chart "Test data" on page E 2.5/1–1)

3 – Cut-in voltage

4 – Return current

Testing no-load voltage

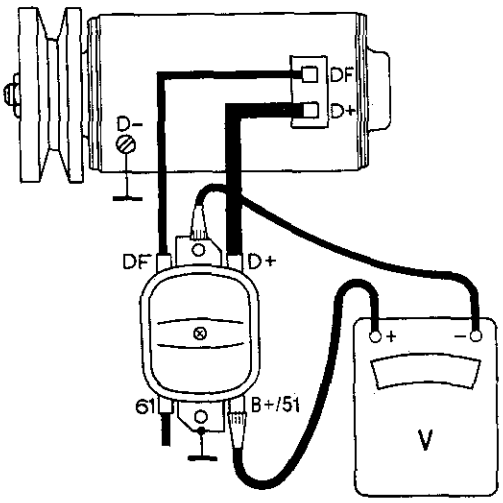
Note

The cut-in speed of the early cut-in generator is so low that in some cases it may be necessary to adjust the engine to the slowest possible idle speed.

1 – Disconnect wire from regulator terminal B+ making certain not to ground lead. Connect voltmeter positive terminal to regulator terminal B+ (51) and voltmeter negative terminal to ground.

2 – Start engine. Slowly increase engine speed to approximately 1700 to 2000 rpm. The voltmeter should show 12 to 14 volts (for specific readings see test data chart, page E 2.5/1).

3 – When the engine is turned off, the voltmeter reading should drop from 12 to 0 volts just before the engine stops completely. This is an indication that the regulator points are not sticking.



Testing generator without regulator (quick check)

1 – Disconnect both leads (D+ and DF) from generator.

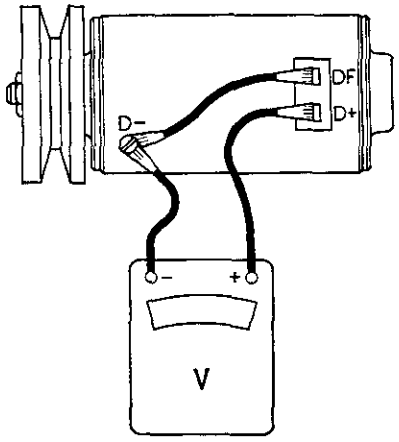
2 – Connect terminal DF of generator (small push-on connection) to ground (D–).

3 – Connect positive lead of voltmeter to large push-on connector (D+) of generator and the negative lead to the (D–) terminal.

4 – Run the generator briefly at the following speeds. The voltage supplied by the generator must be as follows:

Rpm	Voltage
1500	12 volts
3000	36 volts

5 – If the generator supplies no voltage or too little voltage, it must be removed and checked. (See "Testing Instructions" generator removed, E 2.4/1).



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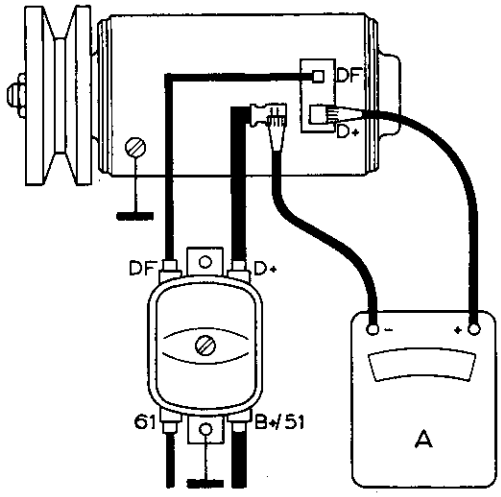


Testing for return current

The D+ terminals on the regulator and on the generator must not be disconnected with the engine running otherwise the field windings of the generator will burn out.

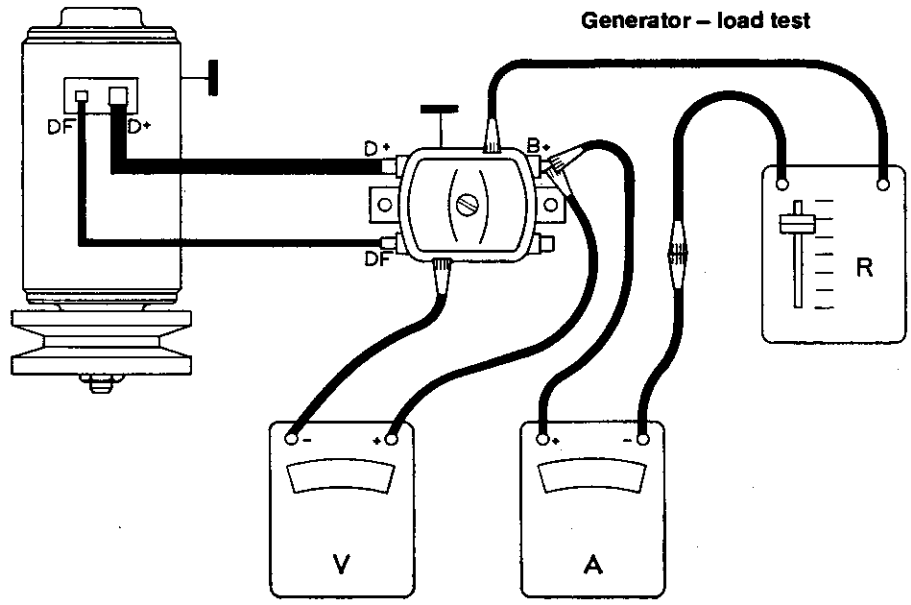
1 – Disconnect D+ lead from generator. Connect ammeter between lead and D+ terminal, the positive ammeter lead to terminal D+, the negative ammeter lead to disconnected wire (range of ammeter should be 15–0–50 amps.).

2 – Start vehicle engine and allow to run at fast idle.

3 – Reduce idle until ammeter moves to negative range (see test data chart). Then turn the engine off. The ammeter must jump back to zero before the engine comes to a complete stop.

4 – If the ammeter does not return to zero when the engine is at a complete stop, the regulator is defective and must be replaced.

Generator – load test



A quick test can be made to determine generator outpout. For this test a voltmeter (range 0–30 volts), an ammeter (range 10–0–50 amps.) and a rheostat (that can be loaded to 50 amps.) are required. No 9 AWG (minimum) wire must be used for current measurements.

1 – Connect leads to regulator terminal B+/51.

2 – Connect voltmeter, ammeter and rheostat as shown in the illustration.

3 – Start engine, bring engine speed to approximately 3000 rpm. Adjust rheostat to proper load current setting (see test data chart). Now the regulating voltage (under load) can be measured.

Checking brushes and commutator

Examine brushes for wear. If they no longer protrude from the holders they must be replaced. (See parts list for proper generator brushes.)

To remove: lift the retaining spring with a wire hook and pull the brushes out of the holders. Remove the brush leads being sure not to drop screws or lock washers into generator housing.

Note

If the commutator is oily or dirty it can be cleaned with a suitable solvent.

If the commutator is scored or burnt disassemble the generator and recondition it.

If the brush springs have to be replaced or the commutator has to be repaired, the generator must be removed.

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Alternator and regulator, testing instructions

Caution
Never run alternator with battery disconnected

When testing the alternator, the instrument leads must be securely connected while the alternator is stationary.

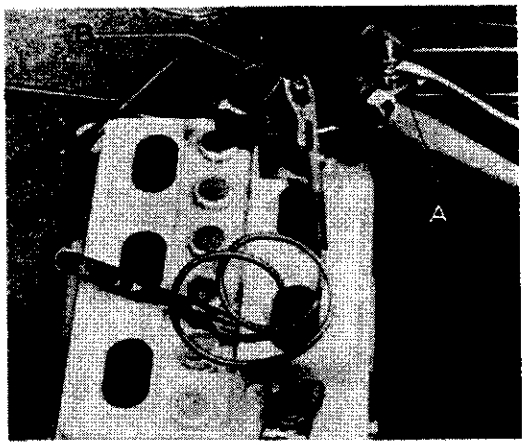
Testing regulating voltage under load

1 – Disconnect positive battery cable.

2 – Connect battery cutout switch to positive battery terminal.

3 – Connect positive terminal to battery cutout switch (switch is on).

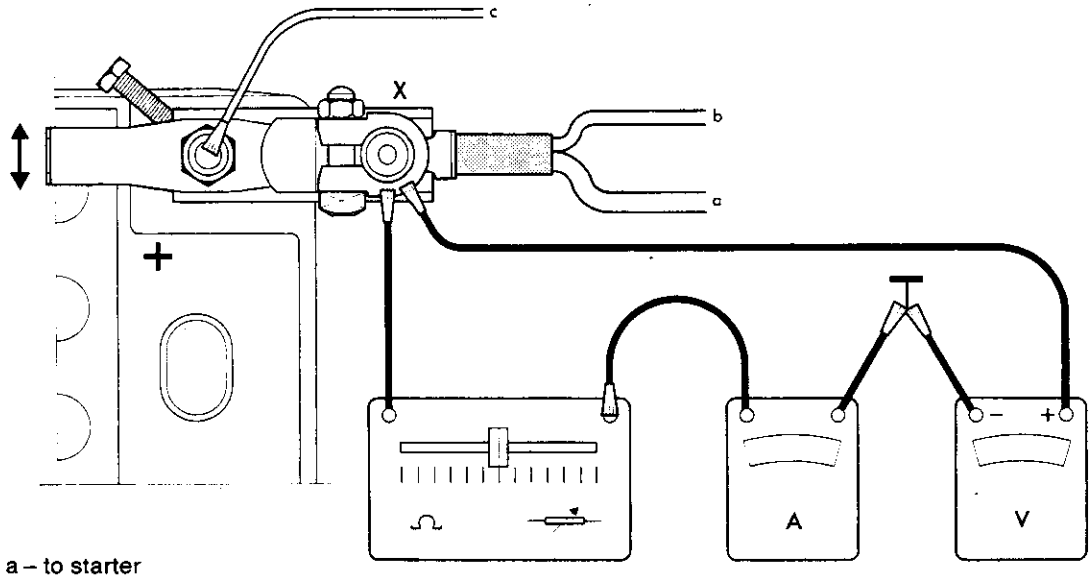
4 – Disconnect black/red wire (power supply to fuel injection control unit) from battery positive terminal. Connect positive terminal with wires for starter and fuse box to battery cutout switch (A). Connect the black/red wire to the center pole of the cutout switch (B) with an alligator clip.



Note

The direct connection of the power supply for the fuel injection control unit to the battery positive pole is necessary in order to separate the control unit supply from the alternator during the check.

This prevents disturbances in the alternator voltage from causing the engine to misfire.



a – to starter
b – to light switch terminal 30
c – to fuel injection control unit
x – battery cutout switch
(SUN electric No. 7052-003 or similar equipment)

5 – Connect ammeter, voltmeter and load resistance as shown (load resistance is connected to positive terminal).

6 – Start engine and run it at 2000 rpm.

7 – Adjust load resistance to give a reading of 20 amps. on the ammeter.

8 – Operate switch to cut battery out of test circuit. The load current is now determined by the load resistance.

9 – Regulate load resistance and set to 25–30 A.

10 – Regulating voltage should be 13.9–14.8 Volts. It should be read within 30 seconds so that the regulator does not have time to warm up.

If there are deviations from the prescribed values, install a new regulator and repeat the test. If there are still deviations, test the alternator. This is best done with an oscilloscope. If this is not available, the alternator must be removed and tested as described on page E 2.4/2.

REMOVING

Caution

The negative battery strap must be removed before disconnecting the wires on the regulator. If this is not done the generator and/or regulator can be damaged.

Installing

When installing the regulator make sure it has a good ground connection and that all the wires are hooked up correctly according to the wiring diagram. If leads DF and D + or B + (51) and 61 are interchanged, the generator and/or regulator will be damaged.

Regulator connections:

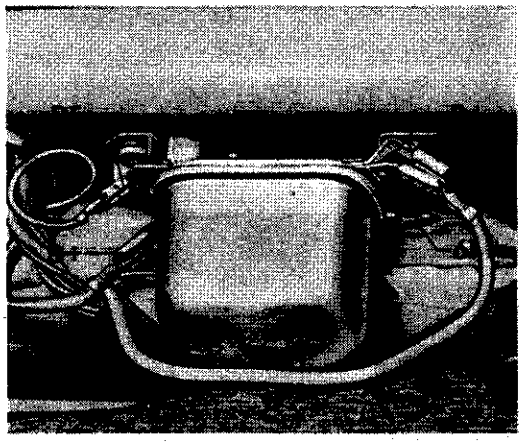
D+ to generator D+ and connection No. 6 of test network
DF to generator DF
B+/51 to negative battery terminal and to terminal 30 of the electrical system
61 to generator charging warning light

Type 1

The regulator is installed on the left under the rear seat.

From November 1971 the connector of terminal DF is protected by a cap.

It can also be service installed on earlier models.

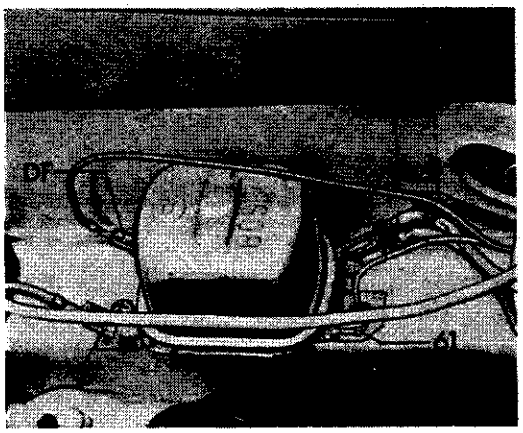


Type 3

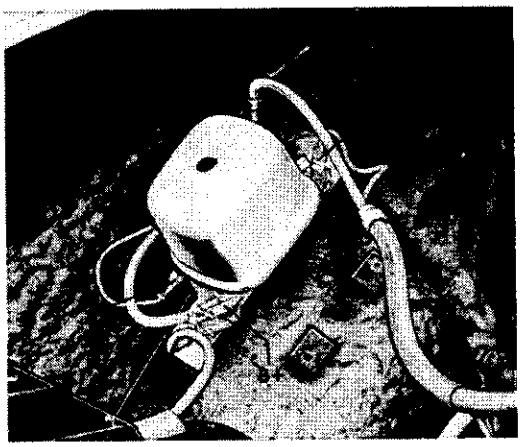
The regulator is installed on the left under the rear seat.

From November 1971 the connector of terminal DF is protected by a cap.

It can also be service installed on earlier models.



Removing and installing regulator, Types 1 and 3 1 - 1

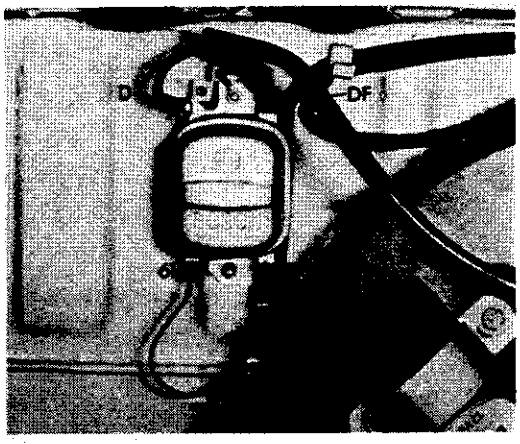


Type 1 / Karmann Ghia

The regulator is installed in the engine compartment.

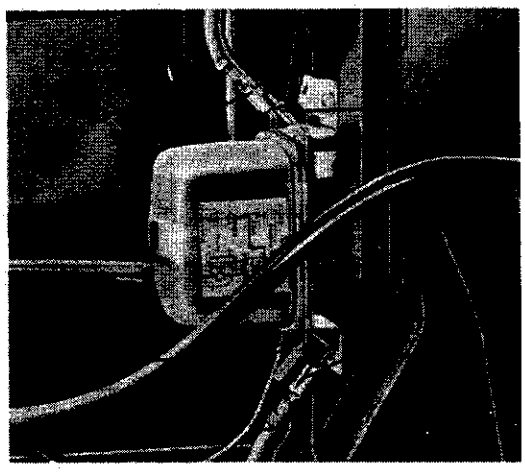
From November 1971 the connector of terminal DF is protected by a cap.

It can also be service installed on earlier models.



Type 1 / Model 181

The regulator is installed in the engine compartment.



Type 2

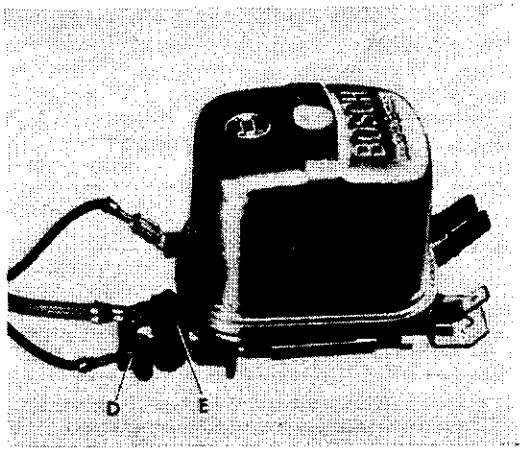
The regulator is installed in the engine compartment.

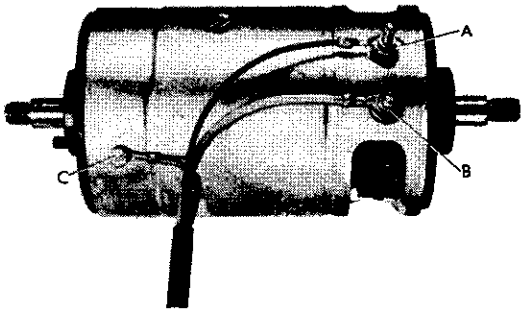
From November 1971 the connector of terminal DF is protected by a cap.

It can also be service installed on earlier models.

Note

Since March 1968, the D+ and DF terminals of the generator and the D+ terminal on the regulator have been changed from the push-on type to the screw type. An additional ground wire has been fitted between generator and regulator.





If generators or regulators with push on connectors are replaced by screw type connectors, use the following parts:

Illustration letter	Terminal	Wire terminal	Dished washer	Lock washer	Nut	Fillister head screw
A	generator DF	111971949*	Cannot be lost		Cannot be lost	
B	generator D+	111971945 B	N 122251		N 110052	
C	generator D–	111971949		N 120051		N 107042
D	regulator D–	111971949	N 122251			N 108861
E	regulator D+	111971945 B	N 122251			N 108861

* Cut open

If a regulator is replaced on a vehicle without a ground wire between regulator and generator, install a wire between regulator and body in addition to the existing ground connection (attaching bolts).

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The chart shows which units interchange with the new units.

	Previous (push-on)	New (screw type)	Installed in:
Generator	211 903 031 211 903 031 A	113 903 031 G	Type 1 from Aug. 1967 and Type 2 from Aug. 1966, Type 2 up to July 1968
	311 903 031 E* 311 903 017 D**	311 903 031 F* 311 903 017 F**	Type 3 from Aug. 1966
Regulator	211 903 803 211 903 803 B	113 903 803 E	Types 1, 2 and 3

* These generators are installed in production and marked with this number.
** These generators are supplied as spare parts (with installed and balanced pulley).

Type/Model	from Chassis No.	Starter	Voltage/ Nominal output	Remarks
1 2 3 4	118000001 218000001 318000001 419000001	311911023 B (Bosch) 111911023 A (VW)	12 v / 0.7 hp	
1 2 3 4	1102000001 2102000001 3102000001 4102000001	311911023 C (Bosch)	12 v / 0.7 hp	aluminium field coils
1 2 3 4	From March 1970	311911023 D (Bosch)	12 v / 0.7 hp	aluminium field coils, short housing
1/Automatic Stick Shift 1/Model 181 2/Automatic 3/Automatic 4/Automatic	118000002 1803000001 2132000001 318000002 419000002	003911023 A (Bosch)	12 v / 0.8 hp	

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Testing solenoid switch

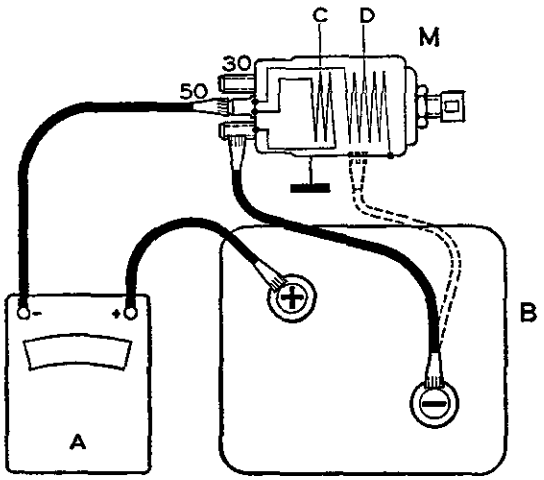
To test the two windings of the solenoid switch, measure the current consumption by connecting an ammeter and battery as illustrated.

Solenoid switches with faulty pull-in or holding windings cannot be repaired.

Testing Bosch solenoid switch:

1 - Test pull-in winding (maximum 35 amp.).

2 - Test holding winding (maximum 11 amp.). Battery negative terminal connected to switch housing (see dotted lines on drawing).



A = Ammeter
B = Battery
C = Pull-in winding
D = Holding winding
M = Solenoid switch

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Starter

Starter type	No load test			Load test			Stall torque test		Pull-in voltage solenoid switch
	Current amps.	Voltage	Speed rpm	Current amps.	Voltage	Speed rpm	Current amps.	Voltage	
311911023 B 311911023 C 311911023 D	35–45	12	7400–9100	170–205	9	900–1300	220–260	6	7
111911023 A	25–40	12	6200–7800	170–195	9	1050–1350	270–290	6	8
003911023 A	35–50	12	6400–7900	160–200	9	1100–1400	250–300	6	8

These values are for a 12 Volt. 135 Ah battery (If necessary, connect batteries in parallel).

All speeds are starter shaft speeds.

Test temperature 68° F (20° C.)

Solenoid switch

	Current draw (amps.) 12-volt solenoid switch	
	Bosch	VW
Pull-in winding, max.	max. 35	max. 30
Holding winding, max.	max. 11	max. 12

Note

When connecting test equipment be sure to follow instructions supplied by the manufacturer of same.

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Symptoms	Cause	Remedy
Starter does not turn when ignition switch is operated	Turn on the lights when testing: a – Lights do not burn. Loose cables or poor ground connection. Battery discharged	a – Check battery cables and connections. Test voltage of battery, charge if necessary
	b – Lights are on but go out when starter switch is operated. Insufficient current due to loose connections or corroded terminals	b – Clean battery terminals and cable clamps. Tighten connections between battery, starter and ground
	c – Lights go dim when starter switch is operated. Battery run down	c – Charge battery
	d – Lights burn brightly. Starter turns when terminals 30 and 50 are bridged. Wire from terminal 50 to starter switch faulty	d – Eliminate open circuits, replace faulty parts
	e – Lights stay bright and solenoid switch operates. Disconnect battery cable from terminal 30 at starter and connect it directly to the connector strip terminal. If the starter operates the contacts of the solenoid switch are worn or dirty	e – Replace solenoid switch
	f – Automatic Stick Shift: corroded connections in starter cut-out switch	f – Replace corroded parts, wrap insulating tape around connection between insulating sleeving and rubber cap
Starter does not operate when battery cable is connected directly to the connector strip terminal	a – Brushes sticking	a – Clean brushes and brush guides
	b – Brushes worn	b – Replace brushes
	c – Weak spring tension. Brushes do not make contact	c – Replace springs
	d – Commutator dirty	d – Clean commutator
	e – Commutator grooved or burned	e – Overhaul starter armature
	f – Armature or field windings faulty	f – Overhaul starter
Starter turns slowly or does not turn engine	a – Battery run down	a – Charge battery
	b – Insufficient current flow due to loose or corroded connections	b – Clean battery terminals and cable clamps, tighten connections
	c – Brushes sticking	c – Clean brushes and brush guides
	d – Brushes worn	d – Replace brushes
	e – Commutator dirty	e – Clean commutator
	f – Commutator grooved or burned	f – Overhaul starter armature
	g – Armature or field windings faulty	g – Overhaul starter
Starter engages but cranks engine erratically or not at all	a – Drive pinion worn or damaged	a – Replace drive pinion
	b – Flywheel ring gear worn or damaged	b – Rework ring gear or replace flywheel if necessary
Starter drive pinion does not disengage	a – Drive pinion or armature shaft dirty or damaged	a – Overhaul starter
	b – Solenoid switch faulty	b – Replace solenoid switch

Symptom	Cause	Remedy
Starter does not turn when ignition switch is operated	Turn on the lights when testing:	
	a - Lights do not burn. Loose wires or poor ground connection. Battery discharged	a - Check battery cables and connections. Test voltage of battery, charge if necessary
	b - Lights are on but go out when starter switch is operated. Insufficient current due to loose connections or corroded terminals	b - Clean battery terminals and cable clamps. Tighten connections between battery, starter and ground
	c - Lights go dim when starter switch is operated. Battery run down	c - Charge battery
	d - Lights burn brightly. Starter turns when terminals 30 and 50 are bridged Cable 50 to starter switch faulty, starter switch faulty	d - Eiminate open circuits, replace faulty parts
	e - Lights stay bright and solenoid switch operates. Disconnect battery cable from terminal 30 at starter and connect it directly to the connector strip terminal. If the starter operates, the contacts of the solenoid switch are worn or dirty	e - Replace solenoid switch
Starter does not operate when battery cable is connected directly to the connector strip terminal	a - Brushes sticking	a - Clean brushes and brush guides
	b - Brushes worn	b - Replace brushes
	c - Weak spring tension. Brushes do not make contact	c - Replace springs
	d - Commutator dirty	d - Clean commutator
	e - Commutator grooved or burned	e - Overhaul starter armature
	f - Armature or field windings faulty	f - Overhaul starter
Starter turns slowly or does not turn engine	a - Battery run down	a - Charge battery
	b - Insufficient current flow due to loose or corroded connections	b - Clean battery terminals and cable clamps, tighten connections
	c - Brushes sticking	c - Clean brushes and brush guides
	d - Brushes worn	d - Replace brushes
	e - Commutator dirty	e - Clean commutator
	f - Commutator grooved or burned	f - Overhaul starter armature
	g - Armature or field windings faulty	g - Overhaul starter
Starter engages but cranks engine erratically or not at all	a - Drive pinion worn or damaged	a - Replace drive pinion
	b - Flywheel ring gear worn or damaged	b - Rework ring gear or replace flywheel if necessary
Starter drive pinion does not disengage	a - Drive pinion or armature shaft dirty or damaged	a - Overhaul starter
	b - Solenoid switch faulty	b - Replace solenoid switch

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Removing and installing starter

Note:

The starter is secured by two bolts. The upper bolt should be removed from the engine compartment (engine/transmission securing bolt).

When installing:

1 - Insert long bolt into mounting bracket hole and together with starter into transmission housing.

2 - After installation, seal mating surface of mounting bracket and transmission housing with housing sealing compound D 3.

3 - Make sure connections are clean and tight.

Removing and installing solenoid switch

Removing

1 - The solenoid switch pull rod can be pulled out of the operating lever easier if the pinion is pulled forward and to the right at the same time.

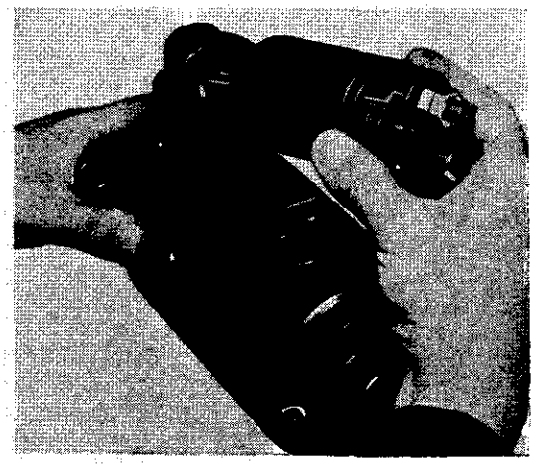
2 - A faulty solenoid switch should be replaced.

Installing

1 - Make sure rubber gasket on starter mounting bracket is properly seated.

2 - Pull operating lever as far back as possible to allow installation of solenoid switch.

3 - Seal joint between solenoid switch and mounting bracket with D 3 sealing compound.



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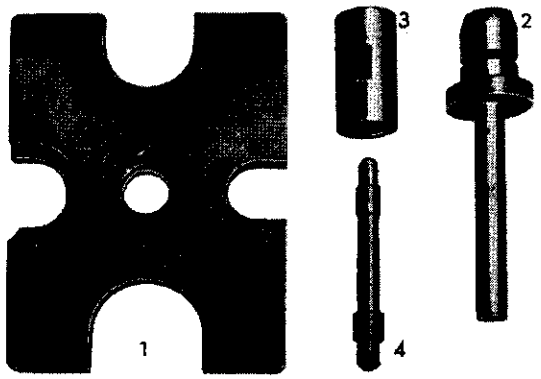

No.	Description	Special Tool No.	Remarks
1	Thrust plate	VW 401	
2	Punch	VW 411	
3	Tube	VW 418a	32.5 mm (1.28 in.) diameter
4	Starter shaft bushing drift	VW 222a	
5	Tube	VW 421	28 mm (1.1 in.) diameter

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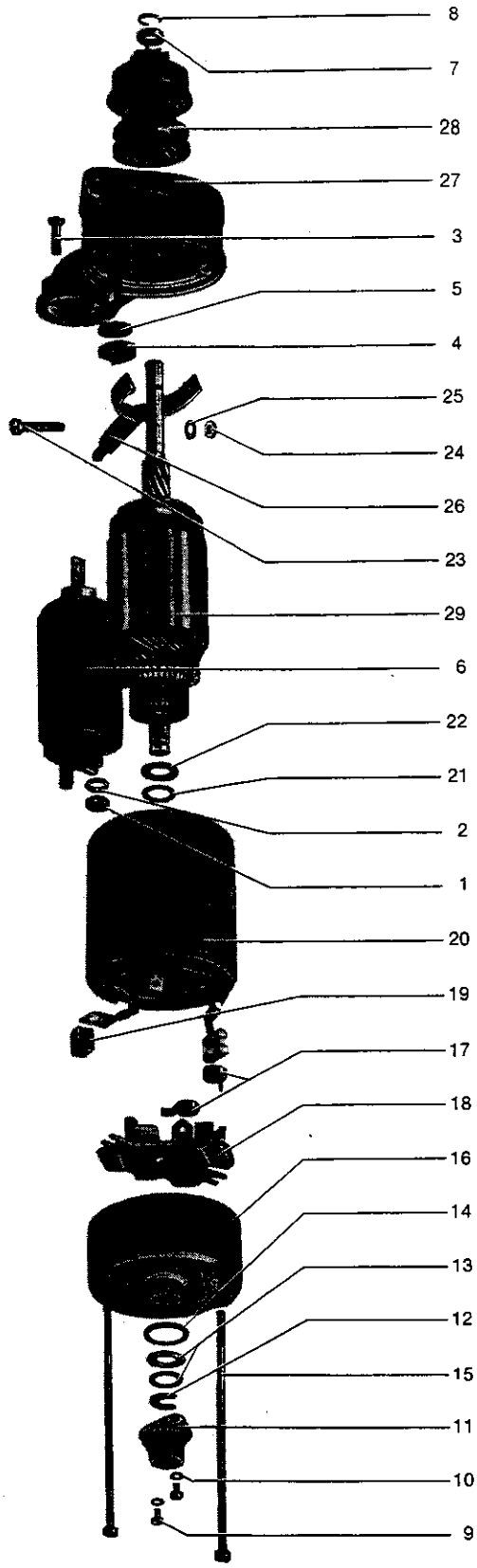
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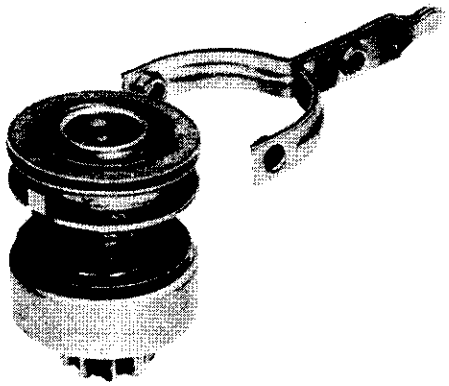
No.	Description	Qty.	Note when disassembling	Note when assembling	Special instructions see
1	Nut	1			
2	Lock washer	1			
3	Screw	2			
4	Rubber seal	1			
5	Disc	1		projection faces upward	
6	Solenoid switch	1	pull out pinion	pull out operating lever	
7	Stop ring	1	drive back with VW 421	annular groove faces outward	
8	Circlip	1	use circlip pliers		
9	Screw	2			
10	Washer	2			
11	End cap	1			
12	C-washer	1			
13	Shim		note quantity of shims	adjust axial play to 0.1–0.3 mm (0.004–0.012 in.) with shims	
14	Sealing ring	1			
15	Housing screw	2		seal screw 32 mm (1.259 in.) shorter for 311 911 023 D	
16	End plate	1	remove with VW 400, VW 401, VW 411, VW 418 and VW 222a	check bushing for wear, lubricate bushing with multi-purpose grease	
17	Spring	2	lift brushes with wire hook		
18	Brush holder	1		check brushes for wear, brush pressure 1200 grams 311 911 023 C and D have four brushes	
19	Rubber grommet	1		check for tightness	
20	Housing	1		test field windings as on generator	
21	Insulating washer	1	note installation position	faces brush holder	
22	Thrust washer	1		faces commutator	
23	Pin	1			
24	Nut	1			
25	Lock washer	1			
26	Operating lever	1			
27	Mounting bracket	1		seal	
28	Drive pinion	1	replace if damaged	insert into mounting bracket from outside so that plastic washer contacts shoulder	
29	Armature	1	Note radial run-out and minimum diameter	electrical test, axial play 0.1–0.3 mm (0.004–0.012 in.)	

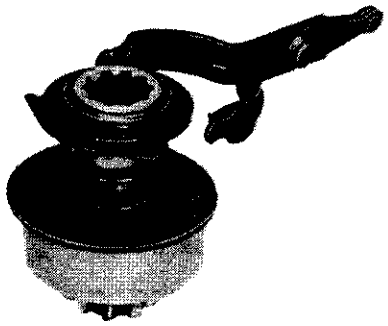
Starters 311911023 C and D have aluminium field coils instead of copper as in starters 311911023 B. Starters 311911023 D differ from the other Bosch starters by the 32 mm (1.259 in.) shorter housing.

The starters with aluminium field coils also differ from starters 311911023 B and from one another in the following parts:

1 – The simplified drive has a drive plate and a thrust disc instead of a guide sleeve for the engaging fork. The fork has also been changed. When assembling, make sure that the plate and disc are passed through the fork. The ends of the fork must contact the two projections on the drive plate.



311911023 B



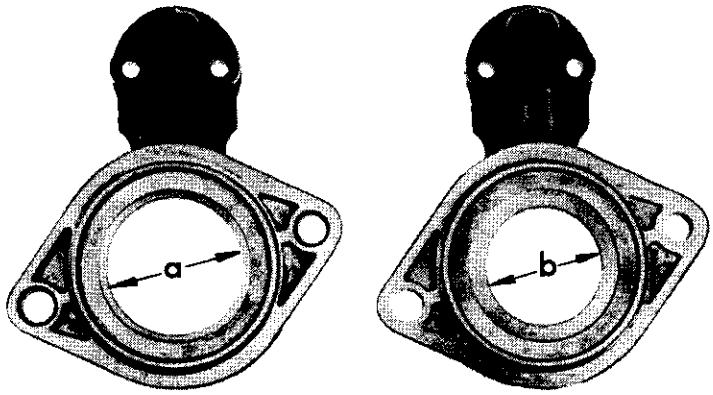
311911023 C
311911023 D

2 – By lengthening the slot in the solenoid pull rod it was possible to eliminate the switch-off spring in the pinion.

311911023 B

311911023 C
311911023 D

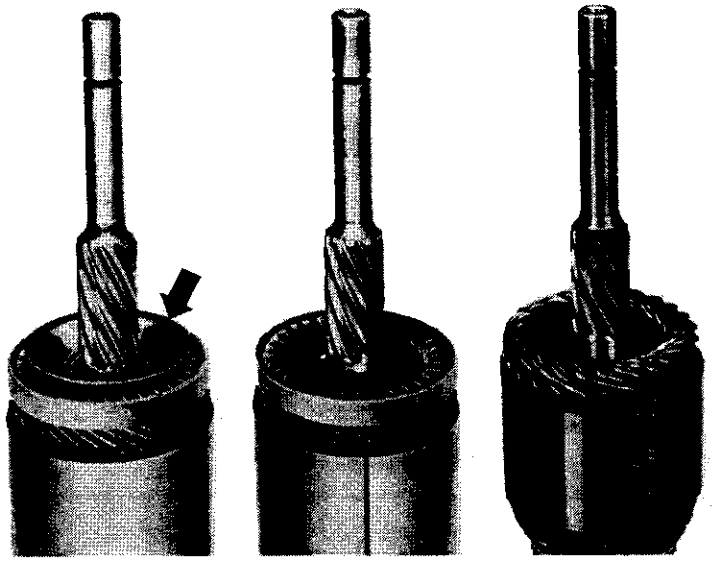
3 – The hole in the mounting bracket for the pinion has been reduced from 50 mm (1.968 in.) (a) to 43 mm (1.692 in.) (b).



311 911 023 B

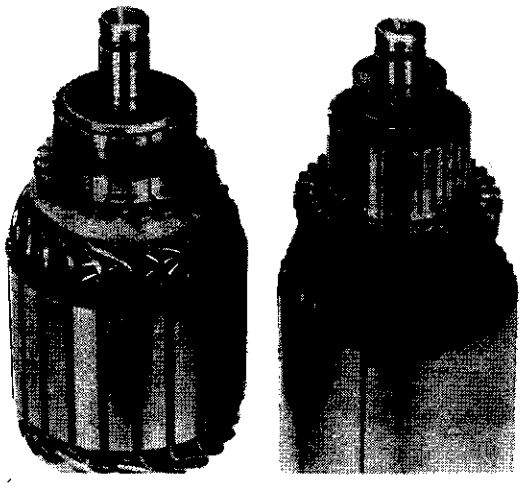
311 911 023 C
311 911 023 D

4 – On the modified starters the friction disc on the armature (arrow) was discontinued.



311 911 023 B | 311 911 023 C | 311 911 023 D

5 – The insulating and thrust washers between brush holder and commutator have been discontinued on starter 311 911 023 D. The function of these parts has been taken over by an insulating layer applied to the end face of the commutator.



311 911 023 D

311 911 023 B
311 911 023 C

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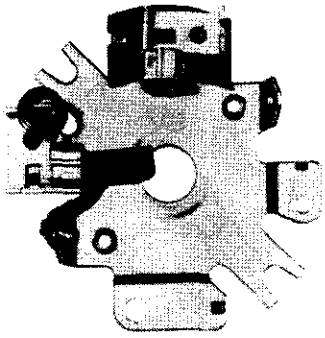
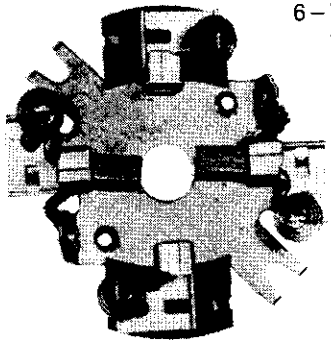
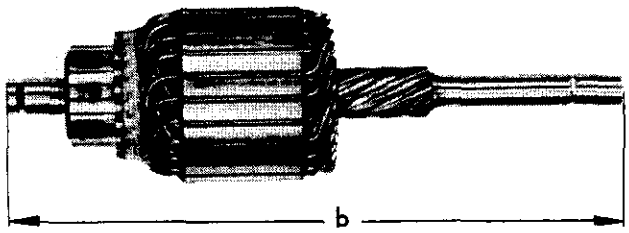


311911023 B



311911023 C
311911023 D

6 – The starter with aluminium field coils has four carbon brushes instead of two.

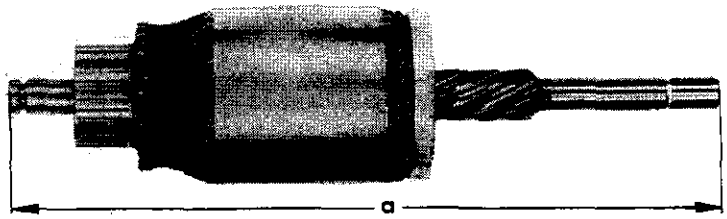


311911023 D

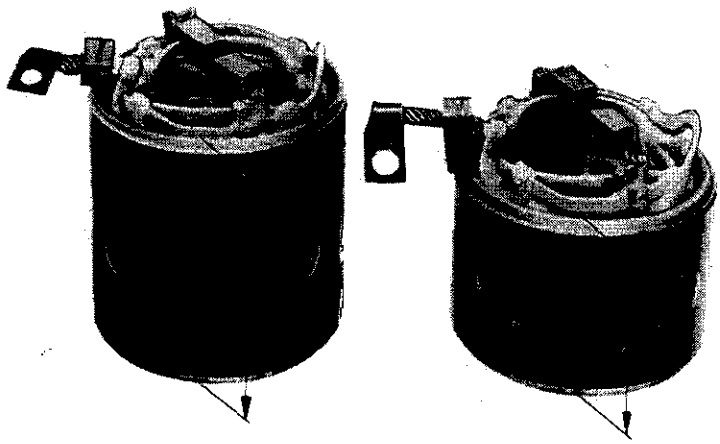
7 – Due to the shorter starter 311911023 D the armature, housing, field coils and mounting bracket were modified.

The new parts cannot be installed in starters 311911023 B and 311911023 C.

a – 245 mm (9.646 in.)
b – 213 mm (8.386 in.)



311911023 C
311911023 B



311911023 B
311911023 C

311911023 D

8 – Housing

a – 94 mm (3.700 in.)
b – 66 mm (2.598 in.)

9 – Mounting bracket

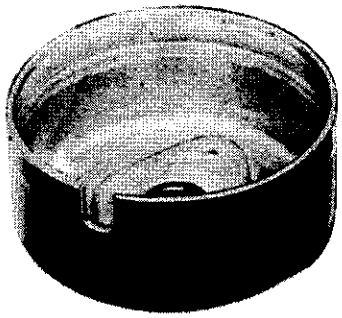
a – 47 mm (1.850 in.)
b – 42 mm (1.653 in.)

311911023 C

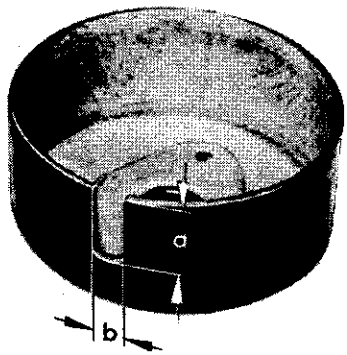
311911023 D

10 – The slot for the rubber seal in the commutator bearing has been lengthened 10 mm. When replacing this part, the slot in the bearing (113911235) must be lengthened as shown.

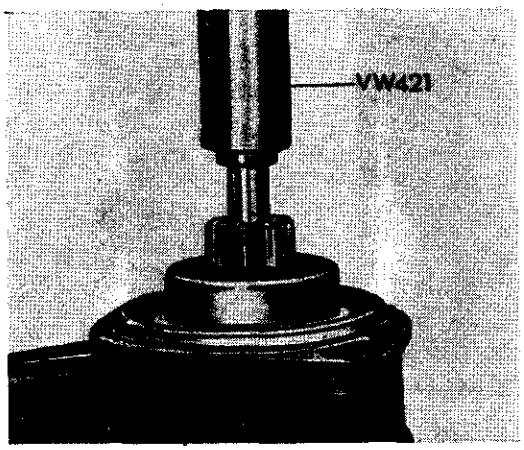
a – 22 mm (0.866 in.)
b – 9 mm (0.354 in.)



311911023 C
311911023 B



311911023 D



Removing the pinion

1 – Hold armature downward and drive the pinion stop ring back by using VW 421.

2 – Remove the circlip with circlip pliers and pull stop ring off. Remove any burrs from circlip groove.

3 – If the pinion is faulty replace complete, because individual parts are not available.

Replacing carbon brushes

The carbon brushes can best be lifted with a wire hook.

Always use the correct carbon brushes for a particular starter, and then only exchange a complete set (see Parts Lists).

Checking commutator

If the commutator is oily or greasy, it can be cleaned with a cloth moistened with cleaning solvent.

If the surface of the commutator is uneven or shows signs of burning, turn the armature.

Testing armature and field winding

Damage to the armature and to the field windings is often not externally visible. The armature, commutator and field windings are tested as on the DC generator. The permissible commutator runout is 0.03 mm (0.001 in.) and the minimum diameter is 34.5 mm (1.358 in.).

Assembling

The individual parts should be washed in cleaning solvent and dried with compressed air. The commutator bushings should only be cleaned externally. The drive pinion should be washed in solvent if it is very oily and does not engage properly in cold weather.

1 – If the commutator bushing is worn, it should be removed and installed on repair press VW 400, using VW 401, 411, 418a and 222a.

2 – Before installing a bushing, place end plate in hot oil.

3 – Lubricate bushing in commutator end plate with multi-purpose grease.

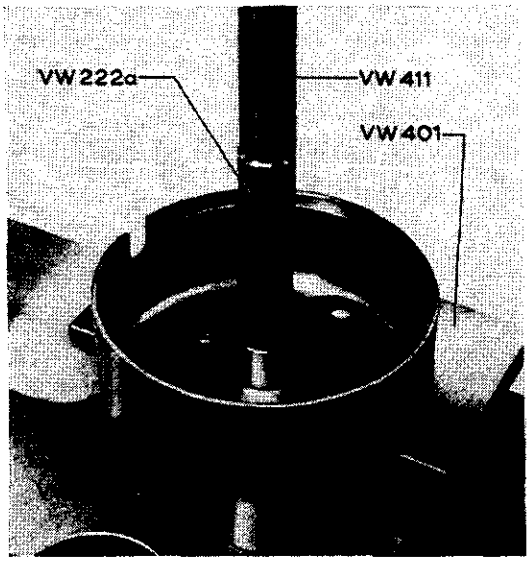
4 – Lubricate bearing surfaces, operating lever and drive pinion thread with universal grease.

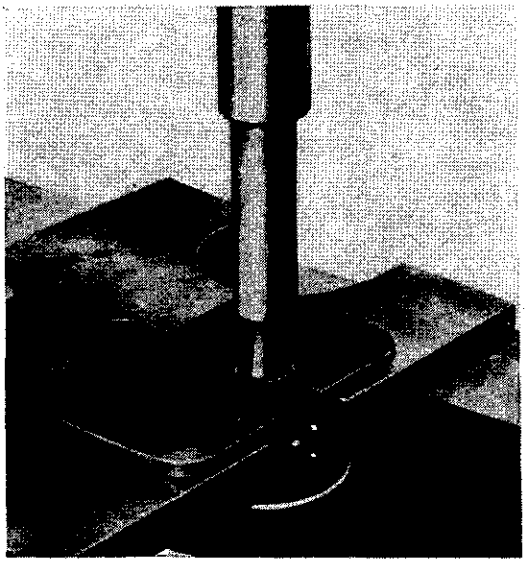
When assembling, make sure that the rubber seal for the cable to the solenoid switch and the sealing ring for the end cap are properly seated.

Place stop ring onto armature shaft, install circlip and press stop ring over circlip.

The stop ring must not jam and should be able to turn on the armature shaft.

The axial play of the armature should be 0.1–0.3 mm (0.004–0.012 in.). If necessary adjust with shims.





To prevent starter damage due to water, the following locations should be sealed with VW housing sealing compound D 3.

A – Holes for end cap screws.

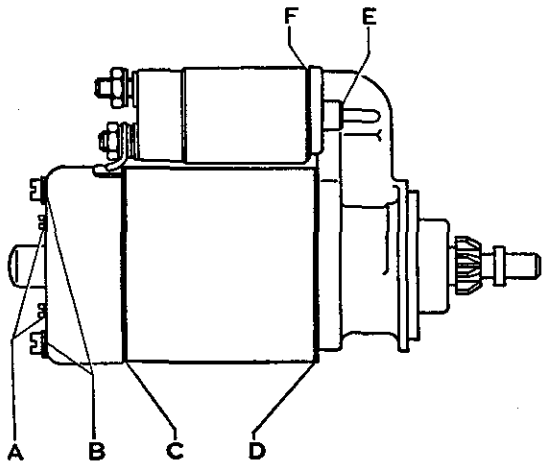
B – Holes for housing screws.

C – Joint between housing and end plate.

D – Joint between housing and mounting bracket.

E – Holes for solenoid switch screws.

F – The sealing surface between solenoid switch and mounting bracket should be sealed with VW plastic sealing compound D 14.



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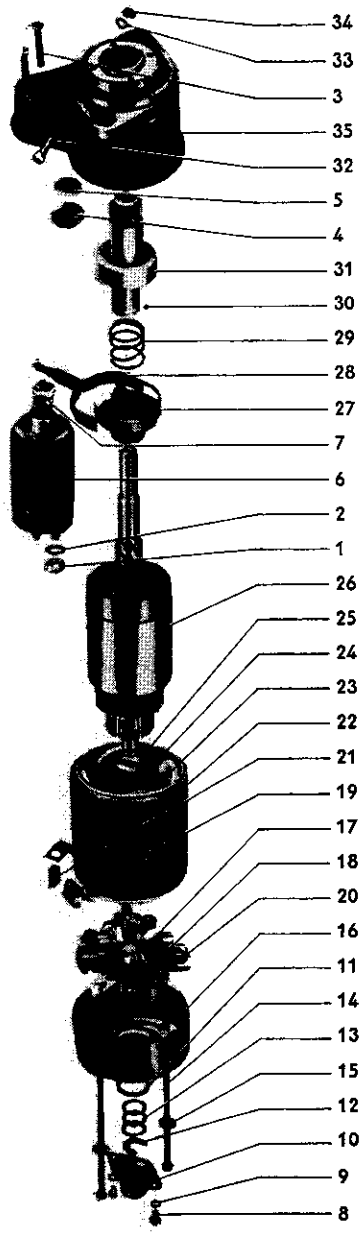

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No.	Description	Qty.	Note when disassembling	Note when assembling	Special instructions see
1	Nut	1			
2	Lock washer	1			
3	Screw	2			
4	Molded rubber	1		insert tongue of rubber into cutout in pole housing	
5	Disc	1			
6	Solenoid return spring	1	pull pinion toward front	test current consumption of switch and check that core moves freely. Seal.	E 3.6/1-2 E 3.3/2-1
7	Solenoid return spring	1			
8	Fillister head screw	2			
9	Washer	2			
10	End cap	1		seal	E 3.7/1-4
11	Sealing ring	1	if damaged, replace		
12	C-washer	1			
13	Shim		note quantity of shims	adjust armature axial play to .004—.006 in. (0.1—.15 mm)	
14	Housing screws	2		seal with housing sealing compound D 3	E 3.7/1-4
15	Washer	2			
16	End plate	1	check bushing, replace if necessary, use VW 401, 411 and 418a	ground connection to pole housing must be clean. Seal after installing	E 3.7/1-4
17	Brush holder	1		ensure correct position of retainer and good ground connection to end plate	
18	Negative carbon brush	2	check for broken, dirty or unsoldered brushes	brushes must be able to move slightly in holder. Replace only in sets	
19	Positive carbon brush	2			
20	Retaining spring	4	lift with wire hook	brush pressure approx. 2.6 lb. (1200 grams)	
21	Rubber grommet	1		ensure good sealing	

No.	Description	Qty.	Note when		Special instructions see
			disassembling	assembling	
22	Pole housing	1		ensure good ground connection between end plate and drive end plate	
23	Field winding			test for open circuit, replace burnt winding	
24	Insulating washer	1		bears against brush holder	
25	Thrust washer	1		bears against commutator	
26	Armature	1	radial runout .002 in. (0.05 mm), minimum diameter 1.318 in. (33.5 mm), if necessary undercut segment insulation .031 in. (0.8 mm)	test for short circuit to ground, check soldered locations between segments and tabs. Install armature and engaging lever	
27	Operating sleeve	1			
28	Engaging lever	1		if engaging lever bent, fit new one	
29	Engaging spring	1			
30	Detent balls	10		insert with lithium grease	
31	Drive pinion	1			
32	Pin	1			
33	Lock washer	1			
34	Nut	1			
35	Drive end plate	1		seal joint between solenoid switch and pole housing	E 3.7/1-4

1 - Removing drive pinion:

Press operating sleeve against drive pinion and pull both off armature shaft by turning them slightly.

2 - Installing drive pinion:

Hold armature in vise, then push drive pinion and operating sleeve on armature shaft until the balls locate in the detent in the armature shaft. After releasing the drive pinion it must move freely on the armature shaft.

3 - Testing armature and field winding:

Damage to the armature and to the field windings is not often visible. The armature, commutator and field windings are tested as on the DC generator. The windings must not be burned or unsoldered and they must not project above the pole shoes. Check windings for breaks, particularly at the connections.

4 - Check brush holder for short circuit.

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5 - Check armature for winding short circuit and/or short circuit to ground.

6 - Starter bushing:

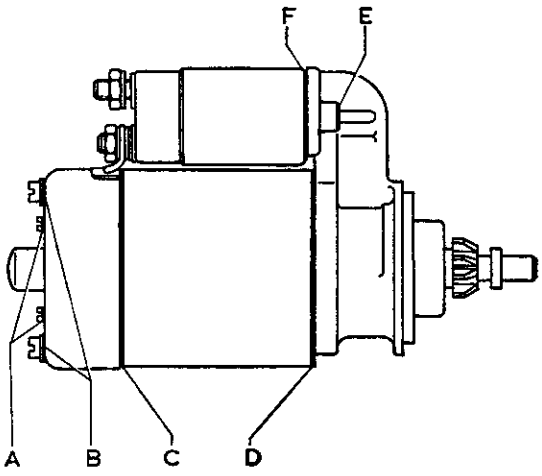
Worn bushings must be replaced. The bushing must be flush on the inside. Use a suitable drift to press the bushing in and out.

When replacing the sintered metal bushing and the seal, the rivets in the mounting should be replaced by screws. Peen the screws.

4 Fillister head screws M 4×10
4 Lock washers
4 Nuts

7 - Center the seal with a centering pilot.

8 - To prevent damage due to water, the following locations should be sealed with VW housing sealing compound D 3.



A = Holes for end cap screws
B = Holes for housing screws
C = Joint between pole housing and end plate
D = Joint between pole housing and mounting bracket
E = Holes for solenoid switch screws
F = The sealing surface between solenoid switch and mounting bracket should be sealed with VW plastic sealing compound D 14

Testing installed windshield wipers

Check windshield wiper operating condition by checking the current draw (at terminal 30) at low and high speed.

At low speed the current draw is about 2.5 amp. and at high speed 3.5 amp. These readings are attained with the wipers turned on and the blades pulled away from the windshield. Readings are inaccurate when the wipers press against the windshield due to the created friction.

If the wipers run slower and squeaking noises occur, along with a high current draw, the probable cause is a lack of bearing lubrication. If there is **no** squeaking noise but still a high current draw then there is a short in the armature winding.

Testing disassembled wiper motor

Testing armature:

1 - If the commutator is oily or dirty, it can be cleaned with a clean cloth moistened with cleaning solvent. If the commutator shows signs of wear or burning, it must be repaired. The commutator may be turned down to a minimum diameter of .846 in. (21.5 mm). The insulation between the segments must afterwards be reworked with a commutator saw. When doing this, ensure that no metal chips remain between the segments and so cause a short circuit between the armature windings. The permissible runout of the armature is .001 in. (0.03 mm).

2 - Often, armature damage cannot be seen. The armature, commutator and field windings are tested in the same way as a D. C. generator.

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Wiper blades

Care

For good visibility and safety, the windshield wipers should always be in good operating condition.

During long, dry period the wiper blades become clogged with road tar, oil droplets and dead insects. In this condition the wiper blades cannot completely remove the water film from the windshield.

To clean the blades thoroughly it is necessary to take them off and scrub them with a hard nylon brush and alcohol or a strong detergent solution. If the blades show cracks or signs of deterioration and the edges are no longer sharp, they should be renewed.

Notes:

Often the quality of the wiped area cannot be improved simply by replacing the wiper blades (see chart "Wiper Blade Troubles — Causes and Remedies"). In such cases the windshield must be treated with silicone remover. The following solvents can be used for cleaning the windshield:

1 - Windshield cleaner (VW part no. 000 096 105).

2 - Clean windshield with benzene and then treat it with an acid solution consisting of 1 part hydrochloric acid and 9 parts water. Afterward, rinse thoroughly with clean water.

Note:

1 - When cleaners containing silicones are used, the brushes, sponges, leathers and rags used to clean the paintwork should not be used for the windshield.

2 - The wiper blades are subject to a certain amount of natural wear even if given the best of care. It is advisable, in the interest of road safety, to fit new blades about every 12 months or earlier if necessary.

Park position

To ensure that the wiper motor always moves to its park position, note the following:

1 - Blades which have frozen to the windshield should be freed before operating the wiper switch. If this is not done, the blades may move slightly when turned on and then stop again. Should this occur at the turned on position, the current supply to the motor will continue as long as ignition is on, despite the fact that the switch has been turned off. This will cause the armature winding to burn out and make the motor unserviceable.

2 - When snow is falling, ensure that it does not build up on the windshield and prevent the blades from reaching the park position.

Symptoms	Cause	Remedy
Motor runs too slowly, cuts out or stops completely	a - Ground connection or feed cable making poor contact b - Brushes worn or sticking c - Brush springs weak d - Commutator dirty e - Wiper bearings and liknage joints dry or jamming f - Battery voltage too low	a - Provide good contact to ground or for feed cable b - Install new or free off brushes c - Install new brush springs d - Clean commutator e - Lubricate bearings and linkage joints with universal grease f - Charge battery; check cables and connections
Motor does not stop exactly in end position when switched off	a - Contacts in wiper gear cover dirty, bent or broken b - Open circuit in cable to terminal 53a of motor c - Crank moved on spindle d - No circuit between switch terminal 31—31 b e - Contact 31 b broken or bent	a - Clean contacts or replace gear cover b - Check cable connections for contact c - Let motor run to end position, loosen crank, move to correct position and re-tighten d - Install new switch e - Straighten contacts or replace cover and contacts
Motor continues to run when switched off	a - Contacts in wiper gear cover bent b - Contacts in switch burnt	a - Check contacts, if necessary replace cover and contacts b - Install new switch
Motor will not run or stops	a - Armature burnt by winding or ground short circuit b - Switch contacts burnt c - As for "Motor runs too slowly, cuts out or stops completely"	a - Install new motor or armature b - Install new switch
Squeaking noise when motor operates and in some cases motor runs slowly	a - Wiper shafts or drive bearing without grease b - Gear housing not correctly located on body c - Armature or worn gear bearing stiff	a - Lubricate with universal grease b - Correct location of gear housing c - Set axial play, if necessary lubricate with molybdenum disulfide grease

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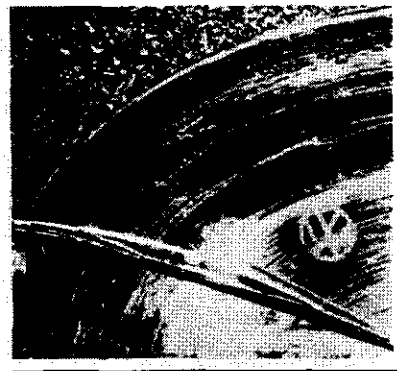
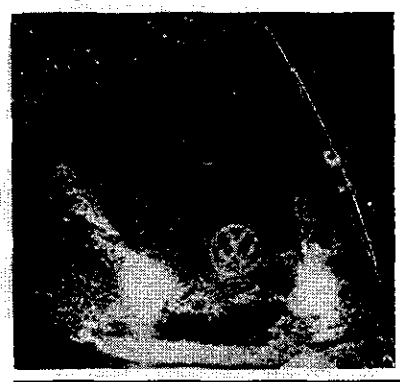
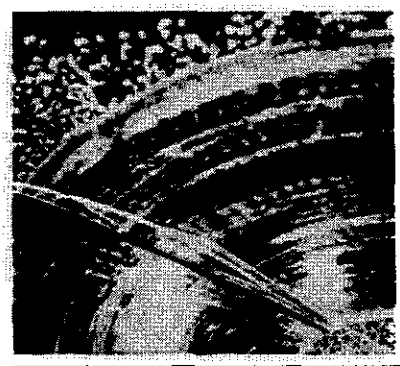
The following table contains various wiper blade troubles with probable causes and remedies.

Symptom	Cause	Remedy
1 - Smearing 	a - Blade dirty	a - Clean rubber with hard nylon brush and soap solution or methylated spirits
	b - Frayed blades lips, rubber damaged or worn out	b - Install new blades
	c - Old blades, edges cracked	c - Install new blades
2 - Traces of water left in blade range form beads 	a - Glass soiled by polish, oil or diesel exhaust deposits	a - Clean windshield with clean cloth and grease-oil-silicone remover (E 5.3/1-2)
3 - Blade wipes well on one side and badly on other, judders 	a - Blade distorted to one side, no longer "flips"	a - Clean blade with hard nylon brush and soap solution or methylated spirits or fit new rubber
	b - Wiper arm distorted, blade not vertical on windshield	b - Twist arm carefully until it is vertical
	c - Glass dirty, thin film of water on it	c - Add glass cleaner to washer fluid
4 - Blade misses parts of windshield	a - Blade torn out of retainer	a - Push blade back into retainer
	b - Blade not contacting glass uniformly due to distorted spring or retainer	b - Install new blade. This defect is often caused by careless fitting of blades
	c - Pressure exerted by wiper insufficient	c - Oil arm linkage and spring sparingly or install new arm

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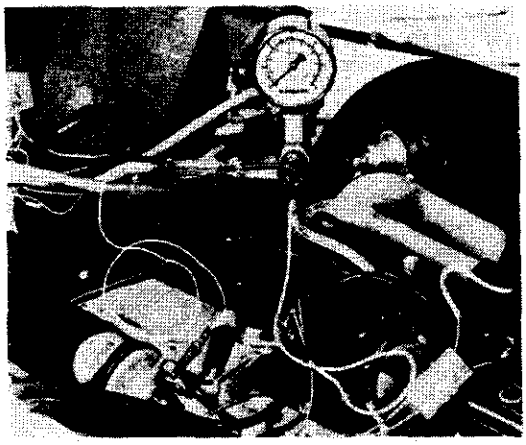
Testing oil pressure switch

The oil pressure switch can be tested on the engine, using a simple testing device with a gauge (local manufacture drawing VW 622/2) and a test light, after the engine has reached operating temperature (about 70° C / 180° F) oil temperature).



1 - Remove oil pressure switch and install into testing device.

2 - Screw testing device into seat for oil pressure switch on crankcase and connect test light to oil pressure switch and to terminal 15 of ignition coil. When the ignition is switched on, the test lamp should light up. If the light does not light up, the switch is defective and must be replaced.

3 - Start engine. The light must go out when the gauge indicates a pressure above 2—6.5 psi. At a lower pressure the contact should remain closed and the light comes on. When the engine is cold, the lamp should go out at normal idling speed and when the engine is warm, the lamp should go out as the engine speed increases.

4 - Increase engine speed. At 2500 rpm the oil pressure should be 28 psi.

5 - Stop engine. A slight delay may occur before the light comes on. This is because the oil pressure drops slowly.

The oil pressure switch cannot be repaired.

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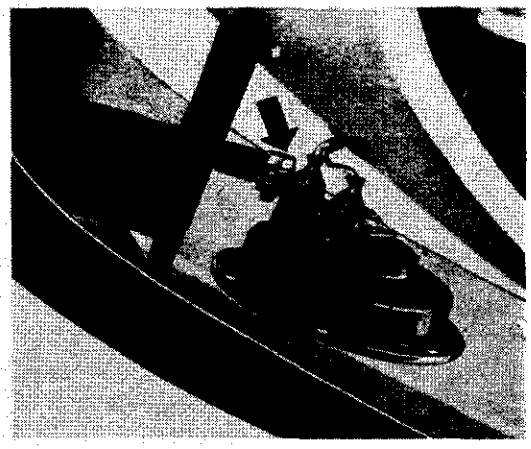
Horn

An electromagnet in the horn produces pulsations in connection with a set of contact points. These pulsations are transmitted to a diaphragm which produces the sound. A condenser between the contact points reduces arcing and burning. Operation of the horn is by a button on the steering wheel hub, which closes the circuit with ground (negative terminal of battery).

Removing horn

1 - Disconnect wires at horn and remove hexagon head bolt and nut from bracket on bumper bracket (arrow).



Installing

When installing, care should be taken that the horn bracket is not damaged and the horn does not touch the vehicle body, as the vibration of the diaphragm will otherwise be affected. Damage may result from worn or dirty breaker points, ingress of water and a faulty condenser.

If trouble is experienced with the horn, always check for faults in the wire from fuse box to horn or from the horn via the horn lever to ground. Corroded or loose connections often affect the operation of the horn.

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Description

The lead-acid battery stores the electrical energy produced by the alternator. When starting the engine, the starter and ignition systems are supplied with the necessary current by the battery. Each of the battery cells has a set of positive lead oxide plates and a set of negative lead plates. The cells are in an acid proof container and are connected in series. The electrolyte has a specific gravity of 1.285. The positive terminal has a larger diameter than the negative terminal. In addition, the terminals are marked + and —.

Cell voltage

The nominal voltage of a cell is 2 volts. When the battery is being charged the available cell voltage increases to about 2.5—2.7 volts, but once the charging current is turned off, this drops to 2—2.1 volts (12—12.6 volts for the complete battery) in a very short time. When the available battery voltage has dropped to 10.5 volts in an unloaded condition, the battery is fully discharged.

Capacity

The capacity of a battery is the amount of current it can deliver for 20 hours at an electrolyte temperature of 81° F (27° C). This is given in Ah (ampere hours). A 54 Ah battery can deliver a current of 2.25 amps. for 20 hours at a temperature of 81° F (27° C).

Discharging process

As the battery discharges, the plates absorb more and more chemical parts of the sulphuric acid and turn into lead sulphate. This reduces the specific gravity of the acid (1.12 at 68° F/20° C in the discharged state).

Charging process

Lead-acid batteries can only be charged with direct current.

On the vehicle this current is supplied by an alternator. It is essential that the positive and negative poles of the direct current source be connected to the correct poles on the battery. Under the influence of the direct current, which should have a voltage of 2.7 volts for each cell, the positive plates turn back to brown lead oxide and the negative plates to spongy lead. The sulphuric acid which was absorbed into the plates during the discharging process is released again and this increases the specific gravity of the diluted acid to 1.285 (in fully charged state at 68° F/20° C). If the charging process in continued, the water in the battery acid electrolyses into hydrogen and the battery starts to "gas".

Specific gravity of electrolyte

The specific gravity of the battery electrolyte and a voltage measurement indicate accurately the state of charge of a battery. The specific gravity is checked with a hydrometer which consists of a glass cylinder housing with a rubber ball and a freely moving float with a calibrated scale. The higher the specific gravity of the electrolyte, the higher the float will rise in the liquid. The density of the acid can then be read off the scale as specific gravity. The following values should be attained:

State of charge	Specific gravity	Specific gravity in tropics
Fully discharged	1.12	1.08
Half discharged	1.20	1.14
Fully charged	1.285	1.23

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Cold weather operation

The conductivity and degree of viscosity of the electrolyte largely depend on temperature. Extreme cold reduces the battery capacity considerably. At an electrolyte temperature of —13° F (—25° F) the capacity is only 50% of that at a temperature of +68° F (+20° C).

The higher the specific gravity of the electrolyte, the lower its temperature must be before it freezes. The battery must, therefore, be kept in a sufficiently charged condition to prevent it from freezing. A frozen battery gives no current but can usually be restored by thawing out and recharging.

Specific gravity	Freezing temperature	
1.285	(—85° F)	—65° C
1.18	(— 9° F)	—22.5° C
1.14	(+ 9° F)	—13° C

The increased stress imposed on the battery at low temperatures by the starter necessitates a more frequent inspection. In the cold season, it is recommended that the battery be removed at 4 week intervals for recharging and checking specific gravity and electrolyte level.

Taking batteries out of service

Batteries which are not used for prolonged periods gradually discharge. At normal room temperature the discharge rate is about 1% of the battery capacity per day.When a discharged battery is stored in a warm room, the plates also tend to "sulphate". This is the formation of a layer of lead sulphate on the plates. Sulphated batteries cannot supply the heavy current required to start the engine and are therefore unserviceable.

When a battery is to be taken out of service for a long time, the following points should be noted in order to prevent self-discharging and sulphating.

1 - Charge battery, check acid level and specific gravity and rectify as necessary.

2 - Store the battery in a cool dry plate, discharge it every 6—8 weeks and then re-charge.

3 - Before a battery is put back into regular use, it should be charged at a very low rate (maximum 3 amp.).

Sulphated batteries must be "boosted" at a high charging rate under any circumstances as this can damage them seriously.

Using pre-charged batteries

When putting pre-charged (dry-charged) batteries into use, follow the battery manufacturer's instructions.

The procedure is usually as follows:

1 - Store batteries in a cool, dry place.

2 - Remove cell plugs and fill cells with electrolyte with a specific gravity of 1.285 at +68° F (+20° C).

3 - After about 15 minutes, shake battery slightly and add battery electrolyte to bring level up to mark.

4 - The battery can now be connected and treated in the same way as any other battery.

Battery care

The average service life of a battery is two to three years. This is due to such conditions as prolonged attempts to start engine (as much as 300 amp. current draw) and vibration while the vehicle is operated.

The battery must be fixed securely in the vehicle and the terminal pillars and terminals must be kept clean to avoid high contact resistances. The connections should be wiped with a clean rag or, when very dirty, with a special pole cleaner. Afterward, they should be coated sparingly with an acid resistant grease or petroleum jelly.

Battery connections that are hard to remove because of oxidation can be pulled off with a special tool.

Important

The plastic casing of the battery must not come into contact with grease, oil or gasoline, otherwise discoloration cannot be avoided.

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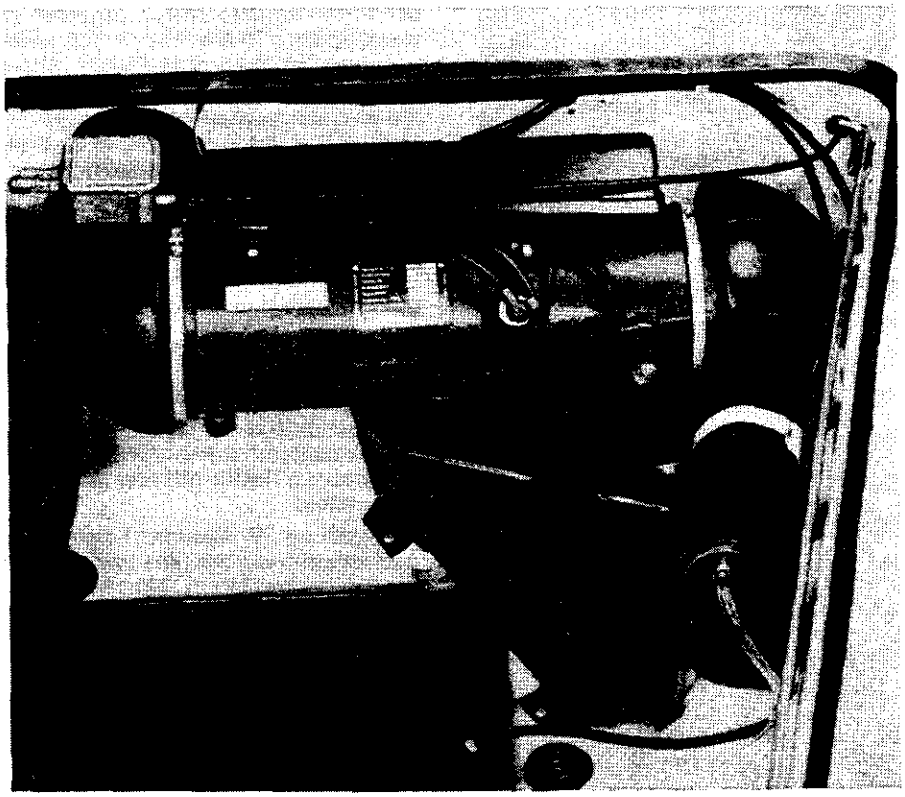
Section F

Gas Heater

BN 4 Recirculating Air and Fresh Air Heaters

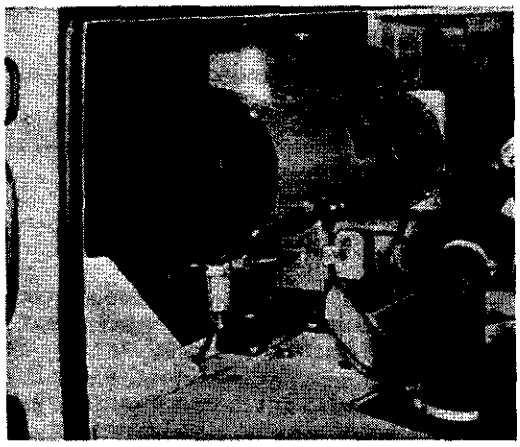
Description : Type 1/Model 181

The gasoline-electric recirculating heater operates independently of the vehicle engine and is installed in the front luggage compartment. The heater is thermostatically controlled and can be used without running the engine.

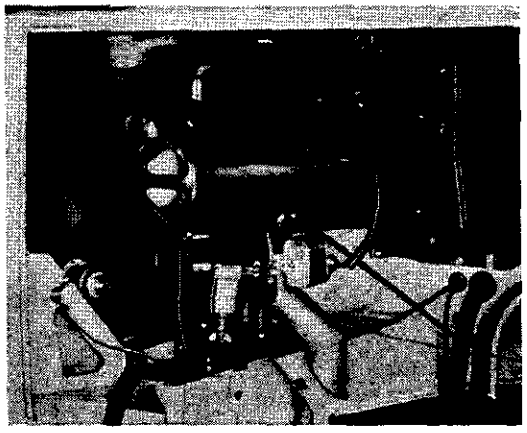


Description: Type 2

The gasoline heater works independently of the vehicle engine and is installed in the engine compartment. The heat range can be adjusted by a temperature regulating lever.



Recirculating heater



Fresh air heater

On the fresh air version a thermostatically operated flap is necessary to prevent cold air flowing from the engine compartment to the passenger compartment when the heater is not operating.

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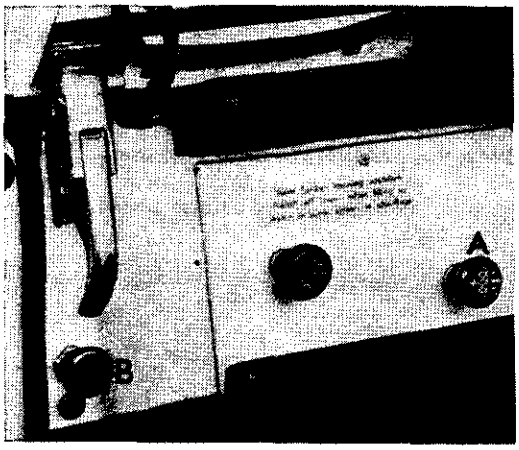


A – time switch knob
B – temperature regulating switch knob

Type 1/Model 181

1 – With engine running

To switch heater on: Pull control switch knob (B) out slightly. Turn time switch knob (A) clockwise until switch engages. The green warning lamp in the time switch knob lights up when the head-or parking lights are switched on.

To switch heater off: Turn time switch knob (A) as far as possible counter-clockwise. With the parking-or headlights turned on the brightness of warning light in knob A and B can regulated like the instrument light.

2 – With engine not running

To switch heater on: Pull regulating switch knob (B) out. Turn time switch knob (A) clockwise as far as possible.

To switch heater off: The clockwork mechanism in the time switch automatically switches the heater off after about 30 minutes.

During these 30 minutes, the clockwork mechanism turns the time switch knob back to its original position. If the engine is started with the time switch knob in this position, the heater switches itself on again automatically and remains on until the ignition is switched off.

When the heater is used with the vehicle parked it can be switched off at any time by turning the time switch knob counter-clockwise to the engaged position or turning it counter-clockwise as far as possible to the zero position. The clockwork mechanism then runs down.

Regulating warm air temperature

Pull temperature regulating switch knob (B) out.
The further the temperature regulating switch knob (B) is pulled out, the higher the temperature of the circulated hot air will be.

Note

1 – After the heater has been turned off, the combustion air blower continues to run (run-on) to cool the heater.

2 – To avoid running the battery down it is recommended not to switch the heater on several times in succession when the vehicle is parked. This applies particularly when outside temperatures are very low as then the full capacity of the battery is required to start the engine.

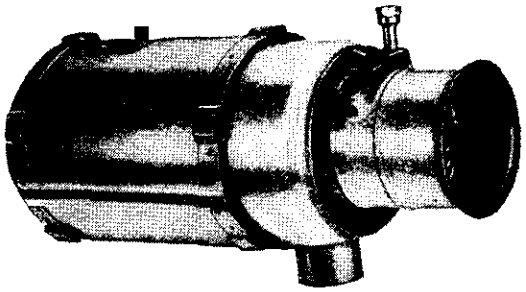
Warning

The heater must be turned off when filling the fuel tank.

Heat exchanger

The heat exchanger is made of stainless sheet steel. The cylindrical combustion chamber and the two annular chambers of the heat exchanger are connected by two openings.

Spark plug, glow plug, flame switch and fuel jet are attached to the heat exchanger.

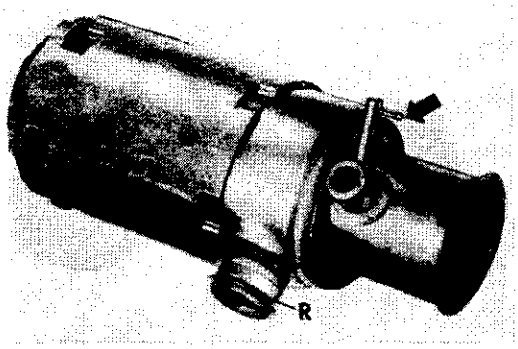


Up to July 1971

Type 2

from August 1971

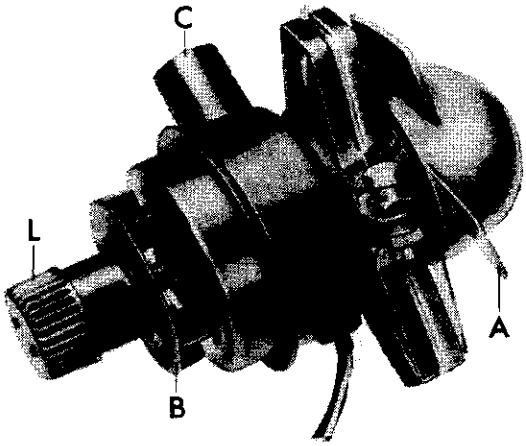
The heat exchanger can be recognized by the connection for the fuel hose (arrow) and by the single adapter for the glow-spark plug.



R – tapered ring / Type 1 / Model 181 only

Combustion air blower

The combustion air blower is connected to one end of the heat exchanger. Two fans are connected to the shaft of the combustion air blower. The fresh air blower fan (A) delivers the warm air. The combustion air blower fan (B) draws the combustion air in through the air intake (C). The air deflection cylinder (L) increases atomization of the fuel.
Ignition of the mixture is controlled by a set of contacts that make/break with each revolution of the motor.

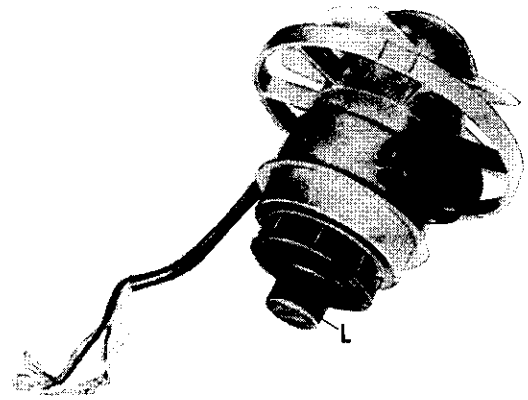


A – fresh air fan
B – combustion air blower fan
C – air intake
L – air deflection cylinder with identation (up to July 1971)

Type 2

from August 1971

The metering pump is operated by an electrical impulse received from the contact points after every 33rd revolution of the combustion air blower.



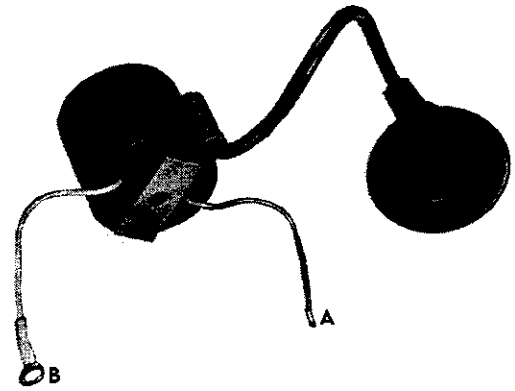
L – Air deflection cylinder

Type 1/Model 181 and Typ 2

Combustion air blower with diaphragm pump has three connecting wires.
Combustion air blower with metering pump has four connecting wires.

Speed

4875 rpm to 5325 rpm at 12 volts.

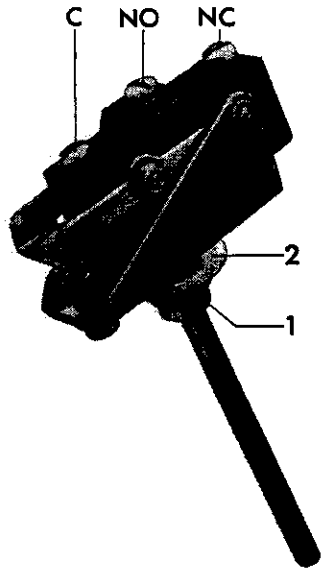


Ignition coil

The ignition coil is attached to the heater housing. The primary and secondary windings as well as the iron core are in a plastic housing. Voltage impulses are passed to the primary winding by the contact breaker on the combustion air blower motor shaft. The primary winding then induces ignition high voltage in the secondary winding. This voltage goes to the spark plug via an ignition cable.

A – to contact breaker points of combustion air blower
B – to condenser

Initial voltage: 12 volts
High voltage: 5000 volts



Flame switch

The sensor of this switch is attached to the heat exchanger by a union nut. The sensor tube protrudes into the combustion chamber. The flame switch controls the cut-in time of the glow plug and the run-on time.

NC – normally closed
NO – normally open, safety switch and glow plug connection
C – common, combustion air blower fan
1 – union nut
2 – seal

from August 1971

Cut-in time:

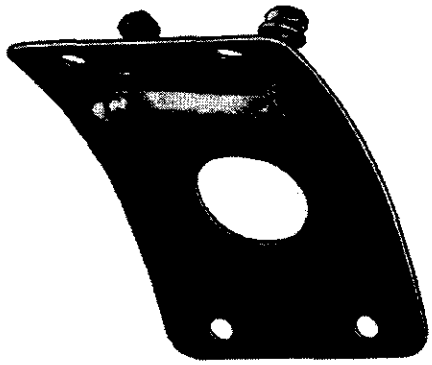
Less then 45 seconds at room temperature.

Run-on time:

110–150 seconds at room temperature.

Overheating switch

The overheating switch is attached to the heater housing. If the temperature rises considerably the bimetal switch interrupts the circuit to the fuel pump and to the solenoid valve.



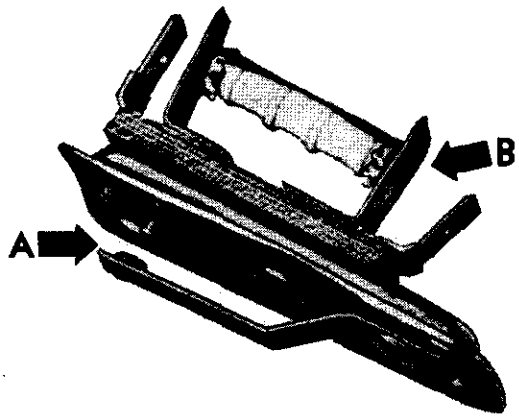
Conditions causing operation of overheating switch:

a – temperature regulation defective
b – hot air outlets plugged
c – fuel mixture to rich.

Overheating switch with fuse holder

Type 1/Model 181 and Type 2
from August 1971

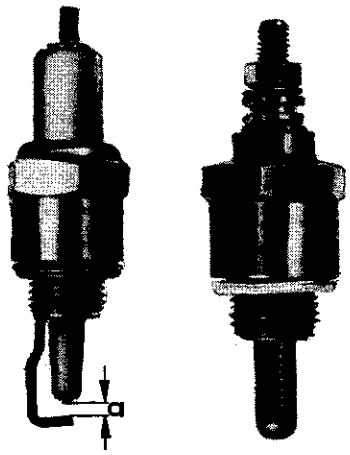
On combustion air blowers with metering pump the contact closes when the heater temperature is too high. This closed contact blows the fuse and cuts-off the operation of the fuel pump (see wiring diagram).



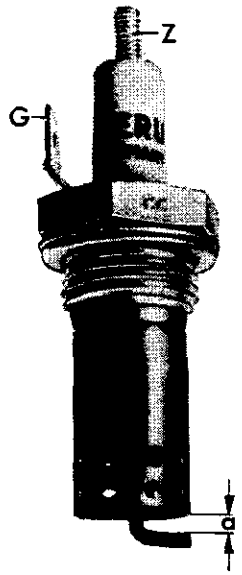
A – overheating switch
B – fuse holder

Glow plug and spark plug
Type 2 up to July 1971

The glow plug and the spark plug protrude into the combustion chamber. The spark plug has a push-on connector and the glow plug has a screw-on connector. The glow plug works only for a brief period after the heater is turned on. The spark plug remains on the entire time the heater is in operation.



a = 2.5 mm (0.1 in.)



G – low voltage connection
Z – high voltage connection
a = 2.5 mm (0.1 in.)

Glow-spark plug
Type 1/Model 181 and Type 2
from August 1971

Caution

The glow-spark plug of the BN 4 heater must **not** be installed in BA 4 heaters because the BA 4 heater requires the special ground connection. It is possible, however, to install the plug from the BA 4 heater in a BN 4 heater.

Technical data

spark plug

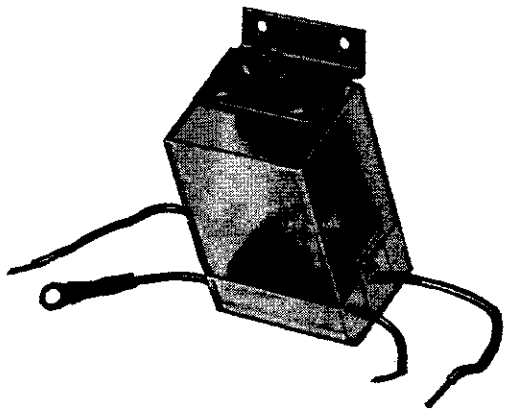
high voltage = 5000 volts
resistance = 5 kΩ

glow plug

voltage = 12 volts
resistance = 2.5 kΩ
current draw = 5 amps

glow-spark plug

voltage = 12 volts and 5000 volts
resistance = 4–6 kΩ
current draw = less than 6.5 amps



Safety switch

This switch interrups current flow to the heater if, for any reason (fuel supply cut off, glow-spark plug defective), combustion does not start within 180 seconds after turning heater on.

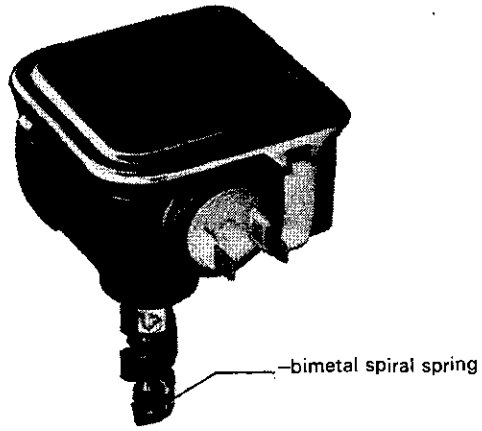
Switch response time

120–180 seconds at 12 volts

Temperature regulating switch

A cam-operated contact switches the current for the heating system on and off depending on the pre-set temperature.

When the cut-off temperature range is attained, the temperature regulating switch interrupts the current flow to the fuel pump. As the heated air cools down to the cut-in temperature range, the temperature regulating switch automatically switches on the current to the fuel pump. The regulating range is adjustable and depends on the position of the regulating linkage. This linkage is operated by a push-pull knob via a Bowden cable.



Type 1 / Model 118

Cut-in or cut-off temperature difference: 20° C (68° F).

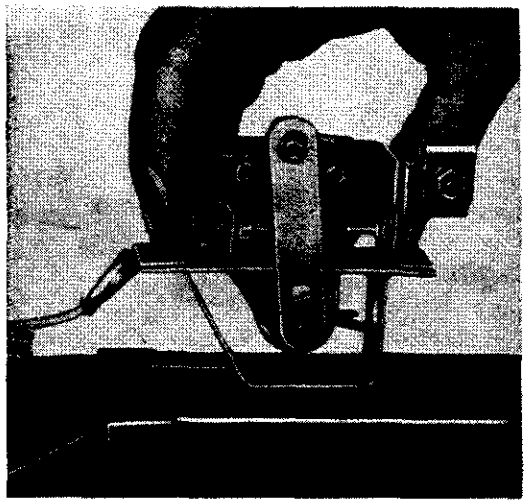
Cut-in temperature: approx. 60° C (140° F).

Cut-off temperature: approx.

Type 1/ Model 181 110–130° C (230–266° F)

Type 2 120–140° C (250–285° F)

These temperatures can be checked only with electronic instruments.



Type 2

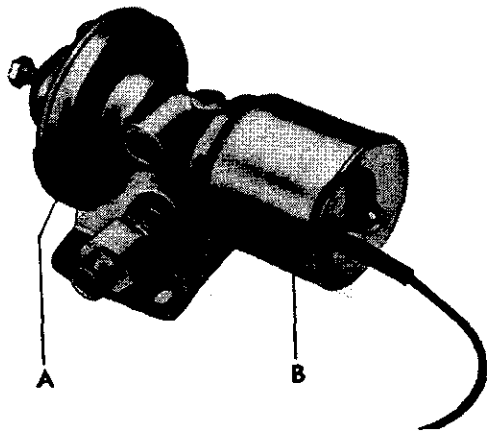
Pressure regulator with solenoid valve

Typ 2 up to July 1971

The diaphragm pressure regulator and the solenoid valve are attached to the heater housing. The fuel delivery quantity is controlled and kept constant by the pressure regulator. When the heater is turned off, the solenoid valve cuts off the fuel supply to the pressure regulator.

Delivery capacity

20 cm³ to 21 cm³ in 2 minutes at 12 volts.



A – diaphragm pressure regulator
B – solenoid valve

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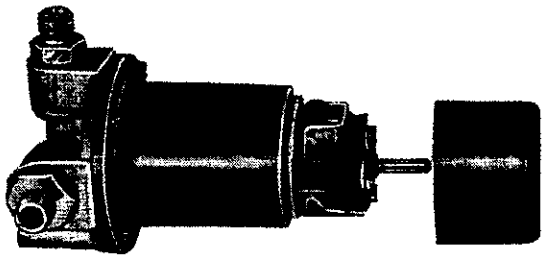


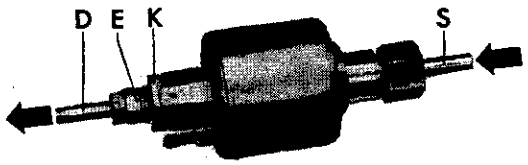
Fuel pump (Diaphragm pump)

Type 2 up to July 1971

This pump can only be used together with the diaphragm pressure regulator.

Installation position:

The adaptor on the pressure side (arrow) must be vertical as otherwise the valve may stick.



D – pressure connection
S – suction connection
K – locknut
E – adjusting screw

Fuel pump (metering pump)

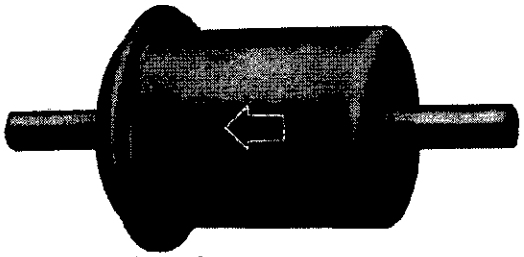
Type 1/Model 181

Type 2 from chassis No. 212 2 000 003, August 1971

The amount of fuel delivered by the electro-magnetic metering pump is directly dependent on the speed of the combustion air blower. At every 33rd revolution of the motor shaft, the pump receives an electrical impulse via the breaker contacts so that the fuel-air mixture is always constant regardless of changes in the speed of the combustion air motor.

Delivery capacity:

200 strokes = 13.4 to 15.1 cm³.



Arrow = direction of flow

Fuel filter

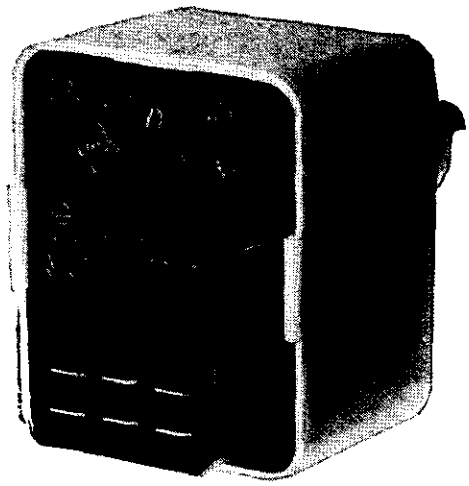
Type 1/Model 181

Type 2 from chassis No. 212 2 000 003, August 1971

The filter with water separator is installed in BN 4 heaters with metering pump.

Time switch

This switch restricts the heater operating period to 25 minutes when ignition is switched off.



Modification

Type 1/Model 181

Type 2 from chassis No. 213 2 000 001, August 1972

6 terminals instead of 4 terminals previously.

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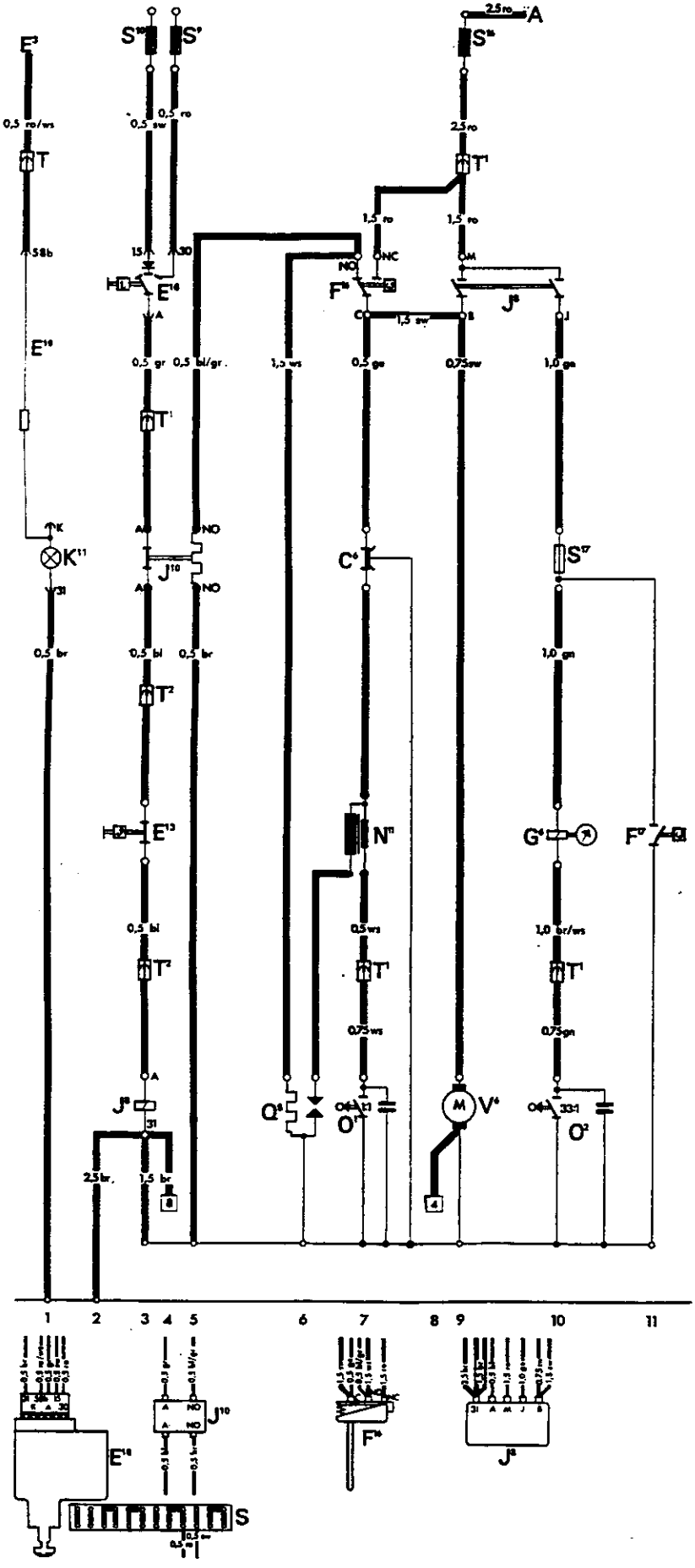


Explanation of current flow

Type 1/Model 181

Type 2 from August 1972

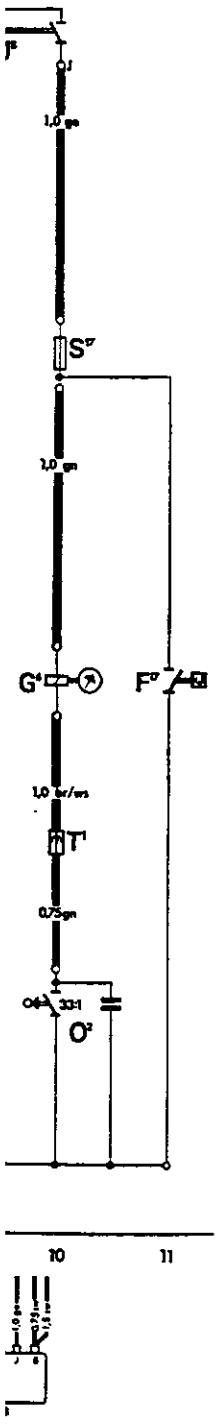
Description

A – Terminal 30 of starter
C4 – Suppression condenser for coil/capaci
E3 – From light switch terminal 58b
E15 – Temperature regulating switch
E16 – Heater switch/operating period 25 min
F16 – Flame switch
F17 – Overheating switch
G4 – Metering pump
J8 – Relay
J10 – Safety switch
K11 – Warning lamp
N11 – Ignition coil/voltage 12/5000
O1 – Ignition contact in combustion air blo (contact opens once per revolution)
O2 – Contact in combustion air blower for n (contact opens once per 33 revolution
O5 – Glow-spark plug
S – Fuse box
S9 – 9th fuse in fuse box – terminal 30
S10 – 10th fuse in fuse box – X contact
S16 – Separate 16 amp fuse
S17 – Overheating fuse/8 amp
T1 – Wire connector, single
T2 – Wire connector, double
T3 – Wire connector, 3 pin
T4 – Wire connector, 4 pin
V4 – Combustion air blower

Color code

ro = red	br = brown
sw = black	ws = white
ge = yellow	gn = green
bl = blue	gr = grey

A



Explanation of current flow diagrams

Type 1/Model 181

Type 2 from August 1972

Description	Current track
A – Terminal 30 of starter	9
C_6 – Suppression condenser for coil/capacity 0.47 µF	7
E_3 – From light switch terminal 58 b	1
E_{15} – Temperature regulating switch	3
E_{16} – Heater switch/operating period 25 minutes	1; 3
F_{16} – Flame switch	7
F_{17} – Overheating switch	11
G_4 – Metering pump	10
J_8 – Relay	3; 9; 10
J_{10} – Safety switch	3; 5
K_{11} – Warning lamp	1
N_{11} – Ignition coil/voltage 12/5000	7
O_1 – Ignition contact in combustion air blower (contact opens once per revolution)	7
O_2 – Contact in combustion air blower for metering pump (contact opens once per 33 revolutions)	10
Q_5 – Glow-spark plug	6
S – Fuse box	3; 4
S_9 – 9th fuse in fuse box – terminal 30	4
S_{10} – 10th fuse in fuse box – X contact	3
S_{14} – Separate 16 amp fuse	9
S_{17} – Overheating fuse/8 amp	10
T_1 – Wire connector, single	
T_2 – Wire connector, double	
T_3 – Wire connector, 3 pin	
T_4 – Wire connector, 4 pin	
V_6 – Combustion air blower	9

Color code

ro = red	br = brown
sw = black	ws = white
ge = yellow	gn = green
bl = blue	gr = grey

Explanation

To switch heater on

a – Pull knob of temperature regulating switch (E 13).
b – Operate time switch (E 16).

Voltage can be measured at:

Terminals 15, 30, A on heater switch (E 16)

Warning lamp (K 11) lights up.

Relay (J 8) operates.
Contacts B–M–J are connected.

Start-up

The heater ignites within 45 seconds if the air being drawn in is at room temperature. The start-up process is terminated by the flame switch (F 16).

Voltage can be measured at:

Terminal A–A of relay (J 8)

Relay (J 8) operates contacts B–M–J.

Terminals M–B of relay (J 8)

The combustion air blower (V 6) delivers warm air and combustion air.

Both contacts of overheating fuse (S 17)

The metering pump (G 6) delivers fuel.

Terminals C–NO of flame switch (F 16)

The glow element of the glow-spark plug (Q 5) warms the fuel-air mixture to make it readily combustible. The spark electrodes of the plug (Q 5) then ignite the mixture.

Heating

When the heater has ignited and warmed up, the flame switch (F 16) operates the contacts C–NC. A uniform roaring noise should be heard at the exhaust pipe.

The following is de-energized:

Contact NO of flame switch (F 16)

The glow element of glow-spark plug (Q 5) is switched off

Regulation

The temperature regulating switch (E 13) stops the flow of fuel from the metering pump when the temperature of the hot air reaches the preset maximum.

The following are de-energized:

Contact A of relay (J 8)

Relay (J 8) separates the contacts B–M–J.

Both contacts overheating fuse (S 17)

The pump (G 6) stops delivering fuel. Combustion stops. When the heater has cooled down to the lower response temperature of the temperature regulating switch (F 13), the fuel pump (G 6) starts to deliver again.

Voltage can be measured at:

Terminal A of relay (J 8)

Relay (J 8) operates.
Fuel pump (G 6) delivers fuel.

Operation of safety switch (J 10)

The safety switch (J 10) responds when the flame switch (F 16) holds the contacts C–NO closed for longer than about two or three minutes because combustion has not taken place in the heater or because the flame switch (F 16) is defective.

Voltage can be measured at:

Terminal NO of flame switch (F 16)
Terminal NO of safety switch (J 10)

The contacts are separated in the safety switch (J 10) after about three minutes by heating up of the resistance.

The following are de-energized:

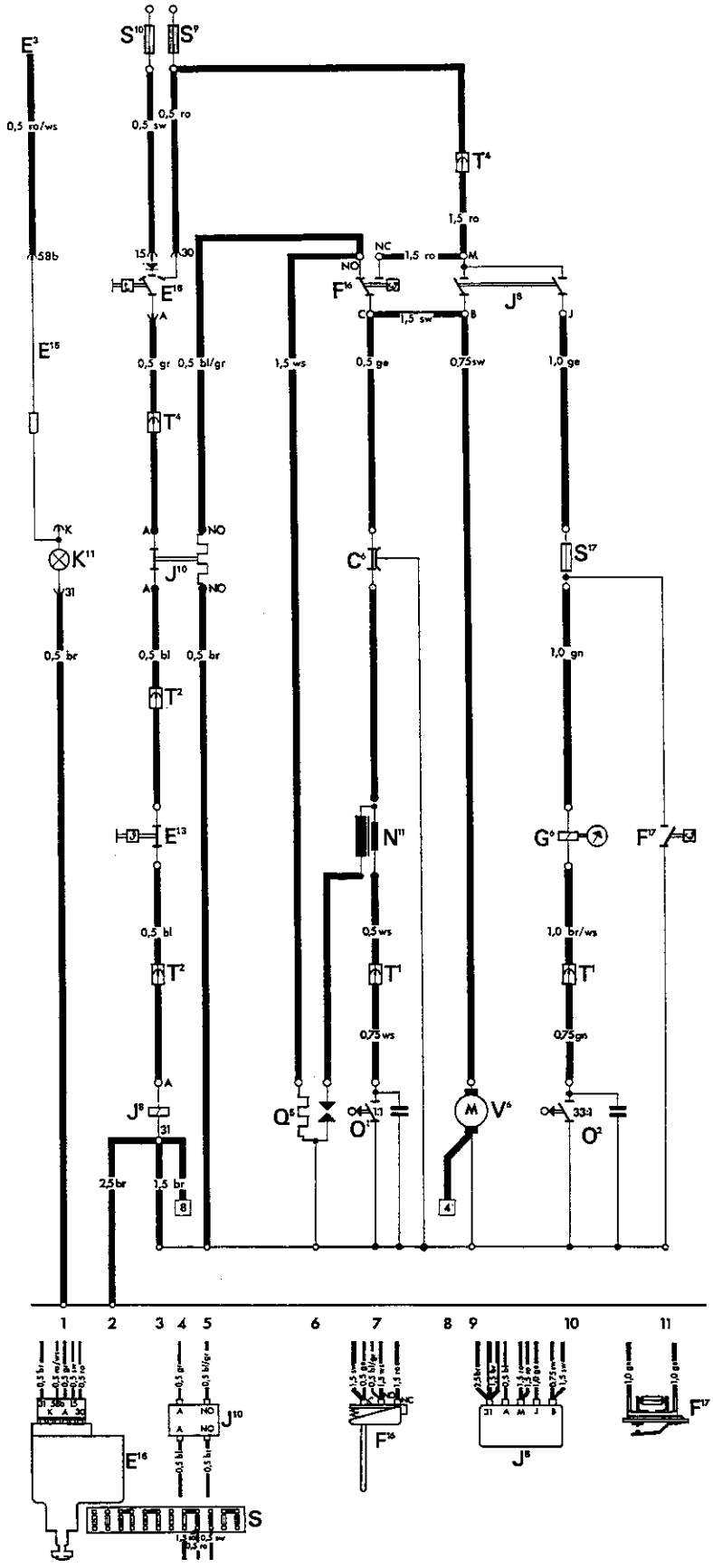
Contacts A, B, J of relay (J 8)

The combustion air blower (V 6) stops and heater cools down.

Operation of overheating circuit

If the heater gets too hot, the overheating switch (F 17) closes and causes a short circuit which blows the fuse (S 17) and stops the delivery of fuel.

The heater can overheat if the temperature regulating switch (E 13) fails to work properly or if there is insufficient air flowing past the heat exchanger (air circulation duct blocked).



Current flow diagram and explanation **Type 1/Model 181** **4 - 7**

Switching heater off

Turn knob of time switch (E 16) back to the stop position. Or push knob of temperature regulating switch (E 13) in fully.

The following is de-energized:

Contact A of relay (J 8)

The relay (J 8) contacts are separated.

Run-on

The run-on lasts for about two minutes at an ambient temperature of 20° C (68° F) and is shorter at lower temperatures. The run-on is necessary in order to clear all traces of gas from the heat exchanger and cool it down. The flame switch limits the run-on period.

The following is de-energized:

Contacts of overheating fuse (S 17)

The fuel pump (G 6) stops working.

Voltage can be measured at:

Terminals NC–C of flame switch (F 16)
Terminal B of relay (J 8)

The combustion air blower (V 6) continues to work until the heater has cooled down an the flame switch (F 16) separates contacts C–NO.

The following are de-energized:

Contacts C–NO of flame switch

The run-on is finished.

List of possible faults

In order to pinpoint a fault in the heating system it is important to troubleshoot systematically. Always follow the proper testing sequence.

Turn time switch knob clockwise as far as possible

The following faults can occur:

A – heater does not work (see F 3.2/1)
B – heater smokes (see F 3.2/2)
C – heat output insufficient (see F 3.2/2)
D – heater goes out (see F 3.2/2)
E – run on does not switch off (see F 3.2/2)
F – heater does not work at low outside temperatures (see F 3.2/2)

See respective trouble shooting chart if one of the above faults is found.

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A – Heater does not work

Operate safety switch (see F 3.1/2 and F 3.3/1). If the heater does not work, first check whether the combustion air blower is running and the fuel pump is working (listen for ticking sound).

If both these units are operating, then check the glow plug and spark plug. Also check whether the pump is delivering fuel into the heater by checking at the exhaust pipe for exhaust fumes.

Faulty components should be repaired or replaced if necessary. If when carrying out these tests the heater does not work, test it further as follows:

Check	Possible fault	Remedy
1 – Test all parts of heater and check warm air ducts as well as all electrical connections for tightness; check exhaust system for damage	a – Blockage in heater exhaust pipe or intake duct b – loose c – loose connection in electrical system	a – eliminate blockage b – tighten securing screws c – secure loose push-on connection
2 – Test 8 amp. fuse with ignition switched on	short circuit in heater electrical system	eliminate defect and replace fuse (see F 3.1/4)
3 – Test 16 amp. fuse	short circuit in vehicle electrical system	eliminate fault, replace fuse (see F 3.1/4)
4 – Test time switch for continuity with ignition switched on and off	switch contact defective	replace time switch (see F 3.5/2)
5 – Pull knob out as far as it will go and test temperature control switch for continuity (F 3.3/1)	a – bimetal strip defective b – contacts defective	a; b – replace temperature regulating switch (see F 3.5/1)
6 – When breaking contact at terminal A, relay must click audibly	no voltage in wire to terminal A, time switch has no continuity, relay defective	replace relay (see F 3.5/1) test time switch (see F 3.3/2)

Check	Possible fault	Remedy
7 – Test relay terminal; if there is voltage at terminal B, terminals M and I must also have voltage after switching heater on	switch contacts defective (see F 3.3/1)	replace relay (see F 3.5/1)
8 – Check voltage at terminal 2 of terminal strip	nominal value 11.6 volts is not attained; battery is discharged too much	start vehicle engine to attain full generator voltage
9 – Test ignition coil (see F 3.3/1)	a – ignition coil insulation is defective	a – replace ignition coil
	b – breaker points of blower motor defective (see F 3.3/1)	b – clean combustion air blower breaker points
	c – short circuit on condenser on contact breaker	c – replace condenser (see F 3.7/1)
	d – short circuit in suppression condenser	d – replace suppression condenser
10 – Check spark plug, but first disconnect wires from fuel pump (see F 3.3/1)	faulty or dirty spark plug	clean spark plug; check spark plug gap (.098 in./2.5 mm) (see F 3.3/1)
11 – Test glow plug with fuel pump disconnected	plug must glow within one minute	replace glow plug (see F 3.3/1) (see F 3.5/2)
12 – Test flame detector switch	switch does not operate	adjust (see F 3.3/1)
13 – Check overheating switch	no continuity	replace (see F 3.5/1)
14 – Check filter (see F 3.3/2)	blocked	clean filters between fuel pump and jet (see F 3.3/2); filter between fuel pump and tank must be cleaned (see F 3.3/2)
15 – Check fuel jet	blocked or damaged	clean or replace (see F 3.3/2)

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Check	Possible fault	Remedy
16 – Test fuel pump and lines (see F 3.6/1)	a – breaker points dirty	clean breaker points and readjust. Lubricate springs and pivot points (see F 3.3/2)
	b – lines leak at connections	
	c – pump clatters, pressure relief valve on outlet side of pump is dry and sticks	disconnect pump outlet line and pour several drops of gasoline into pump connection (see F 3.6/1)
17 – Check pressure regulator and solenoid valve	incorrect adjustment	adjust pressure regulator (see F 3.3/2)
18 – Combustion air blower motor (listen to determine if motor is running) (see F 3.7/1)	a – bearing and winding defects	a – replace combustion air blower; cannot be disassembled because air blower fan and motor are balanced together (see F 3.7/1)
	b – fresh air fan contacts housing	b – remove housing and tighten securing clamp of combustion air blower; (see F 3.5/1)
	c – combustion air blower fan is damaged and has jammed in vaned housing	c – replace complete combustion air blower (see F 3.5/1)
	d – too little combustion air, voltage too low (nominal value 11.6 volts)	d – check ground cable and test battery
	e – combustion air blower motor does not attain prescribed speed (nominal value 5000 rpm at nominal voltage)	e – replace complete combustion air blower (see F 3.5/1)

B – Heater smokes

Check	Possible fault	Remedy
1 – Excess fuel	a – pressure regulator incorrectly adjusted	a – adjust pressure regulator (see F 3.3/2)
	b – fuel jet damaged	b – replace fuel jet
2 – Combustion air motor: measure speed (see F 3.3/1)	a – voltage too low (nominal value 11.6 volts); lack of combustion air	a – check wires and test battery
	b – blower motor defective	b – replace complete combustion air blower (see F 3.5/1)

C – Heat output insufficient

Check	Possible fault	Remedy
1 – Check delivery quantity of fuel pump	a – delivery quantity too small	a – adjust pressure regulator (see F 3.3/2)
	b – filter blocked	b – clean (see F 3.5/2 and F 3.3/2)
2 – Test temperature regulating switch	bi-metal strip damaged (switching temperature altered)	replace (see F 3.5/1) or adjust (see F 3.3/1)

D – Heater goes out

Check	Possible fault	Remedy
1 – Check electrical system	loose connections	tighten
2 – Overheating switch faulty (see point 6)	a – contact dirty	a – clean
	b – bi-metal strip worn	b – replace (see F 3.5/1)
3 – Check exhaust pipe for obstructions	blocked	clean (see F 3.4/1)
4 – Cut-in time of glow plug too short	flame detector switch incorrectly adjusted	adjust (see F 3.3/1)
5 – Check delivery quantity of fuel pump	filter dirty, valve blocked, jet blocked	clean or replace (see F 3.3/2)
6 – Overheating switch actuated	hot air ducting blocked	eliminate blockage

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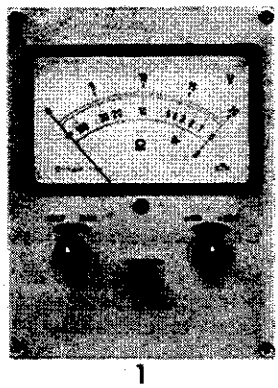
E – Run-on does not switch off

Check	Possible fault	Remedy
1 – Check flame detector switch	flame detector switch is incorrecty adjusted	readjust (see F 3.3/1)
2 – Quartz rod of flame detector switch broken		replace quartz rod and readjust flame detector switch (see F 3.5/2 and F 3.3/1)

F – Heater does not work at low outside temperatures

Check	Possible fault	Remedy
1 – Check battery voltage		if necessary, charge battery
2 – Check delivery quantity of pressure regulator (see F 3.3/2)	delivery quantity too low because a – improperly adjusted b – filter dirty c – strainer blocked d – valve guide dirty e – pressure regulator improperly adjusted	a – correct adjustment b – replace filter c – clean strainer d – replace pressure regulator e – adjust pressure regulator
3 a – Remove glow plug and check glow element b – check spark plug (see F 3.3/1)	a – glow element broken b – no circuit in suppression resistor electrode gap too large	replace glow plug (see F 3.5/2) replace spark plug (see F 3.5/2)
4 – Check flame detector switch	flame detector switch defective (cut-in time too short)	replace flame detector switch (see F 3.5/2)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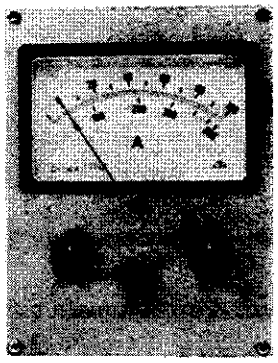
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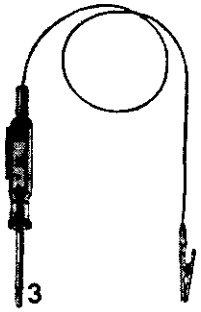
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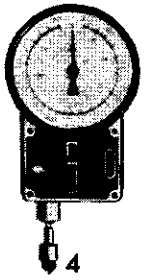
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5

No.	Description	Special tool	Remarks
1	Ohmmeter/voltmeter		Range 0–20 volts
2	Ammeter		Range 0–20 amps.
3	Tachometer		0–8000 rpm
4	Test lamp		12 volts
5	Stop watch		

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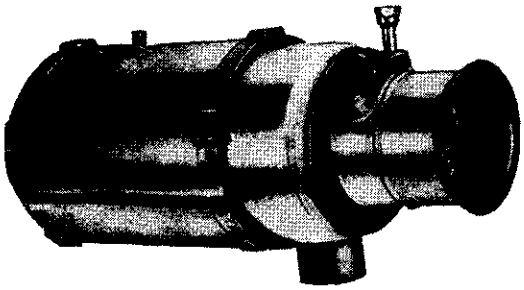
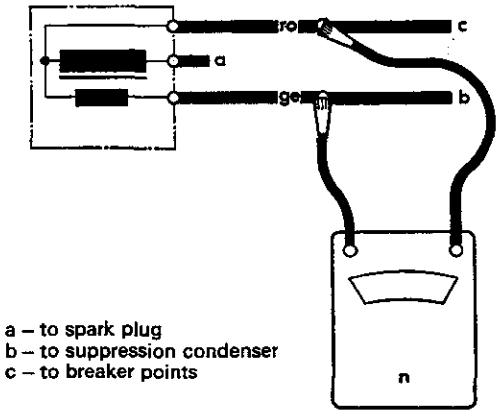


Heat exchanger

Check combustion chamber for damages (overheating, corrosion etc.) and soot.

Damaged or soot covered units must be replaced.



a – to spark plug
b – to suppression condenser
c – to breaker points

Combustion air blower

Check blower for damages caused by overheating and bearings for free movement. Connect tachometer as shown and check speed.

Counting revolutions

The contacts in the combustion air motor give one audible impulse for the metering pump every 33 revolutions of motor shaft.

Count impulses in one minute and multiply by 33 = Speed.

Speed:
running for 10 minutes at 12 volts:
4875–5325 rpm.

Flame switch

Measuring voltage

The flame switch requires 45 seconds to start to operate after the heater ignites. A uniform roaring noise should be heard at the exhaust pipe. The flame switch is "ok" if terminal NO is pulled off, held against ground and the switch is de-energized within 45 seconds.

If the operating limit is delayed the flame switch must be adjusted, or if necessary replaced.

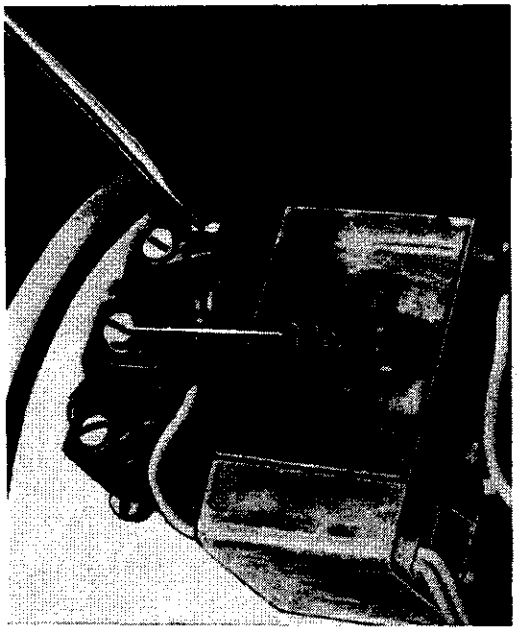
Adjusting

1 – Turn heater on. Pull temperature regulator switch all the way out. Let heater run for five minutes.

2 – Turn time switch knob back until warning light goes out. Start stop watch.

3 – The combustion air blower fan, controlled by the flame switch, must continue running 110–150 seconds. This run-on time is based on a nominal voltage of 12 volts and an outside temperature of about 20° C (68° F). At lower temperatures the run-on time is shorter.

If proper shut off time is not attained, the flame switch must be adjusted (if run-on is too long, turn adjusting screw clockwise; if run-on is too short, turn screw counter-clockwise).

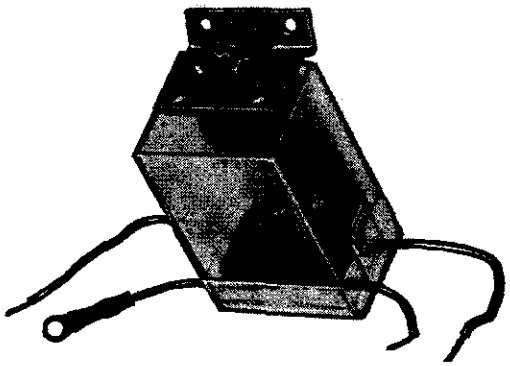


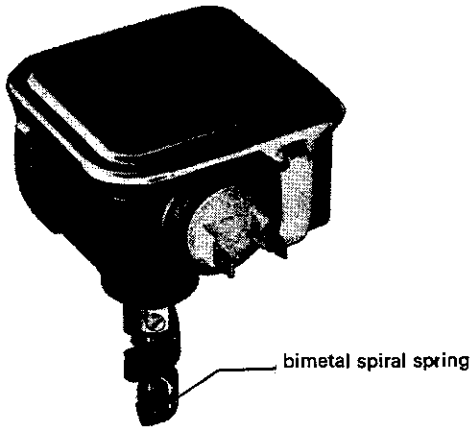
Safety switch

1 – Disconnect wires at pump so that fuel pump does not operate.

2 – Turn heater on. After 120–180 seconds (at nominal voltage and at about 20° C (68° F) ambient temperature) the safety switch interrupts the heating system circuit.

3 – If the safety switch has operated within the specified time, the switch is "OK." Reset lever on safety switch in direction of arrow.





Type 1/Model 181

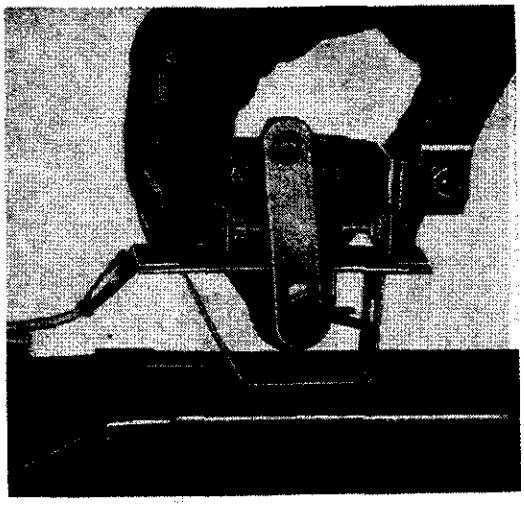
Temperature regulating switch
Type 1/Model 181

The linkage is lubricated with a special oil. Therefore the linkage must always be kept clean otherwise the switch will not operate with in the adjusted limits.

Checking temperature limits
Type 1/Model 181 and Type 2

To check the temperature for correct operation, use an electronic temperature measuring device (a mercury thermometer is to slow).

Position device close to bimetallic spring (do not touch spring).



Type 2

Working instructions

1 – Switch heater on and wait until heater has regulated 3 times.

2 – Pull knob for temperature regulating switch all way out and measure the temperature when the switch stops operating.
Cut-off temperatures: approx.
Type 1/Model 181: 110–130° C (230–266° F)
Type 2 120–140° C (250–285° F)

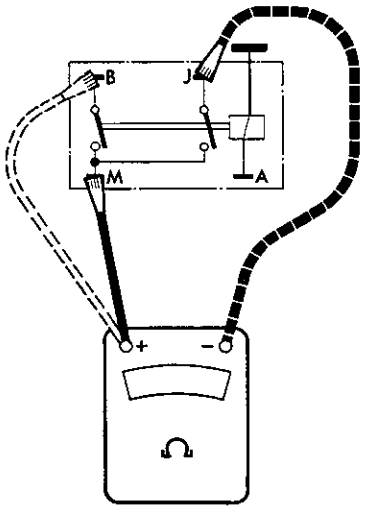
3 – Push knob halfway in and measure temperature difference during one regulation stage.
Approx.: 20° C (68° F).

4 – Push knob allway in and measure cut-in temperature.
Approx.: 60° C (140° F).

Note

If the measured temperatures show a tolerance of more then 20° C (68° F) the temperature regulating switch must be replaced.

Checking relay



1 – Disconnect wires from terminals J, B and M at relay and turn on heater.

2 – Disconnect wire from terminal A. When doing this the relay armature de-energizes (listen for clicking sound). If there is no sound check voltage between ground and plug. If there is voltage at this point, measure between relay housing and terminal A with an ohmmeter. If the ohmmeter shows 0 ohm the relay winding is faulty.

3 – If the relay armature can be heard de-energizing when disconnecting terminal A, connect ohmmeter between terminals J–M and B–M.

Nominal value: ∞ ohm otherwise replace relay.

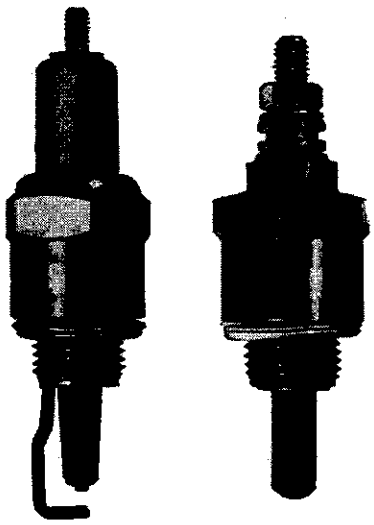
4 – Reconnect cable to terminal A. If the relay armature energizes audibly, check whether there is continuity from terminal J to terminal B. If there is no continuity with the relay switched on (∞ ohm), the relay must be replaced.

Checking glow plug and spark plug

The glow plug has a spiral element protected by a metal casing. Deposits can be carefully removed with a wire brush. The glow plug is serviceable if it glows bright red after one minute when connected to a 12 volt power source, otherwise the glow plug must be replaced.

The spark plug can be cleaned with a wire brush. Check electrode gap (2.5 mm) .10 in.

There is a 5 K Ω resistor installed in the spark plug. The resistor can be measured with an ohmmeter (connect terminals of ohmmeter between center electrode and ignition wire terminal). If the ohmmeter shows more than 10 K Ω, the spark plug must be replaced.



spark plug glow plug

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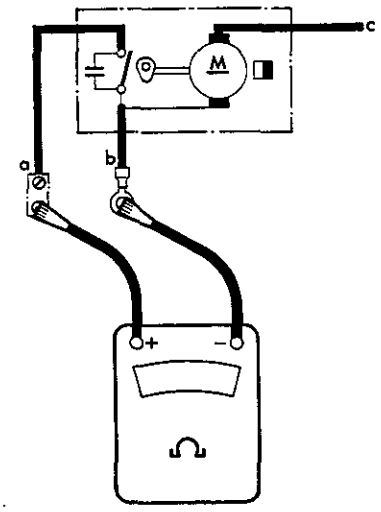
Testing breaker points

The breaker points can be tested with an ohmmeter with the heater shut off.

1 – Unscrew intake pipe.

2 – Disconnect wire connector between breaker point and ignition coil.

3 – Connect ohmmeter to wire connector (a) and to ground cable (b), turning the fan by hand. Breaker points must make/break once for each revolution of the motor (the ohmmeter must deflect between 0 and ∞).



a – to ignition coil
b – ground
c – to terminal 1

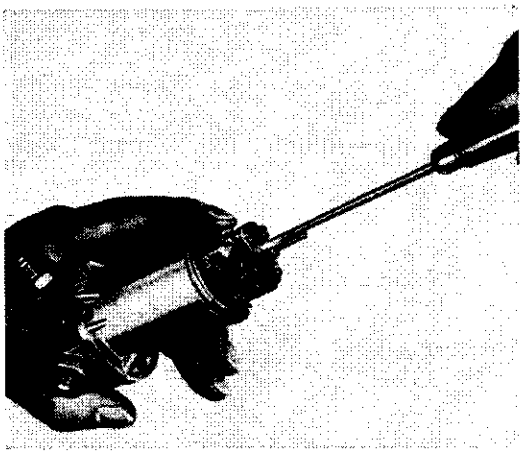
Possible fault	**Ohmmeter shows**
Short circuit in condenser	0 Ω
Contact breaker points burnt. Partial short circuit in condenser	Deflection between ∞ Ω and a resistance value (e.g. 10 Ω)
Open circuit in breaker point circuit (e.g.: connecting wire broken, breaker point gap too large)	∞ Ω only

The breaker point assembly of the combustion air blower can be repaired (see F 3.7/1).

Diaphragm pump

1 – Remove pump.

2 – Remove the nut from the terminal post and take off cover. Check breaker points. Lightly lubricate moving parts and springs if necessary.



Note

The breaker point gap should be 1 mm (0.04 in.) (hold lower contact breaker arm against housing). The points are set with adjusting screw.

3 – Remove four fillister head screws on housing and take pump housing off. Turn diaphragm bracket counterclockwise to remove it and check it visually.

4 – When reinstalling, first screw diaphragm bracket in, clockwise, as far as it will go. Then back off 2½ turns counterclockwise. The correct delivery quantity of the fuel pump is then adjusted.

5 – The fuel pump must be installed so that the connection on the outlet is pointing upward as shown by the arrow. After installation, the fuel line on the outlet side may have to be bled. Also, moisten pressure valve with a few drops of gasoline (see F 3.6/1).

Note

When assembling, make sure that the diaphragm is located in the groove and the winding housing is firmly bolted to the pump housing (the pump will not deliver fuel if air is drawn in at the side). (See F 3.6/1.) There is a vent hole in the winding housing. Secure pump housing to winding housing with four fillister head screws with the outlet connection opposite vent hole (see F 3.6/1).

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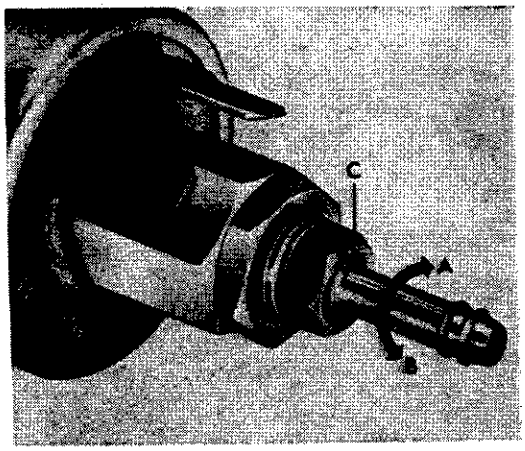
Metering pump

1 – Pull hose off on pressure side connection.
2 – Disconnect glow-spark plug. (Safety reasons.)
3 – Switch heater on.
4 – Count **200 strokes** of the metering pump (ticking noise). The amount of fuel ejected must be within **13.4 to 15.1 cm³.**

Note

The strokes can be counted as follows:
a – Write down the numbers 1–20 one under the other.
b – After each 10 strokes (ticks), cross out a number. It is thus only necessary to count from 1 to 10 and when all the numbers have been crossed out, 200 strokes have been counted.

If the amount delivered is not within the tolerance given, the pump must be adjusted.



Adjusting delivery quantity

Increase consumption
= Turn valve counter-clockwise (B)
Decrease consumption
= Turn valve clockwise (A)

To do this, first back off lock nut and after adjusting, tighten and seal with paint.

Pressure regulator and solenoid valve

Adjusting

Note

The fuel delivery quantity can only be set accurately by measuring the fuel consumption on the heater. The fuel quantity is measured at the fuel jet.

Before carrying out a consumption measurement or adjustment, clean the filters.

Part	Location	Remarks
Filter	between tank and fuel pump	replace (see F 3.5)
Screen	pressure regulator inlet side	clean
Screen	between union nut and jet	clean

1 – Disconnect glow plug and spark plug. Bridge temperature control switch connections.

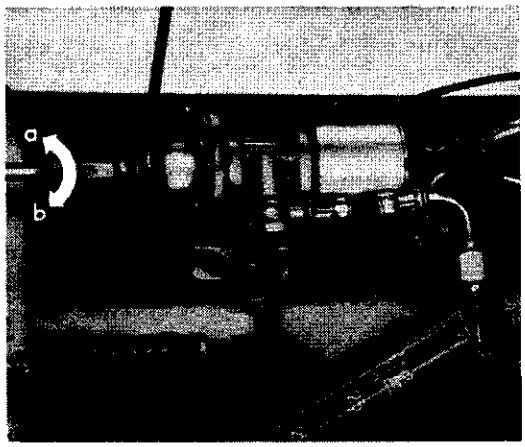
2 – Loosen union nut from jet carrier.

3 – Remove jet from jet carrier and clean screen.

4 – Connect jet and screen to fuel hose and hold at the same height as when installed (see illustration).

5 – Turn heater on. Fuel emitted is collected in a measuring glass for two minutes and should amount to 20–21 cm³.

6 – To adjust: Turn screw counterclockwise (a) to decrease the fuel quantity delivered. Turn clockwise (b) to increase the fuel quantity delivered.



Note

If, after performing these operations, the fuel delivery quantity is still insufficient, the valve screen (No. 10 on page F 3.8/1) is blocked and must be cleaned.

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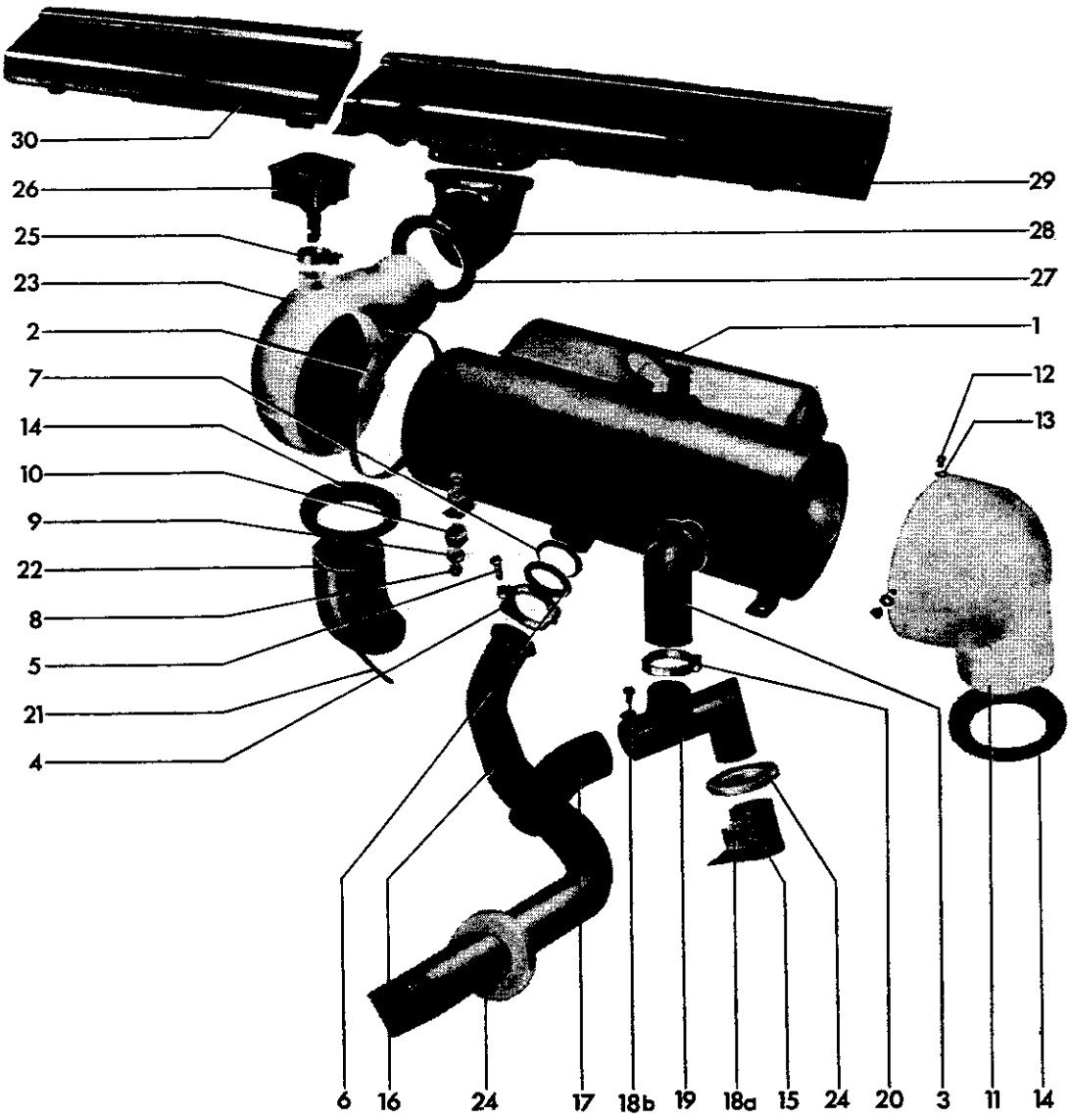

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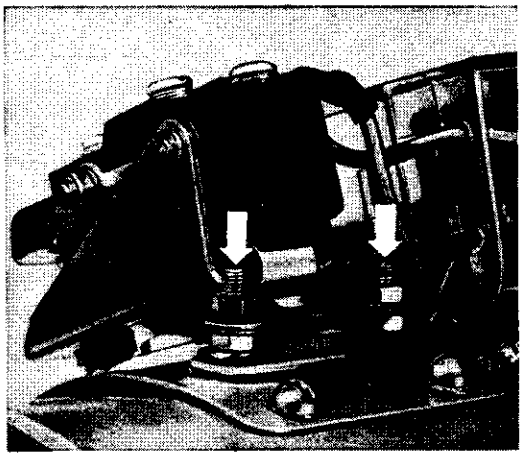
F 3.4 Heater and Warm Air Duct

No.	Designation	Qty.	Note when removing	Note when installing	Special instructions see
1	Heater	1	remove nut and spring washers under luggage pan	axial fan must not contact heater casing	F 3.5/1
2	Clamp	1		ensure clamp is tight	
3	Combustion air pipe elbow	1	can be pulled out	the shoulder must seal the casing hole sufficiently	
4	Exhaust pipe clamp	1		ensure clamp is tight	
5	Screw M 6×35	1			
6	Conical seal	1	attached to heater pipe		
7	Exhaust pipe seal	1		replace damaged seals ensure good sealing	
8	Nut M 6	8			
9	Spring washer B 6	8			
10	Bonded rubber mounting	4		make sure that thread is tight in rubber	
11	Circulating air pipe	1	after removing heater detach intake pipe	before installing the heater attach the intake pipe. The intake pipe must be vertical and face downward	
12	Fillister head screw AM 5×11	4			
13	Spring washer A 5.3	4			
14	Seal	2		the groove is pressed into the luggage pan (lip downward)	
15	Intake pipe	1		before installing, check seal in luggage pan for tightness	
16	Exhaust pipe	1		before installing, check seal for damage and tightness	
17	Combustion air pipe hose	1			
18	a – Fillister head screw Bz 3.9×6.5 b – Fillister head screw Bz 4.8×9.5	2 1			
19	Combustion air intake pipe	1		before installing, check seal for damage and tightness	
20	Clamp	1		check for tightness	
21	Bowden cable linkage	1			
22	Outlet for footwell	1			
23	Warm air pipe	1	first disconnect linkage (21), then lift out	push into seal	
24	Seal for exhaust pipe and intake pipe	2	check for damage	press in from wheel housing	
25	Clamp	1			
26	Temperature regulating switch	1	lift out vertically		
27	Warm air pipe seal	1			
28	Elbow	1			
29	Warm air duct, left	1			
30	Warm air duct, right	1			

Overheating switch

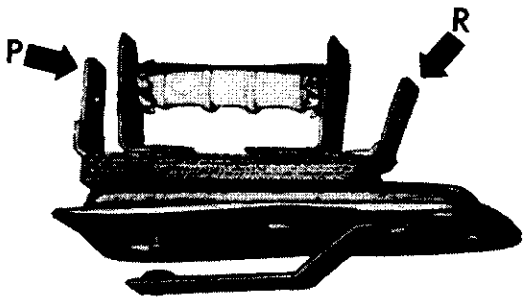
Type 2 up to chassis No. 211 2 276 560, July 1971

The connections (arrows) may be interchanged at installation without causing damage to the heater.



Type 1/Model 181
Type 2 from chassis No. 212 2 000 001, August 1971

Do **not** interchange wires.



P – from metering pump (connection on adjusting srew)

R – from relay

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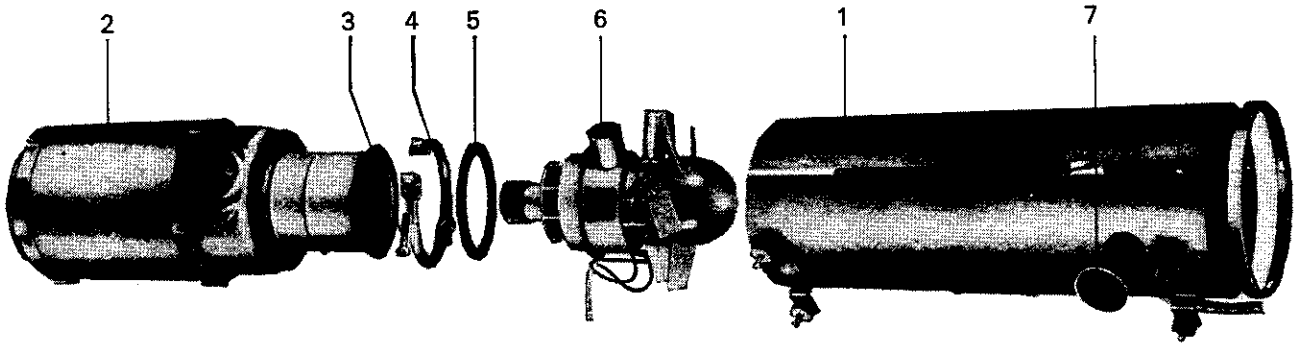
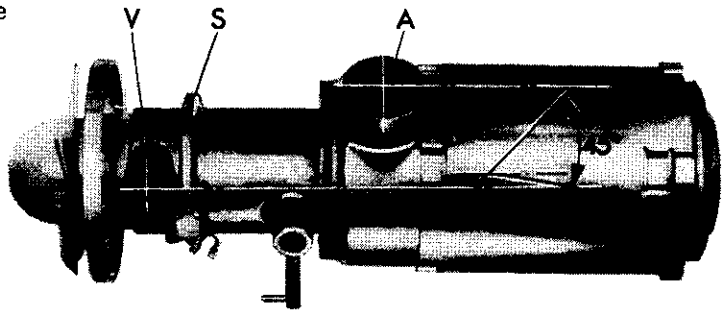


No.	Description	Qty.	Note when removing	Note when installing	Special instructions see
1	Housing	1	pull housing apart and lift housing off heat exchanger	pull combustion air blower wires through hole in housing; pull housing apart and slide over heat exchanger; ensure that fan does not rub on housing; tighten four round head screws	
2	Heat exchanger	1	remove deposits		
3	Screw	1		screw must not be tightened until heater is assembled; first secure housing to heat exchanger then insert screwdriver trough hole with grommet and tighten screw; due to this work sequence, screw must face combustion air intake pipe	
4	Clamp	1		jaws of clamp must align with exhaust pipe connection	
5	Seal	1		replace damaged seal	
6	Combustion air blower motor	1	do not tilt when lifting off	combustion air blower motor must be able to be turned with the heat exchanger until combustion air intake pipe is aligned with housing hole by turning	
7	Plug	1		after tightening clamp, plug hole	

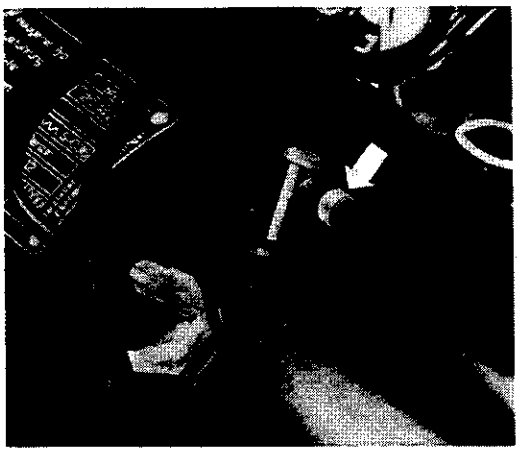
Installation instructions

a – The combustion air blower must be attached to the heat exchanger so that the combustion air connection (V) is offset 45° to the right from the exhaust connection (A).

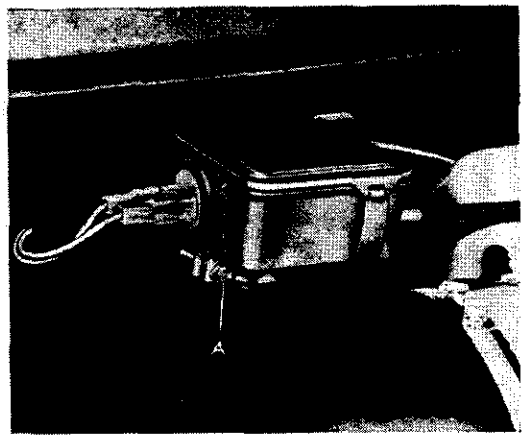


V – combustion air connection
S – clamp
A – exhaust connection

b – The fuel hose must be secured on the pipe with a clamp (arrow).



Temperature regulating switch

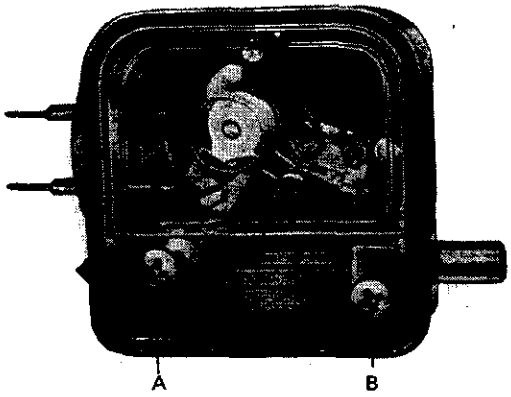


A – clamp

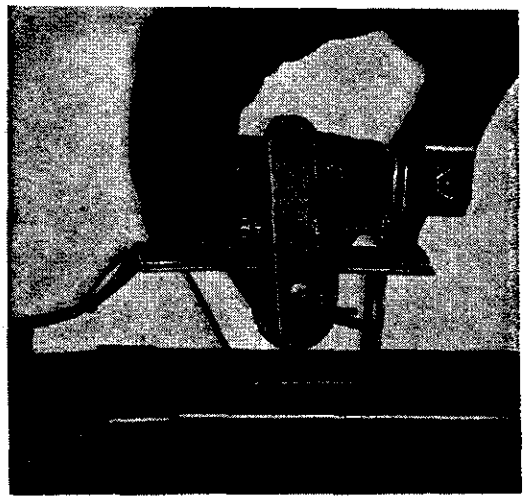
Type 1/Model 181

Do not touch the bimetal spiral spring

The linkage is lubricated with special oil. Therefore always keep the linkage clean; otherwise the switch will not operate within the adjusted limits.



A – inner cable clamping screw
B – outer cable securing screw

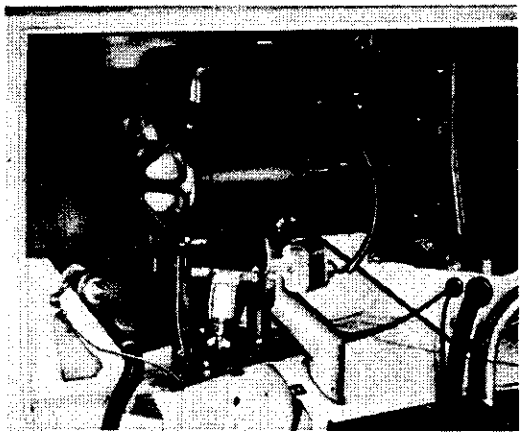


Type 2

The temperature regulating switch can be removed only, after the complete heater is removed from the vehicle.

Relay

Type 2



Removing

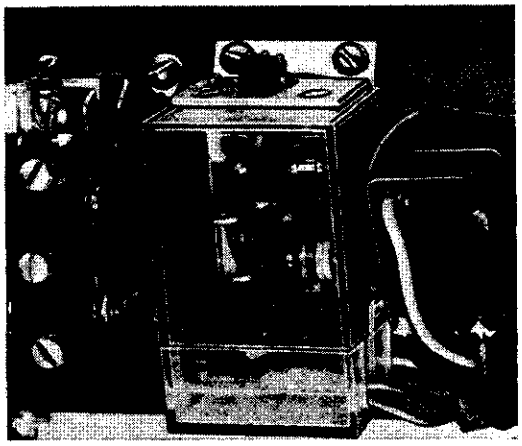
1 – Disconnect battery ground strap.
2 – Disconnect wires on relay and remove relay.

Installing

Ensure that wires are connected according to wiring diagram (see F 3.1/4).

Safety switch

Type 1/Model 181 and Type 2



Removing

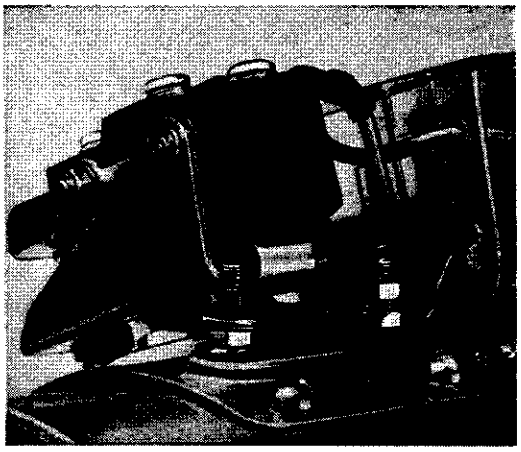
1 – Disconnect battery ground strap.
2 – Detach heater and swing slightly toward front.
3 – Remove two round head screws holding the switch.

Installing

1 – Connect wires according to wiring diagram (see F 3.1/4).
2 – Install heater.
3 – Connect battery ground strap and check operation of heater.

Flame switch

Type 1/Model 181 and Type 2



Removing

1 – Disconnect battery ground strap.
2 – Remove heater (see F 3.4).
3 – Disconnect three wire leads, each locked with two lock washers.
4 – Back off flame switch union nut with 12 mm open-end wrench, then turn switch to pull it out vertically (if necessary use solvent).

Installing

1 – Carefully insert flame switch into combustion chamber and tighten union nut. The hole in the heater housing is covered with the plug.
2 – Connect wires according to wiring diagram (see F 3.1).
3 – Install heater (see F 3.4).
4 – Connect battery ground strap and check operation of heater.

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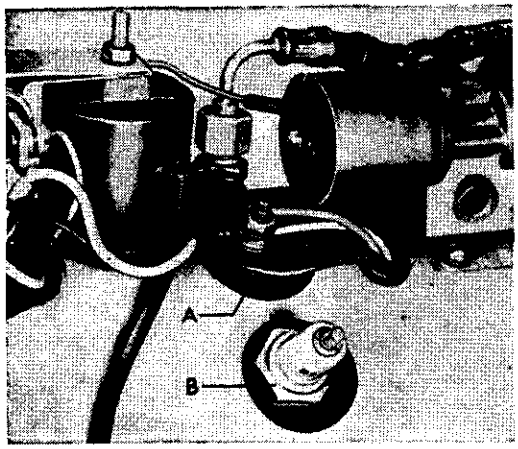


A – glow plug
B – spark plug

Glow plug / spark plug

Type 2

up to chassis No. 211 2 276 560, July 1971.

Removing

1 – Disconnect spark plug connector from spark plug. Remove glow plug terminal nut using an 8 mm open-end wrench.

2 – Remove spark plug and glow plug with a 21 mm socket wrench.

Installing

Install plugs. Make sure that two lock washers are used for glow plug.

Pressure regulator and solenoid valve

Removing

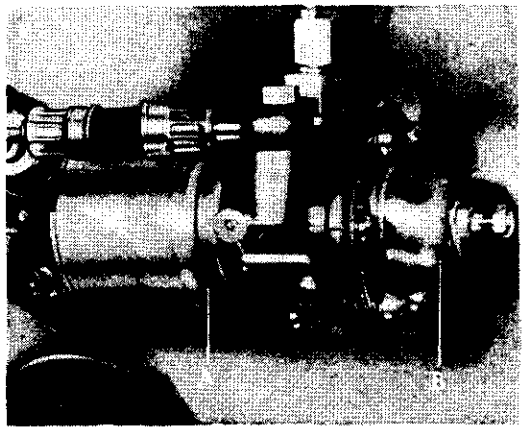
1 – Disconnect battery ground strap.

2 – Disconnect cable of solenoid valve from terminal 5.

3 – Disconnect fuel line between jet and pressure regulator at regulator. The gland nut can be backed off with a 12 mm open-end wrench.

4 – Fuel line between pump and pressure regulator is disconnected at fuel pump while counterholding with a 14 mm open-end wrench. Catch leaking fuel.

5 – Remove four round head screws and washers. Take solenoid valve and pressure regulator off heater.
The lead for the ground wire is secured by two round head screws.



A – Solenoid valve
B – Pressure regulator

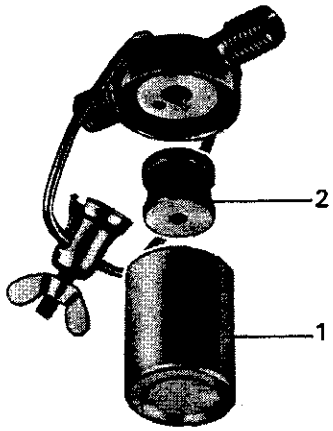
Installing

1 – Secure pressure regulator and solenoid valve with four round head screws and washers. Use two of the screws for securing the lead for the ground wire.

2 – Connect fuel lines. Hold locknut on fuel pump with a 14 mm open-end wrench.

3 – Connect solenoid valve wire to terminal 5. Connect battery ground strap and check operation of heater.

Filter



1 – Filter housing
2 – Filter screen

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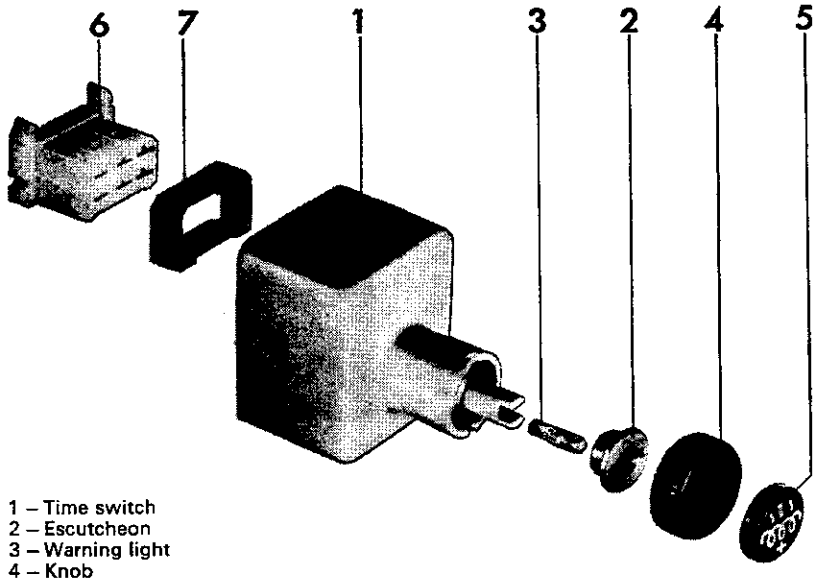


1 – Time switch
2 – Escutcheon
3 – Warning light
4 – Knob
5 – Lens
6 – Plug
7 – Plug frame

Time switch

Removing

1 – Disconnect battery ground strap.

2 – Pull knob off and take out bulb.

3 – Remove self tapping screw in instrument panel insert and open the insert.

4 – Disconnect wires at switch.

5 – Unscrew escutcheon with special wrench VW 674/1 and pull switch out.

Installing

1 – Secure escutcheon to time switch in instrument panel insert with special wrench VW 674/1.

2 – Connect wires according to wiring diagram (see F 3.1/3).

3 – Connect battery ground strap and check operation of heater.

Pressure regulator and solenoid valve

Type 2

Removing

1 – Disconnect battery ground strap.

2 – Disconnect wire of solenoid valve from terminal 5.

3 – Disconnect fuel line between jet and pressure regulator at regulator. The gland nut can be backed off with a 12 mm open-end wrench.

4 – Fuel line between pump and pressure regulator is disconnected at fuel pump while counterholding with a 14 mm open-end wrench. Catch leaking fuel.

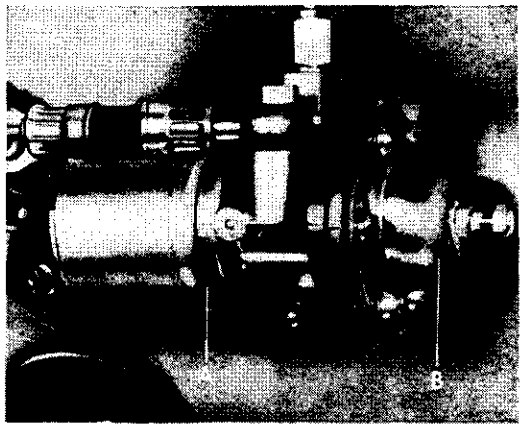
5 – Remove four round head screws and washers. Take solenoid valve and pressure regulator off heater.
The lead for the ground wire is secured by two round head screws.

Installing

1 – Secure pressure regulator and solenoid valve with four round head screws and washers. Use two of the screws for securing the lead for the ground wire.

2 – Connect fuel lines. Hold locknut on fuel pump with a 14 mm open-end wrench.

3 – Connect wires according to wiring diagram. Connect battery ground strap and check operation of heater.



A – solenoid valve
B – pressure regulator

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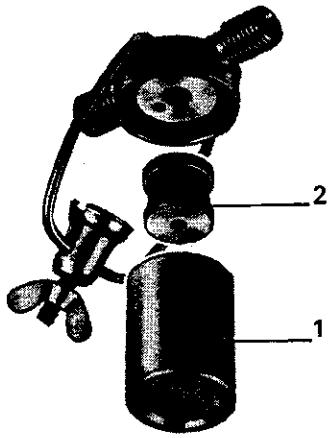
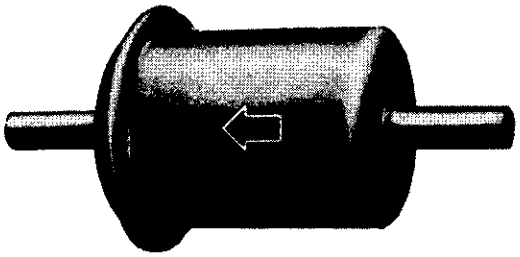


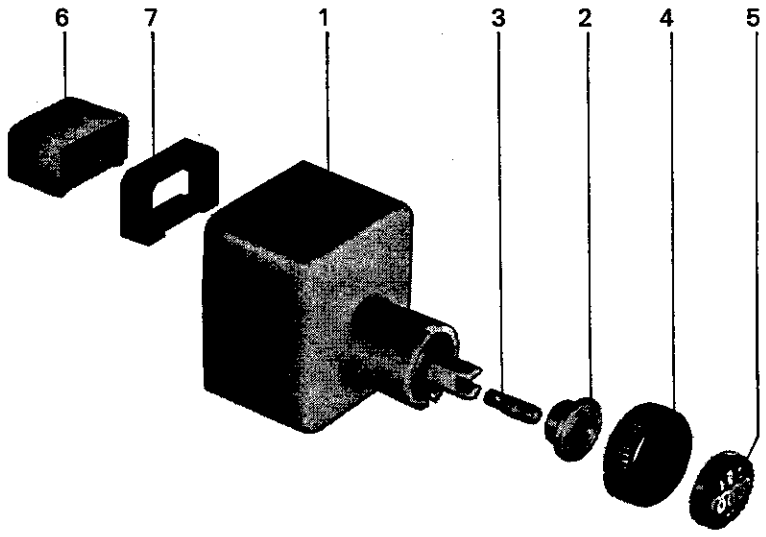
1 – filter housing
2 – filter screen

Filter

Ensure that the filter is installed properly. The arrow on the housing shows the direction of flow.



Time switch

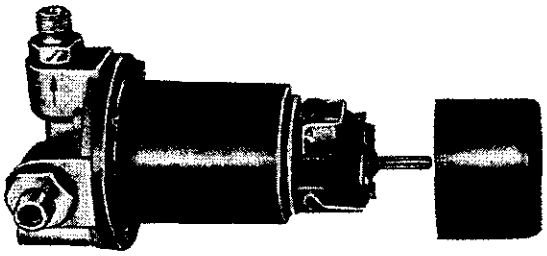


1 – time switch
2 – escutcheon
3 – warning light
4 – knob
5 – lens
6 – plug
7 – plug frame

Fuel pump

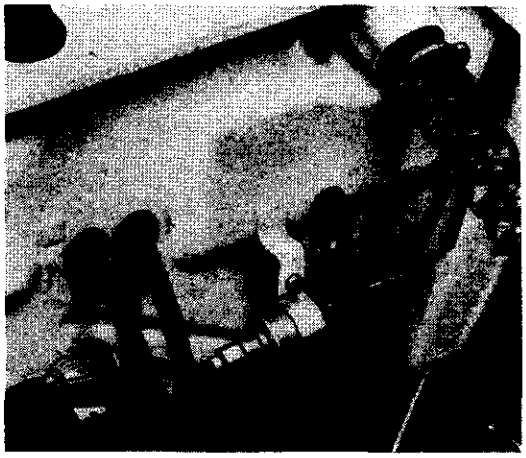
(Diaphragm pump)

Install pump so that pressure connection (with arrow) is vertical. After installation it may become necessary to bleed the pump. This is done by loosening union nut of pressure side and filling outlet union with a few drops of fuel and tightening union nut again.



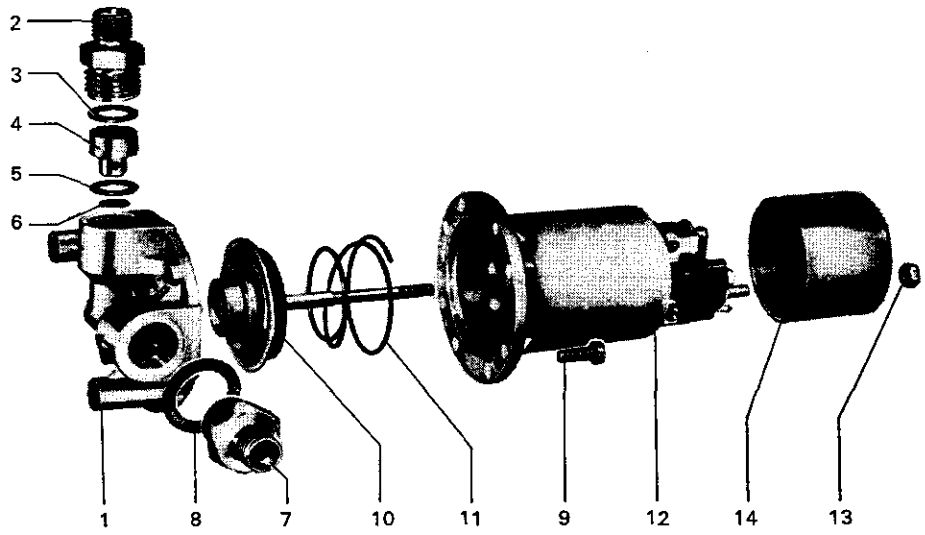
Metering pump

Always make sure that pump is installed horizontally. Otherwise the quantity of fuel delivered will change.



(Installation in Type 1/Model 181)

Fuel pump



No.	Description	Qty.	Note when disassembling	Note when assembling	Special instructions see
1	Pump body	1		pump must be installed in vehicle with outlet union at top (arrow points outward)	F 3.5/2
2	Outlet union (pressure side)	1	12 mm wrench; look for damage; spherical surface must be smooth; outlet union has smaller drilling and is smaller across flats than intake union	if pump clatters, unscrew union nut and moisten outlet union with fuel; when assembling, ensure that inlet union and outlet union are not mistaken	F 3.3/2
3	Seal	1			
4	Pressure valve	1	make sure valve is not dirty		
5	Seal	1			
6	Suction valve	1	if pump clatters after moistening with fuel, suction valve is tilted and jammed	ensure that suction valve is in correct position	F 3.3/2
7	Inlet union	1	17 mm wrench; look for damage; spherical surface must be smooth; intake union has larger drilling and is larger across flats than outlet union		F 3.6/1
8	Seal	1			
9	Screw	4			

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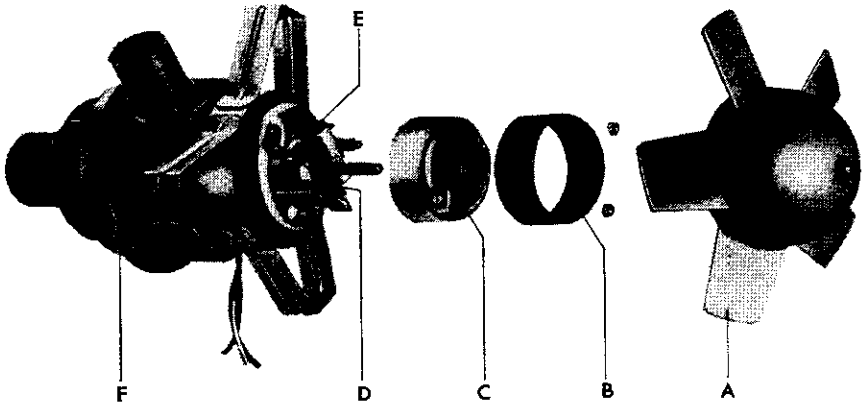
No.	Description	Qty.	Note when		Special instructions see
			disassembling	assembling	
10	Diaphragm unit	1	unscrew counter-clockwise	delivery quantity adjustment: screw diaphragm unit in as far as possible, then back off 2½ turns; the diaphragm also acts as seal between pump and winding housing, therefore make sure that the diaphragm is correctly positioned	F 3.3/2
11	Spring	1		ensure that spring is correctly installed	
12	Winding housing	1	vent hole must not be blocked	pump and winding housings as screwed together so that vent hole is opposite outlet union	F 3.3/2
13	Nut	2			
14	Bakelite cap	1			

Disassembling and assembling combustion air blower

The breaker points in the combustion air blower are replaceable so that the complete blower assembly does not have to be replaced.



A – Fan
C – Cover
E – Condenser
B – Seal
D – Breaker points
F – Blower motor

1 – Screw an M 4 screw into hole in center of fan and press off.

2 – Remove seal and take cover off.

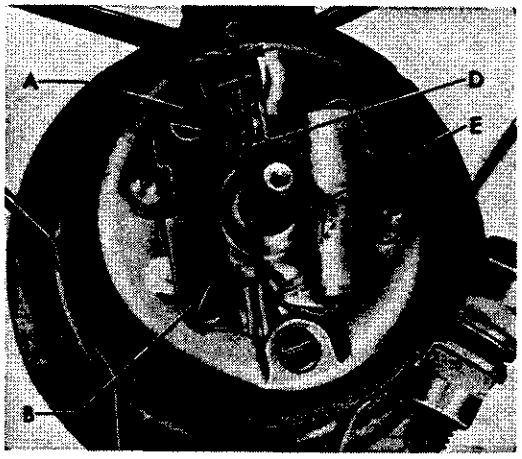
3 – Unsolder the condenser and wire to ignition coil at breaker points.

4 – Remove securing screw and clamp screw and take breaker points out.

5 – Install new breaker points so that projection in contact carrier is pretensioned against end plate.

6 – Turn cam on motor shaft against insulating strip and set breaker point gap to .014–.02 in. (0.35–0.5 mm). Tighten securing screw and clamping screw and seal with paint. The contact pressure should be about 180 grams.

7 – Lubricate cam and insulating strip with multi-purpose grease. Grease must not contact the breaker point surfaces.



A – Securing screw
B – Clamping screw
C – Gap of 0.14–.02 in. (0.35–0.5 mm)
D – Projection on contact carrier
E – Cam and insulating strip

8 – Solder condenser and cable to ignition coil. The connecting cable between condenser and breaker points must have a gap of at least .08 in. (2 mm) between end plate, condenser clamp and cover. It is advisable to replace the condenser when replacing the breaker points.

9 – When assembling, ensure that the seal covers the joint between cover and motor.

Testing:

Warning

When using the following test procedure, disconnect wires to fuel pump and glow plug (see F 3.3/1).

Insert a screw into spark plug connector and hold screw about 7 mm (.3 in.) from ground at a motor speed of 5,000 rpm. A continuous spark must jump to ground.

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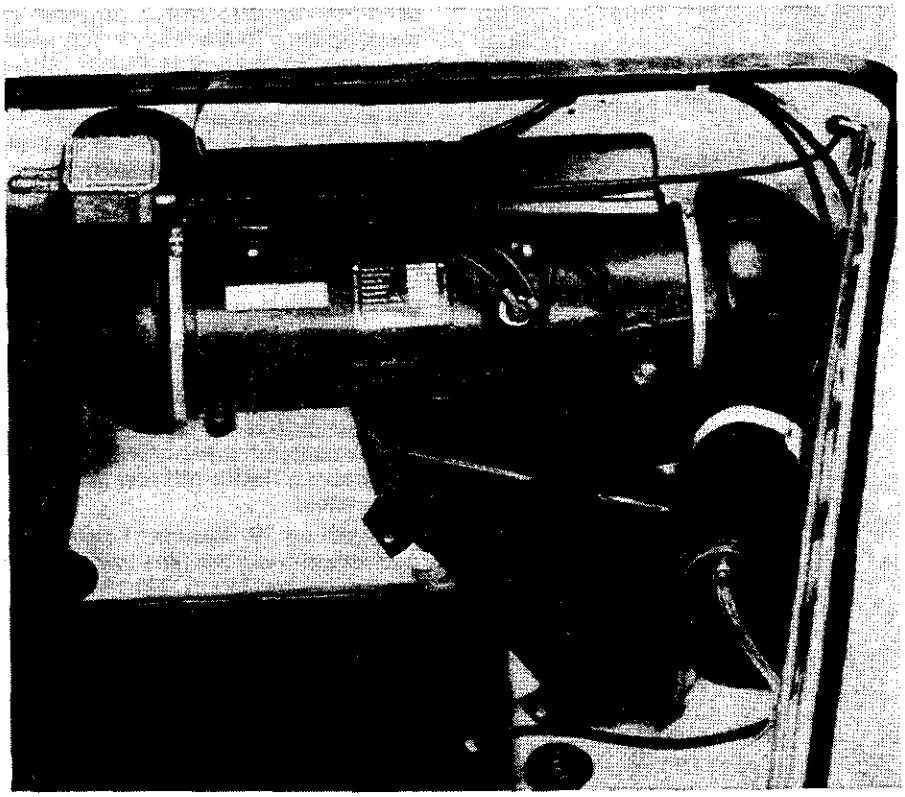
Section F

Gas Heater

BN 4 Recirculating Air and Fresh Air Heaters

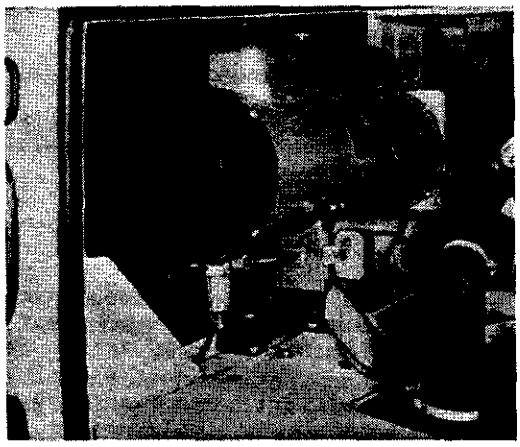
Description : Type 1/Model 181

The gasoline-electric recirculating heater operates independently of the vehicle engine and is installed in the front luggage compartment. The heater is thermostatically controlled and can be used without running the engine.

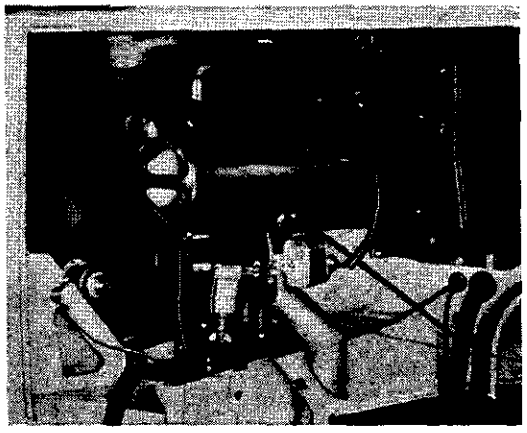


Description: Type 2

The gasoline heater works independently of the vehicle engine and is installed in the engine compartment. The heat range can be adjusted by a temperature regulating lever.



Recirculating heater



Fresh air heater

On the fresh air version a thermostatically operated flap is necessary to prevent cold air flowing from the engine compartment to the passenger compartment when the heater is not operating.

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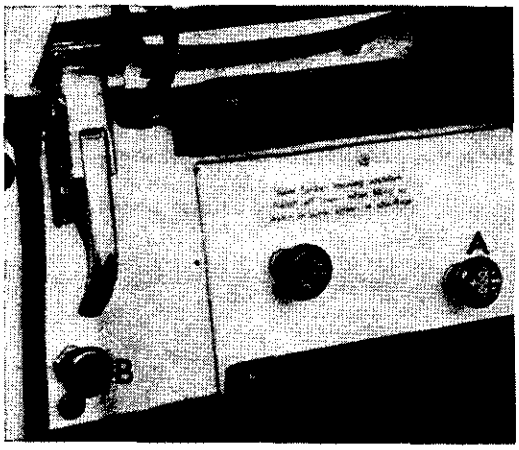


A – time switch knob
B – temperature regulating switch knob

Type 1/Model 181

1 – With engine running

To switch heater on: Pull control switch knob (B) out slightly. Turn time switch knob (A) clockwise until switch engages. The green warning lamp in the time switch knob lights up when the head-or parking lights are switched on.

To switch heater off: Turn time switch knob (A) as far as possible counter-clockwise. With the parking-or headlights turned on the brightness of warning light in knob A and B can regulated like the instrument light.

2 – With engine not running

To switch heater on: Pull regulating switch knob (B) out. Turn time switch knob (A) clockwise as far as possible.

To switch heater off: The clockwork mechanism in the time switch automatically switches the heater off after about 30 minutes.

During these 30 minutes, the clockwork mechanism turns the time switch knob back to its original position. If the engine is started with the time switch knob in this position, the heater switches itself on again automatically and remains on until the ignition is switched off.

When the heater is used with the vehicle parked it can be switched off at any time by turning the time switch knob counter-clockwise to the engaged position or turning it counter-clockwise as far as possible to the zero position. The clockwork mechanism then runs down.

Regulating warm air temperature

Pull temperature regulating switch knob (B) out.
The further the temperature regulating switch knob (B) is pulled out, the higher the temperature of the circulated hot air will be.

Note

1 – After the heater has been turned off, the combustion air blower continues to run (run-on) to cool the heater.

2 – To avoid running the battery down it is recommended not to switch the heater on several times in succession when the vehicle is parked. This applies particularly when outside temperatures are very low as then the full capacity of the battery is required to start the engine.

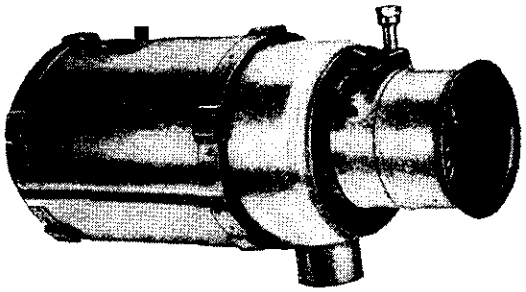
Warning

The heater must be turned off when filling the fuel tank.

Heat exchanger

The heat exchanger is made of stainless sheet steel. The cylindrical combustion chamber and the two annular chambers of the heat exchanger are connected by two openings.

Spark plug, glow plug, flame switch and fuel jet are attached to the heat exchanger.

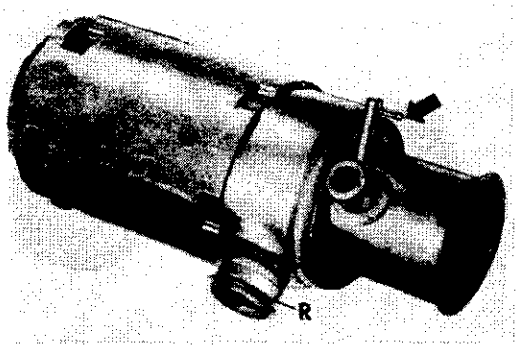


Up to July 1971

Type 2

from August 1971

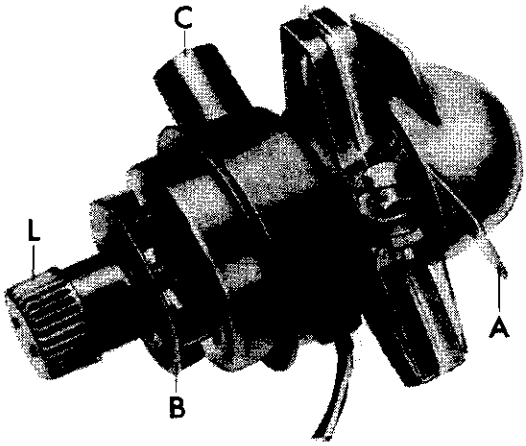
The heat exchanger can be recognized by the connection for the fuel hose (arrow) and by the single adapter for the glow-spark plug.



R – tapered ring / Type 1 / Model 181 only

Combustion air blower

The combustion air blower is connected to one end of the heat exchanger. Two fans are connected to the shaft of the combustion air blower. The fresh air blower fan (A) delivers the warm air. The combustion air blower fan (B) draws the combustion air in through the air intake (C). The air deflection cylinder (L) increases atomization of the fuel.
Ignition of the mixture is controlled by a set of contacts that make/break with each revolution of the motor.

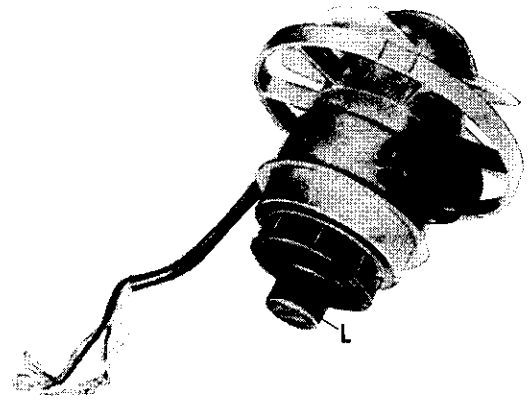


A – fresh air fan
B – combustion air blower fan
C – air intake
L – air deflection cylinder with identation (up to July 1971)

Type 2

from August 1971

The metering pump is operated by an electrical impulse received from the contact points after every 33rd revolution of the combustion air blower.



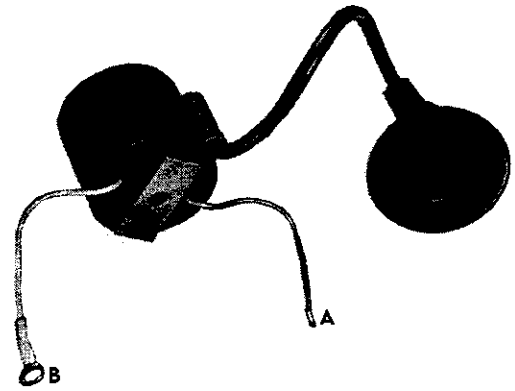
L – Air deflection cylinder

Type 1/Model 181 and Typ 2

Combustion air blower with diaphragm pump has three connecting wires.
Combustion air blower with metering pump has four connecting wires.

Speed

4875 rpm to 5325 rpm at 12 volts.

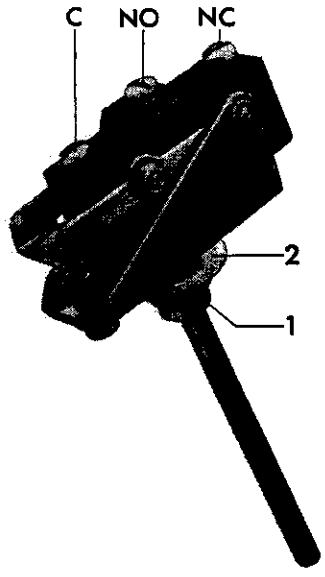


Ignition coil

The ignition coil is attached to the heater housing. The primary and secondary windings as well as the iron core are in a plastic housing. Voltage impulses are passed to the primary winding by the contact breaker on the combustion air blower motor shaft. The primary winding then induces ignition high voltage in the secondary winding. This voltage goes to the spark plug via an ignition cable.

A – to contact breaker points of combustion air blower
B – to condenser

Initial voltage: 12 volts
High voltage: 5000 volts



Flame switch

The sensor of this switch is attached to the heat exchanger by a union nut. The sensor tube protrudes into the combustion chamber. The flame switch controls the cut-in time of the glow plug and the run-on time.

NC – normally closed
NO – normally open, safety switch and glow plug connection
C – common, combustion air blower fan
1 – union nut
2 – seal

from August 1971

Cut-in time:

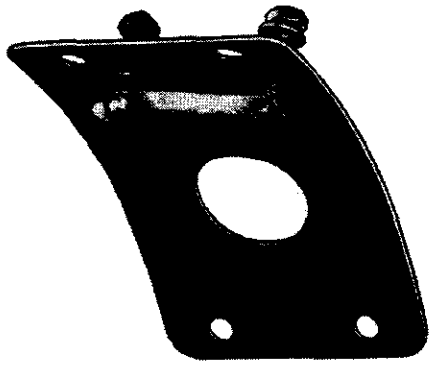
Less then 45 seconds at room temperature.

Run-on time:

110–150 seconds at room temperature.

Overheating switch

The overheating switch is attached to the heater housing. If the temperature rises considerably the bimetal switch interrupts the circuit to the fuel pump and to the solenoid valve.



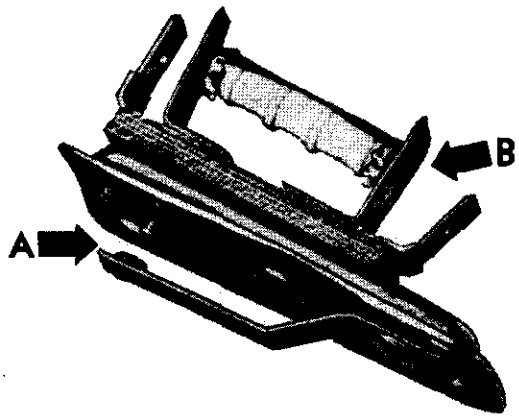
Conditions causing operation of overheating switch:

a – temperature regulation defective
b – hot air outlets plugged
c – fuel mixture to rich.

Overheating switch with fuse holder

Type 1/Model 181 and Type 2
from August 1971

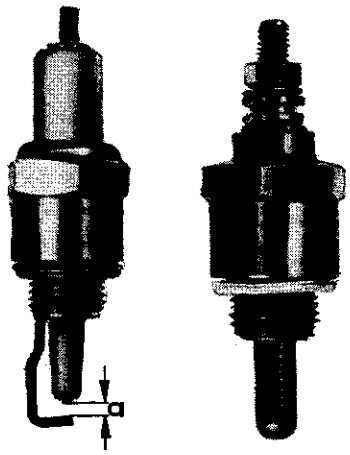
On combustion air blowers with metering pump the contact closes when the heater temperature is too high. This closed contact blows the fuse and cuts-off the operation of the fuel pump (see wiring diagram).



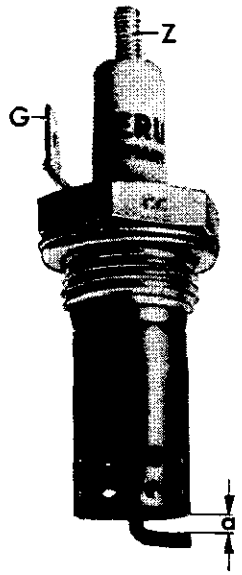
A – overheating switch
B – fuse holder

Glow plug and spark plug
Type 2 up to July 1971

The glow plug and the spark plug protrude into the combustion chamber. The spark plug has a push-on connector and the glow plug has a screw-on connector. The glow plug works only for a brief period after the heater is turned on. The spark plug remains on the entire time the heater is in operation.



a = 2.5 mm (0.1 in.)



G – low voltage connection
Z – high voltage connection
a = 2.5 mm (0.1 in.)

Glow-spark plug
Type 1/Model 181 and Type 2
from August 1971

Caution

The glow-spark plug of the BN 4 heater must **not** be installed in BA 4 heaters because the BA 4 heater requires the special ground connection. It is possible, however, to install the plug from the BA 4 heater in a BN 4 heater.

Technical data

spark plug

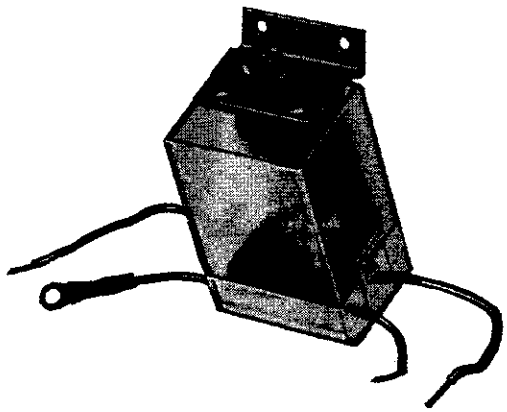
high voltage = 5000 volts
resistance = 5 kΩ

glow plug

voltage = 12 volts
resistance = 2.5 kΩ
current draw = 5 amps

glow-spark plug

voltage = 12 volts and 5000 volts
resistance = 4–6 kΩ
current draw = less than 6.5 amps



Safety switch

This switch interrups current flow to the heater if, for any reason (fuel supply cut off, glow-spark plug defective), combustion does not start within 180 seconds after turning heater on.

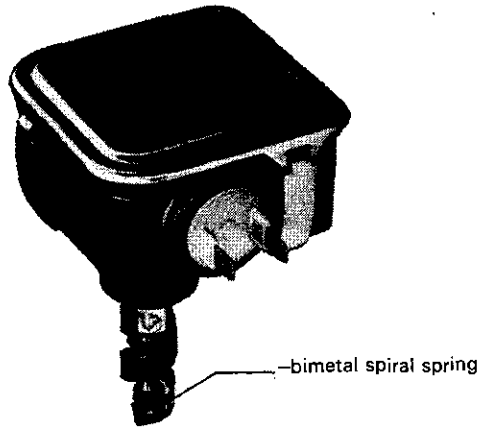
Switch response time

120–180 seconds at 12 volts

Temperature regulating switch

A cam-operated contact switches the current for the heating system on and off depending on the pre-set temperature.

When the cut-off temperature range is attained, the temperature regulating switch interrupts the current flow to the fuel pump. As the heated air cools down to the cut-in temperature range, the temperature regulating switch automatically switches on the current to the fuel pump. The regulating range is adjustable and depends on the position of the regulating linkage. This linkage is operated by a push-pull knob via a Bowden cable.



Type 1 / Model 118

Cut-in or cut-off temperature difference: 20° C (68° F).

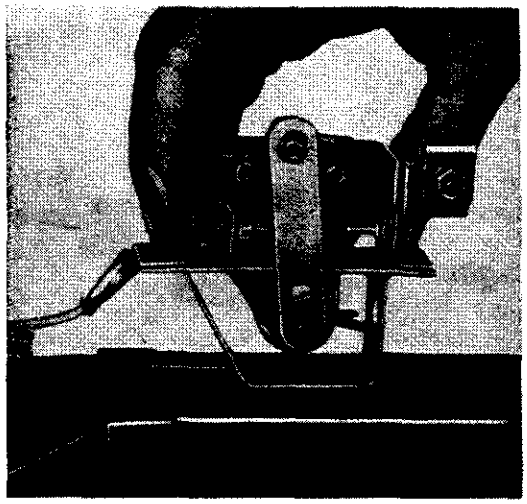
Cut-in temperature: approx. 60° C (140° F).

Cut-off temperature: approx.

Type 1/ Model 181 110–130° C (230–266° F)

Type 2 120–140° C (250–285° F)

These temperatures can be checked only with electronic instruments.



Type 2

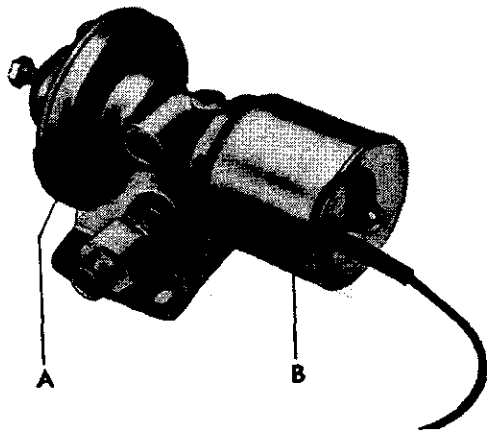
Pressure regulator with solenoid valve

Typ 2 up to July 1971

The diaphragm pressure regulator and the solenoid valve are attached to the heater housing. The fuel delivery quantity is controlled and kept constant by the pressure regulator. When the heater is turned off, the solenoid valve cuts off the fuel supply to the pressure regulator.

Delivery capacity

20 cm³ to 21 cm³ in 2 minutes at 12 volts.



A – diaphragm pressure regulator
B – solenoid valve

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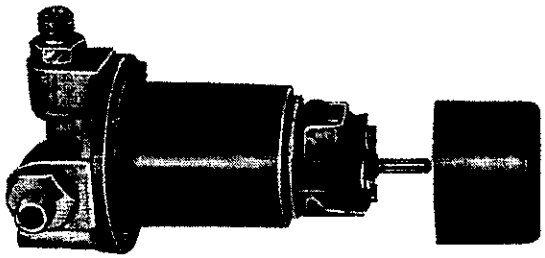


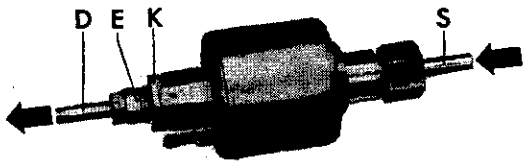
Fuel pump (Diaphragm pump)

Type 2 up to July 1971

This pump can only be used together with the diaphragm pressure regulator.

Installation position:

The adaptor on the pressure side (arrow) must be vertical as otherwise the valve may stick.



D – pressure connection
S – suction connection
K – locknut
E – adjusting screw

Fuel pump (metering pump)

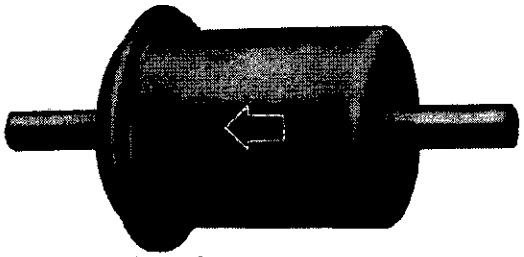
Type 1/Model 181

Type 2 from chassis No. 212 2 000 003, August 1971

The amount of fuel delivered by the electro-magnetic metering pump is directly dependent on the speed of the combustion air blower. At every 33rd revolution of the motor shaft, the pump receives an electrical impulse via the breaker contacts so that the fuel-air mixture is always constant regardless of changes in the speed of the combustion air motor.

Delivery capacity:

200 strokes = 13.4 to 15.1 cm³.



Arrow = direction of flow

Fuel filter

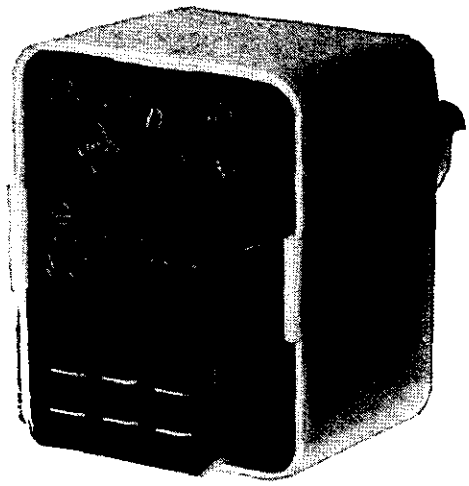
Type 1/Model 181

Type 2 from chassis No. 212 2 000 003, August 1971

The filter with water separator is installed in BN 4 heaters with metering pump.

Time switch

This switch restricts the heater operating period to 25 minutes when ignition is switched off.



Modification

Type 1/Model 181

Type 2 from chassis No. 213 2 000 001, August 1972

6 terminals instead of 4 terminals previously.

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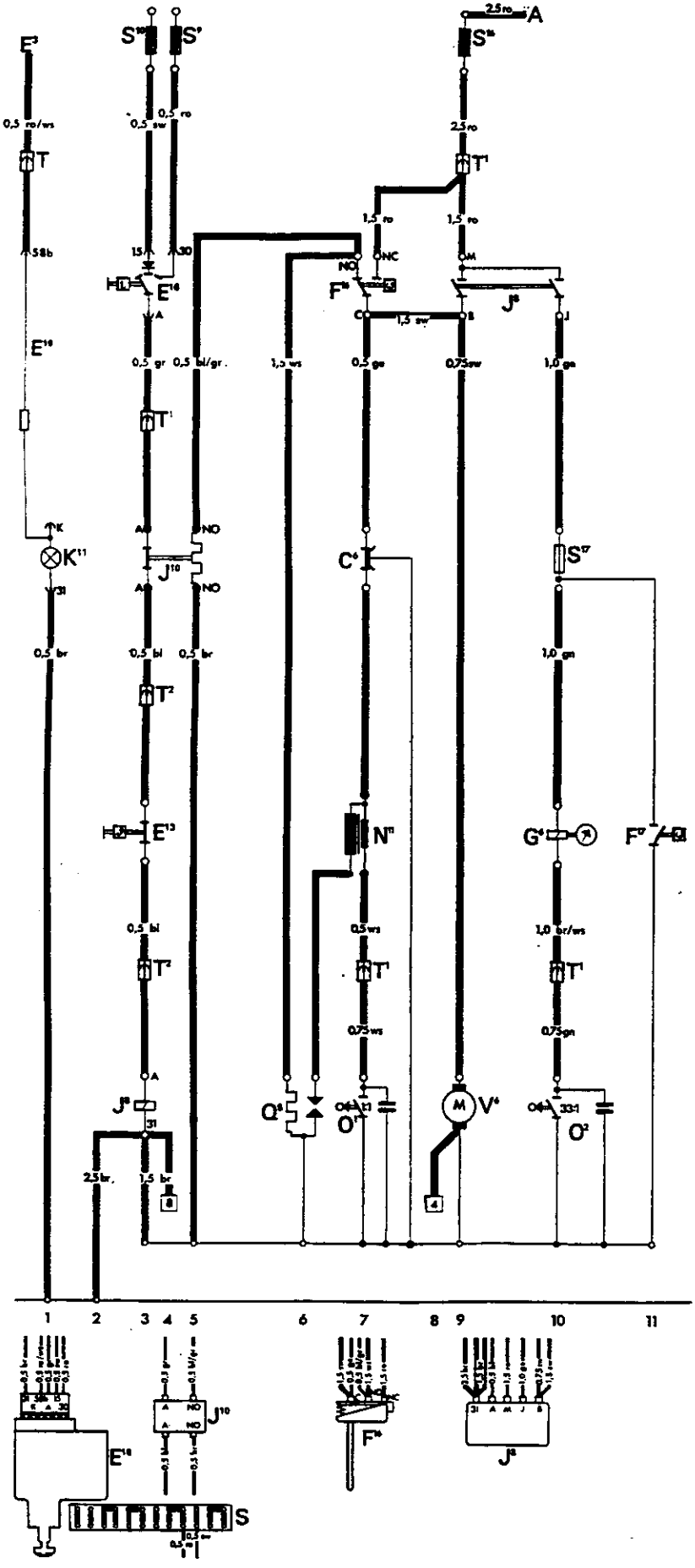


Explanation of current flow

Type 1/Model 181

Type 2 from August 1972

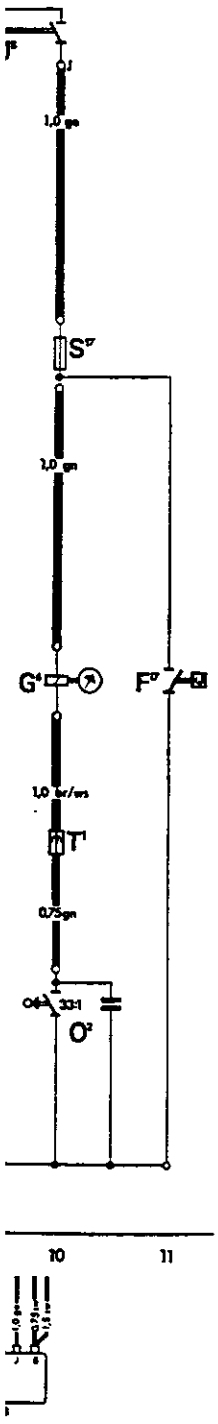
Description

A – Terminal 30 of starter
C4 – Suppression condenser for coil/capaci
E3 – From light switch terminal 58b
E15 – Temperature regulating switch
E16 – Heater switch/operating period 25 min
F16 – Flame switch
F17 – Overheating switch
G4 – Metering pump
J8 – Relay
J10 – Safety switch
K11 – Warning lamp
N11 – Ignition coil/voltage 12/5000
O1 – Ignition contact in combustion air blo (contact opens once per revolution)
O2 – Contact in combustion air blower for n (contact opens once per 33 revolution
O5 – Glow-spark plug
S – Fuse box
S9 – 9th fuse in fuse box – terminal 30
S10 – 10th fuse in fuse box – X contact
S16 – Separate 16 amp fuse
S17 – Overheating fuse/8 amp
T1 – Wire connector, single
T2 – Wire connector, double
T3 – Wire connector, 3 pin
T4 – Wire connector, 4 pin
V4 – Combustion air blower

Color code

ro = red	br = brown
sw = black	ws = white
ge = yellow	gn = green
bl = blue	gr = grey

A



Explanation of current flow diagrams

Type 1/Model 181

Type 2 from August 1972

Description	Current track
A – Terminal 30 of starter	9
C_6 – Suppression condenser for coil/capacity 0.47 µF	7
E_3 – From light switch terminal 58 b	1
E_{15} – Temperature regulating switch	3
E_{16} – Heater switch/operating period 25 minutes	1; 3
F_{16} – Flame switch	7
F_{17} – Overheating switch	11
G_4 – Metering pump	10
J_8 – Relay	3; 9; 10
J_{10} – Safety switch	3; 5
K_{11} – Warning lamp	1
N_{11} – Ignition coil/voltage 12/5000	7
O_1 – Ignition contact in combustion air blower (contact opens once per revolution)	7
O_2 – Contact in combustion air blower for metering pump (contact opens once per 33 revolutions)	10
Q_5 – Glow-spark plug	6
S – Fuse box	3; 4
S_9 – 9th fuse in fuse box – terminal 30	4
S_{10} – 10th fuse in fuse box – X contact	3
S_{14} – Separate 16 amp fuse	9
S_{17} – Overheating fuse/8 amp	10
T_1 – Wire connector, single	
T_2 – Wire connector, double	
T_3 – Wire connector, 3 pin	
T_4 – Wire connector, 4 pin	
V_6 – Combustion air blower	9

Color code

ro = red	br = brown
sw = black	ws = white
ge = yellow	gn = green
bl = blue	gr = grey

Explanation

To switch heater on

a – Pull knob of temperature regulating switch (E 13).
b – Operate time switch (E 16).

Voltage can be measured at:

Terminals 15, 30, A on heater switch (E 16)

Warning lamp (K 11) lights up.

Relay (J 8) operates.
Contacts B–M–J are connected.

Start-up

The heater ignites within 45 seconds if the air being drawn in is at room temperature. The start-up process is terminated by the flame switch (F 16).

Voltage can be measured at:

Terminal A–A of relay (J 8)

Relay (J 8) operates contacts B–M–J.

Terminals M–B of relay (J 8)

The combustion air blower (V 6) delivers warm air and combustion air.

Both contacts of overheating fuse (S 17)

The metering pump (G 6) delivers fuel.

Terminals C–NO of flame switch (F 16)

The glow element of the glow-spark plug (Q 5) warms the fuel-air mixture to make it readily combustible. The spark electrodes of the plug (Q 5) then ignite the mixture.

Heating

When the heater has ignited and warmed up, the flame switch (F 16) operates the contacts C–NC. A uniform roaring noise should be heard at the exhaust pipe.

The following is de-energized:

Contact NO of flame switch (F 16)

The glow element of glow-spark plug (Q 5) is switched off

Regulation

The temperature regulating switch (E 13) stops the flow of fuel from the metering pump when the temperature of the hot air reaches the preset maximum.

The following are de-energized:

Contact A of relay (J 8)

Relay (J 8) separates the contacts B–M–J.

Both contacts overheating fuse (S 17)

The pump (G 6) stops delivering fuel. Combustion stops. When the heater has cooled down to the lower response temperature of the temperature regulating switch (F 13), the fuel pump (G 6) starts to deliver again.

Voltage can be measured at:

Terminal A of relay (J 8)

Relay (J 8) operates.
Fuel pump (G 6) delivers fuel.

Operation of safety switch (J 10)

The safety switch (J 10) responds when the flame switch (F 16) holds the contacts C–NO closed for longer than about two or three minutes because combustion has not taken place in the heater or because the flame switch (F 16) is defective.

Voltage can be measured at:

Terminal NO of flame switch (F 16)
Terminal NO of safety switch (J 10)

The contacts are separated in the safety switch (J 10) after about three minutes by heating up of the resistance.

The following are de-energized:

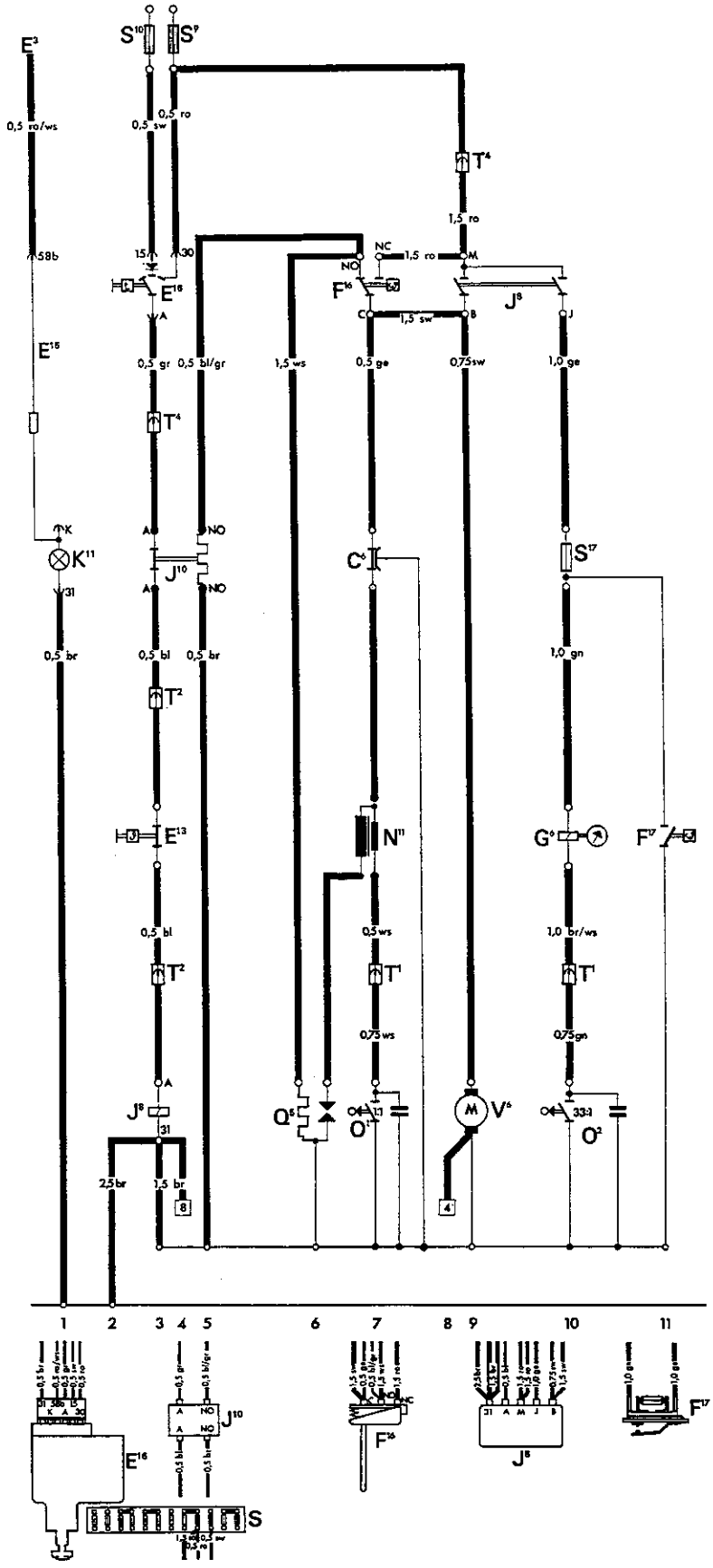
Contacts A, B, J of relay (J 8)

The combustion air blower (V 6) stops and heater cools down.

Operation of overheating circuit

If the heater gets too hot, the overheating switch (F 17) closes and causes a short circuit which blows the fuse (S 17) and stops the delivery of fuel.

The heater can overheat if the temperature regulating switch (E 13) fails to work properly or if there is insufficient air flowing past the heat exchanger (air circulation duct blocked).



Current flow diagram and explanation **Type 1/Model 181** **4 - 7**

Switching heater off

Turn knob of time switch (E 16) back to the stop position. Or push knob of temperature regulating switch (E 13) in fully.

The following is de-energized:

Contact A of relay (J 8)

The relay (J 8) contacts are separated.

Run-on

The run-on lasts for about two minutes at an ambient temperature of 20° C (68° F) and is shorter at lower temperatures. The run-on is necessary in order to clear all traces of gas from the heat exchanger and cool it down. The flame switch limits the run-on period.

The following is de-energized:

Contacts of overheating fuse (S 17)

The fuel pump (G 6) stops working.

Voltage can be measured at:

Terminals NC–C of flame switch (F 16)
Terminal B of relay (J 8)

The combustion air blower (V 6) continues to work until the heater has cooled down an the flame switch (F 16) separates contacts C–NO.

The following are de-energized:

Contacts C–NO of flame switch

The run-on is finished.

List of possible faults

In order to pinpoint a fault in the heating system it is important to troubleshoot systematically. Always follow the proper testing sequence.

Turn time switch knob clockwise as far as possible

The following faults can occur:

A – heater does not work (see F 3.2/1)
B – heater smokes (see F 3.2/2)
C – heat output insufficient (see F 3.2/2)
D – heater goes out (see F 3.2/2)
E – run on does not switch off (see F 3.2/2)
F – heater does not work at low outside temperatures (see F 3.2/2)

See respective trouble shooting chart if one of the above faults is found.

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A – Heater does not work

Operate safety switch (see F 3.1/2 and F 3.3/1). If the heater does not work, first check whether the combustion air blower is running and the fuel pump is working (listen for ticking sound).

If both these units are operating, then check the glow plug and spark plug. Also check whether the pump is delivering fuel into the heater by checking at the exhaust pipe for exhaust fumes.

Faulty components should be repaired or replaced if necessary. If when carrying out these tests the heater does not work, test it further as follows:

Check	Possible fault	Remedy
1 – Test all parts of heater and check warm air ducts as well as all electrical connections for tightness; check exhaust system for damage	a – Blockage in heater exhaust pipe or intake duct b – loose c – loose connection in electrical system	a – eliminate blockage b – tighten securing screws c – secure loose push-on connection
2 – Test 8 amp. fuse with ignition switched on	short circuit in heater electrical system	eliminate defect and replace fuse (see F 3.1/4)
3 – Test 16 amp. fuse	short circuit in vehicle electrical system	eliminate fault, replace fuse (see F 3.1/4)
4 – Test time switch for continuity with ignition switched on and off	switch contact defective	replace time switch (see F 3.5/2)
5 – Pull knob out as far as it will go and test temperature control switch for continuity (F 3.3/1)	a – bimetal strip defective b – contacts defective	a; b – replace temperature regulating switch (see F 3.5/1)
6 – When breaking contact at terminal A, relay must click audibly	no voltage in wire to terminal A, time switch has no continuity, relay defective	replace relay (see F 3.5/1) test time switch (see F 3.3/2)

Check	Possible fault	Remedy
7 – Test relay terminal; if there is voltage at terminal B, terminals M and I must also have voltage after switching heater on	switch contacts defective (see F 3.3/1)	replace relay (see F 3.5/1)
8 – Check voltage at terminal 2 of terminal strip	nominal value 11.6 volts is not attained; battery is discharged too much	start vehicle engine to attain full generator voltage
9 – Test ignition coil (see F 3.3/1)	a – ignition coil insulation is defective	a – replace ignition coil
	b – breaker points of blower motor defective (see F 3.3/1)	b – clean combustion air blower breaker points
	c – short circuit on condenser on contact breaker	c – replace condenser (see F 3.7/1)
	d – short circuit in suppression condenser	d – replace suppression condenser
10 – Check spark plug, but first disconnect wires from fuel pump (see F 3.3/1)	faulty or dirty spark plug	clean spark plug; check spark plug gap (.098 in./2.5 mm) (see F 3.3/1)
11 – Test glow plug with fuel pump disconnected	plug must glow within one minute	replace glow plug (see F 3.3/1) (see F 3.5/2)
12 – Test flame detector switch	switch does not operate	adjust (see F 3.3/1)
13 – Check overheating switch	no continuity	replace (see F 3.5/1)
14 – Check filter (see F 3.3/2)	blocked	clean filters between fuel pump and jet (see F 3.3/2); filter between fuel pump and tank must be cleaned (see F 3.3/2)
15 – Check fuel jet	blocked or damaged	clean or replace (see F 3.3/2)

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Check	Possible fault	Remedy
16 – Test fuel pump and lines (see F 3.6/1)	a – breaker points dirty	clean breaker points and readjust. Lubricate springs and pivot points (see F 3.3/2)
	b – lines leak at connections	
	c – pump clatters, pressure relief valve on outlet side of pump is dry and sticks	disconnect pump outlet line and pour several drops of gasoline into pump connection (see F 3.6/1)
17 – Check pressure regulator and solenoid valve	incorrect adjustment	adjust pressure regulator (see F 3.3/2)
18 – Combustion air blower motor (listen to determine if motor is running) (see F 3.7/1)	a – bearing and winding defects	a – replace combustion air blower; cannot be disassembled because air blower fan and motor are balanced together (see F 3.7/1)
	b – fresh air fan contacts housing	b – remove housing and tighten securing clamp of combustion air blower; (see F 3.5/1)
	c – combustion air blower fan is damaged and has jammed in vaned housing	c – replace complete combustion air blower (see F 3.5/1)
	d – too little combustion air, voltage too low (nominal value 11.6 volts)	d – check ground cable and test battery
	e – combustion air blower motor does not attain prescribed speed (nominal value 5000 rpm at nominal voltage)	e – replace complete combustion air blower (see F 3.5/1)

B – Heater smokes

Check	Possible fault	Remedy
1 – Excess fuel	a – pressure regulator incorrectly adjusted	a – adjust pressure regulator (see F 3.3/2)
	b – fuel jet damaged	b – replace fuel jet
2 – Combustion air motor: measure speed (see F 3.3/1)	a – voltage too low (nominal value 11.6 volts); lack of combustion air	a – check wires and test battery
	b – blower motor defective	b – replace complete combustion air blower (see F 3.5/1)

C – Heat output insufficient

Check	Possible fault	Remedy
1 – Check delivery quantity of fuel pump	a – delivery quantity too small	a – adjust pressure regulator (see F 3.3/2)
	b – filter blocked	b – clean (see F 3.5/2 and F 3.3/2)
2 – Test temperature regulating switch	bi-metal strip damaged (switching temperature altered)	replace (see F 3.5/1) or adjust (see F 3.3/1)

D – Heater goes out

Check	Possible fault	Remedy
1 – Check electrical system	loose connections	tighten
2 – Overheating switch faulty (see point 6)	a – contact dirty	a – clean
	b – bi-metal strip worn	b – replace (see F 3.5/1)
3 – Check exhaust pipe for obstructions	blocked	clean (see F 3.4/1)
4 – Cut-in time of glow plug too short	flame detector switch incorrectly adjusted	adjust (see F 3.3/1)
5 – Check delivery quantity of fuel pump	filter dirty, valve blocked, jet blocked	clean or replace (see F 3.3/2)
6 – Overheating switch actuated	hot air ducting blocked	eliminate blockage

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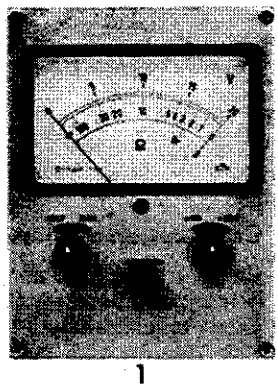
E – Run-on does not switch off

Check	Possible fault	Remedy
1 – Check flame detector switch	flame detector switch is incorrecty adjusted	readjust (see F 3.3/1)
2 – Quartz rod of flame detector switch broken		replace quartz rod and readjust flame detector switch (see F 3.5/2 and F 3.3/1)

F – Heater does not work at low outside temperatures

Check	Possible fault	Remedy
1 – Check battery voltage		if necessary, charge battery
2 – Check delivery quantity of pressure regulator (see F 3.3/2)	delivery quantity too low because a – improperly adjusted b – filter dirty c – strainer blocked d – valve guide dirty e – pressure regulator improperly adjusted	a – correct adjustment b – replace filter c – clean strainer d – replace pressure regulator e – adjust pressure regulator
3 a – Remove glow plug and check glow element b – check spark plug (see F 3.3/1)	a – glow element broken b – no circuit in suppression resistor electrode gap too large	replace glow plug (see F 3.5/2) replace spark plug (see F 3.5/2)
4 – Check flame detector switch	flame detector switch defective (cut-in time too short)	replace flame detector switch (see F 3.5/2)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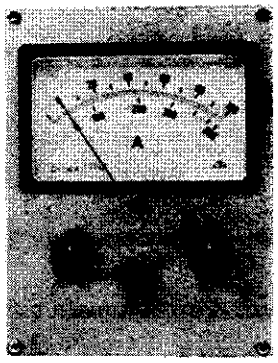
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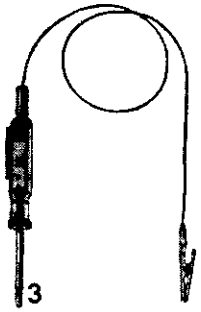
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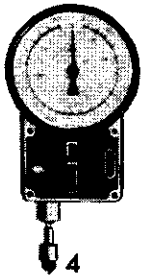
4


5

No.	Description	Special tool	Remarks
1	Ohmmeter/voltmeter		Range 0–20 volts
2	Ammeter		Range 0–20 amps.
3	Tachometer		0–8000 rpm
4	Test lamp		12 volts
5	Stop watch		

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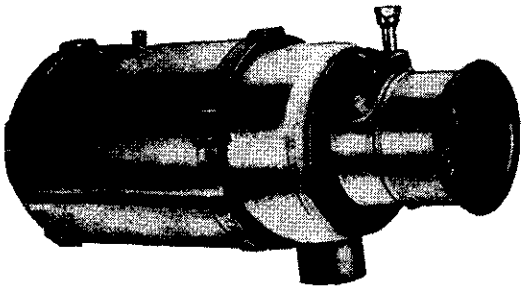
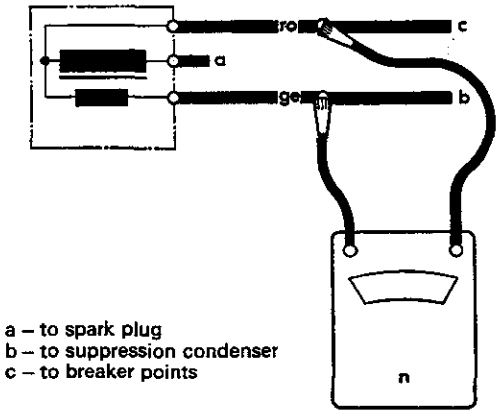


Heat exchanger

Check combustion chamber for damages (overheating, corrosion etc.) and soot.

Damaged or soot covered units must be replaced.



a – to spark plug
b – to suppression condenser
c – to breaker points

Combustion air blower

Check blower for damages caused by overheating and bearings for free movement. Connect tachometer as shown and check speed.

Counting revolutions

The contacts in the combustion air motor give one audible impulse for the metering pump every 33 revolutions of motor shaft.

Count impulses in one minute and multiply by 33 = Speed.

Speed:
running for 10 minutes at 12 volts:
4875–5325 rpm.

Flame switch

Measuring voltage

The flame switch requires 45 seconds to start to operate after the heater ignites. A uniform roaring noise should be heard at the exhaust pipe. The flame switch is "ok" if terminal NO is pulled off, held against ground and the switch is de-energized within 45 seconds.

If the operating limit is delayed the flame switch must be adjusted, or if necessary replaced.

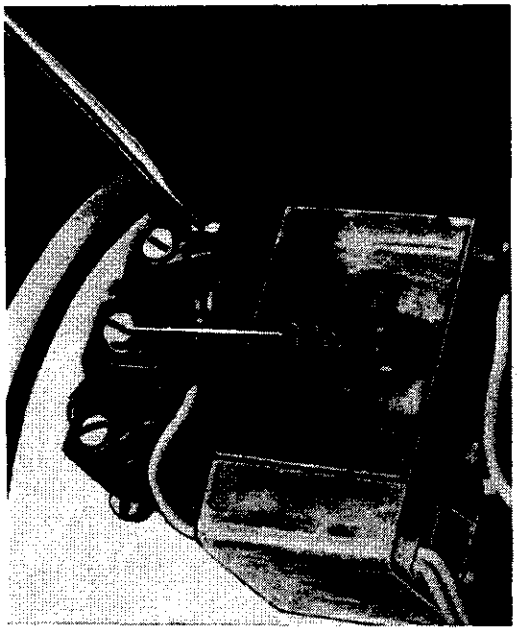
Adjusting

1 – Turn heater on. Pull temperature regulator switch all the way out. Let heater run for five minutes.

2 – Turn time switch knob back until warning light goes out. Start stop watch.

3 – The combustion air blower fan, controlled by the flame switch, must continue running 110–150 seconds. This run-on time is based on a nominal voltage of 12 volts and an outside temperature of about 20° C (68° F). At lower temperatures the run-on time is shorter.

If proper shut off time is not attained, the flame switch must be adjusted (if run-on is too long, turn adjusting screw clockwise; if run-on is too short, turn screw counter-clockwise).

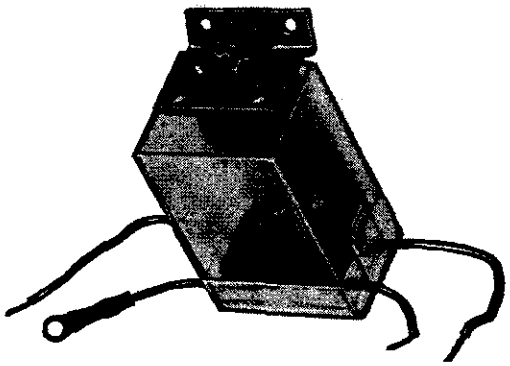


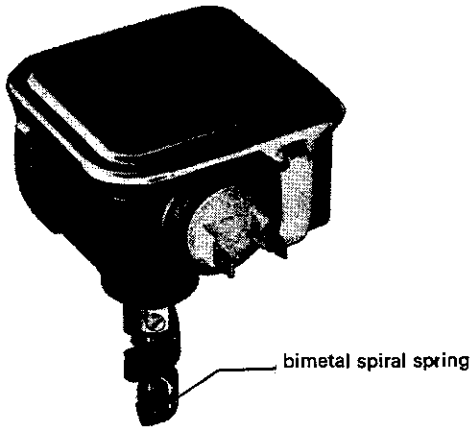
Safety switch

1 – Disconnect wires at pump so that fuel pump does not operate.

2 – Turn heater on. After 120–180 seconds (at nominal voltage and at about 20° C (68° F) ambient temperature) the safety switch interrupts the heating system circuit.

3 – If the safety switch has operated within the specified time, the switch is "OK." Reset lever on safety switch in direction of arrow.





Type 1/Model 181

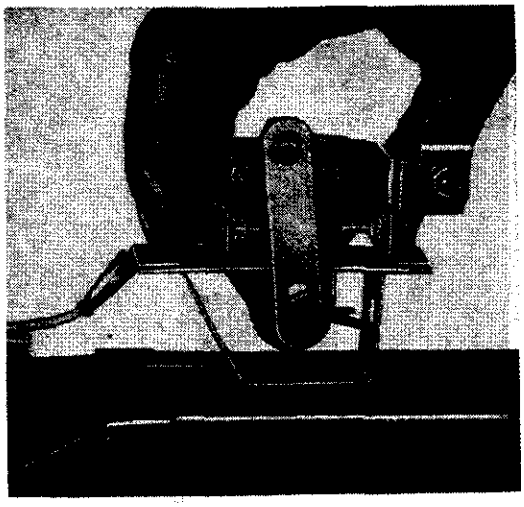
Temperature regulating switch
Type 1/Model 181

The linkage is lubricated with a special oil. Therefore the linkage must always be kept clean otherwise the switch will not operate with in the adjusted limits.

Checking temperature limits
Type 1/Model 181 and Type 2

To check the temperature for correct operation, use an electronic temperature measuring device (a mercury thermometer is to slow).

Position device close to bimetallic spring (do not touch spring).



Type 2

Working instructions

1 – Switch heater on and wait until heater has regulated 3 times.

2 – Pull knob for temperature regulating switch all way out and measure the temperature when the switch stops operating.
Cut-off temperatures: approx.
Type 1/Model 181: 110–130° C (230–266° F)
Type 2 120–140° C (250–285° F)

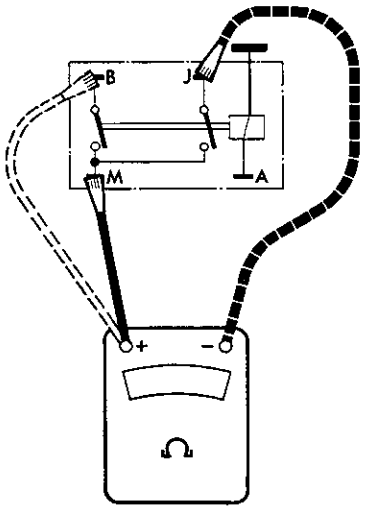
3 – Push knob halfway in and measure temperature difference during one regulation stage.
Approx.: 20° C (68° F).

4 – Push knob allway in and measure cut-in temperature.
Approx.: 60° C (140° F).

Note

If the measured temperatures show a tolerance of more then 20° C (68° F) the temperature regulating switch must be replaced.

Checking relay



1 – Disconnect wires from terminals J, B and M at relay and turn on heater.

2 – Disconnect wire from terminal A. When doing this the relay armature de-energizes (listen for clicking sound). If there is no sound check voltage between ground and plug. If there is voltage at this point, measure between relay housing and terminal A with an ohmmeter. If the ohmmeter shows 0 ohm the relay winding is faulty.

3 – If the relay armature can be heard de-energizing when disconnecting terminal A, connect ohmmeter between terminals J–M and B–M.

Nominal value: ∞ ohm otherwise replace relay.

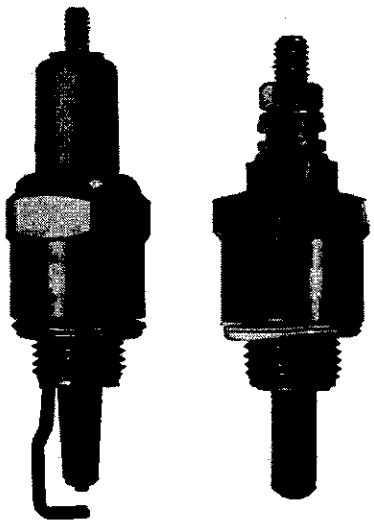
4 – Reconnect cable to terminal A. If the relay armature energizes audibly, check whether there is continuity from terminal J to terminal B. If there is no continuity with the relay switched on (∞ ohm), the relay must be replaced.

Checking glow plug and spark plug

The glow plug has a spiral element protected by a metal casing. Deposits can be carefully removed with a wire brush. The glow plug is serviceable if it glows bright red after one minute when connected to a 12 volt power source, otherwise the glow plug must be replaced.

The spark plug can be cleaned with a wire brush. Check electrode gap (2.5 mm) .10 in.

There is a 5 K Ω resistor installed in the spark plug. The resistor can be measured with an ohmmeter (connect terminals of ohmmeter between center electrode and ignition wire terminal). If the ohmmeter shows more than 10 K Ω, the spark plug must be replaced.



spark plug glow plug

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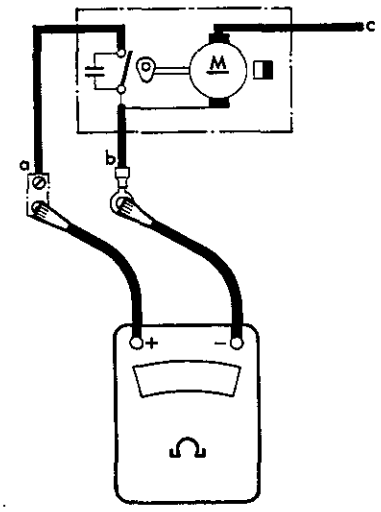
Testing breaker points

The breaker points can be tested with an ohmmeter with the heater shut off.

1 – Unscrew intake pipe.

2 – Disconnect wire connector between breaker point and ignition coil.

3 – Connect ohmmeter to wire connector (a) and to ground cable (b), turning the fan by hand. Breaker points must make/break once for each revolution of the motor (the ohmmeter must deflect between 0 and ∞).



a – to ignition coil
b – ground
c – to terminal 1

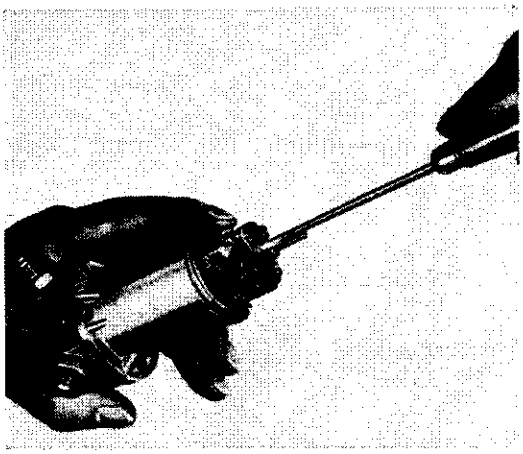
Possible fault	**Ohmmeter shows**
Short circuit in condenser	0 Ω
Contact breaker points burnt. Partial short circuit in condenser	Deflection between ∞ Ω and a resistance value (e.g. 10 Ω)
Open circuit in breaker point circuit (e.g.: connecting wire broken, breaker point gap too large)	∞ Ω only

The breaker point assembly of the combustion air blower can be repaired (see F 3.7/1).

Diaphragm pump

1 – Remove pump.

2 – Remove the nut from the terminal post and take off cover. Check breaker points. Lightly lubricate moving parts and springs if necessary.



Note

The breaker point gap should be 1 mm (0.04 in.) (hold lower contact breaker arm against housing). The points are set with adjusting screw.

3 – Remove four fillister head screws on housing and take pump housing off. Turn diaphragm bracket counterclockwise to remove it and check it visually.

4 – When reinstalling, first screw diaphragm bracket in, clockwise, as far as it will go. Then back off 2½ turns counterclockwise. The correct delivery quantity of the fuel pump is then adjusted.

5 – The fuel pump must be installed so that the connection on the outlet is pointing upward as shown by the arrow. After installation, the fuel line on the outlet side may have to be bled. Also, moisten pressure valve with a few drops of gasoline (see F 3.6/1).

Note

When assembling, make sure that the diaphragm is located in the groove and the winding housing is firmly bolted to the pump housing (the pump will not deliver fuel if air is drawn in at the side). (See F 3.6/1.) There is a vent hole in the winding housing. Secure pump housing to winding housing with four fillister head screws with the outlet connection opposite vent hole (see F 3.6/1).

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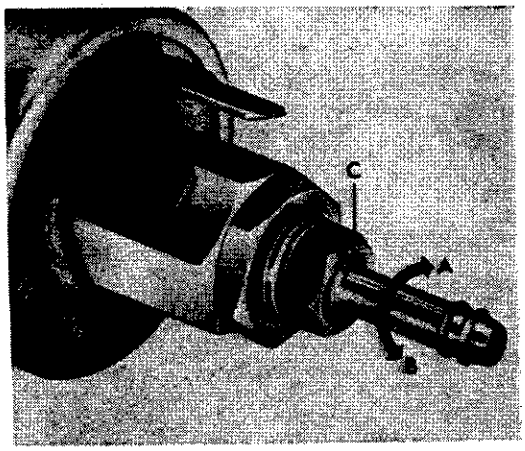
Metering pump

1 – Pull hose off on pressure side connection.
2 – Disconnect glow-spark plug. (Safety reasons.)
3 – Switch heater on.
4 – Count **200 strokes** of the metering pump (ticking noise). The amount of fuel ejected must be within **13.4 to 15.1 cm³.**

Note

The strokes can be counted as follows:
a – Write down the numbers 1–20 one under the other.
b – After each 10 strokes (ticks), cross out a number. It is thus only necessary to count from 1 to 10 and when all the numbers have been crossed out, 200 strokes have been counted.

If the amount delivered is not within the tolerance given, the pump must be adjusted.



Adjusting delivery quantity

Increase consumption
= Turn valve counter-clockwise (B)
Decrease consumption
= Turn valve clockwise (A)

To do this, first back off lock nut and after adjusting, tighten and seal with paint.

Pressure regulator and solenoid valve

Adjusting

Note

The fuel delivery quantity can only be set accurately by measuring the fuel consumption on the heater. The fuel quantity is measured at the fuel jet.

Before carrying out a consumption measurement or adjustment, clean the filters.

Part	Location	Remarks
Filter	between tank and fuel pump	replace (see F 3.5)
Screen	pressure regulator inlet side	clean
Screen	between union nut and jet	clean

1 – Disconnect glow plug and spark plug. Bridge temperature control switch connections.

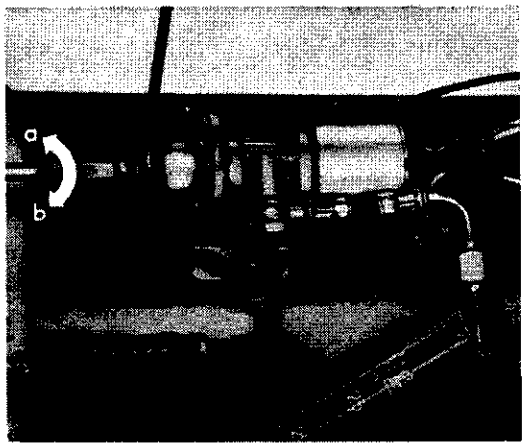
2 – Loosen union nut from jet carrier.

3 – Remove jet from jet carrier and clean screen.

4 – Connect jet and screen to fuel hose and hold at the same height as when installed (see illustration).

5 – Turn heater on. Fuel emitted is collected in a measuring glass for two minutes and should amount to 20–21 cm³.

6 – To adjust: Turn screw counterclockwise (a) to decrease the fuel quantity delivered. Turn clockwise (b) to increase the fuel quantity delivered.



Note

If, after performing these operations, the fuel delivery quantity is still insufficient, the valve screen (No. 10 on page F 3.8/1) is blocked and must be cleaned.

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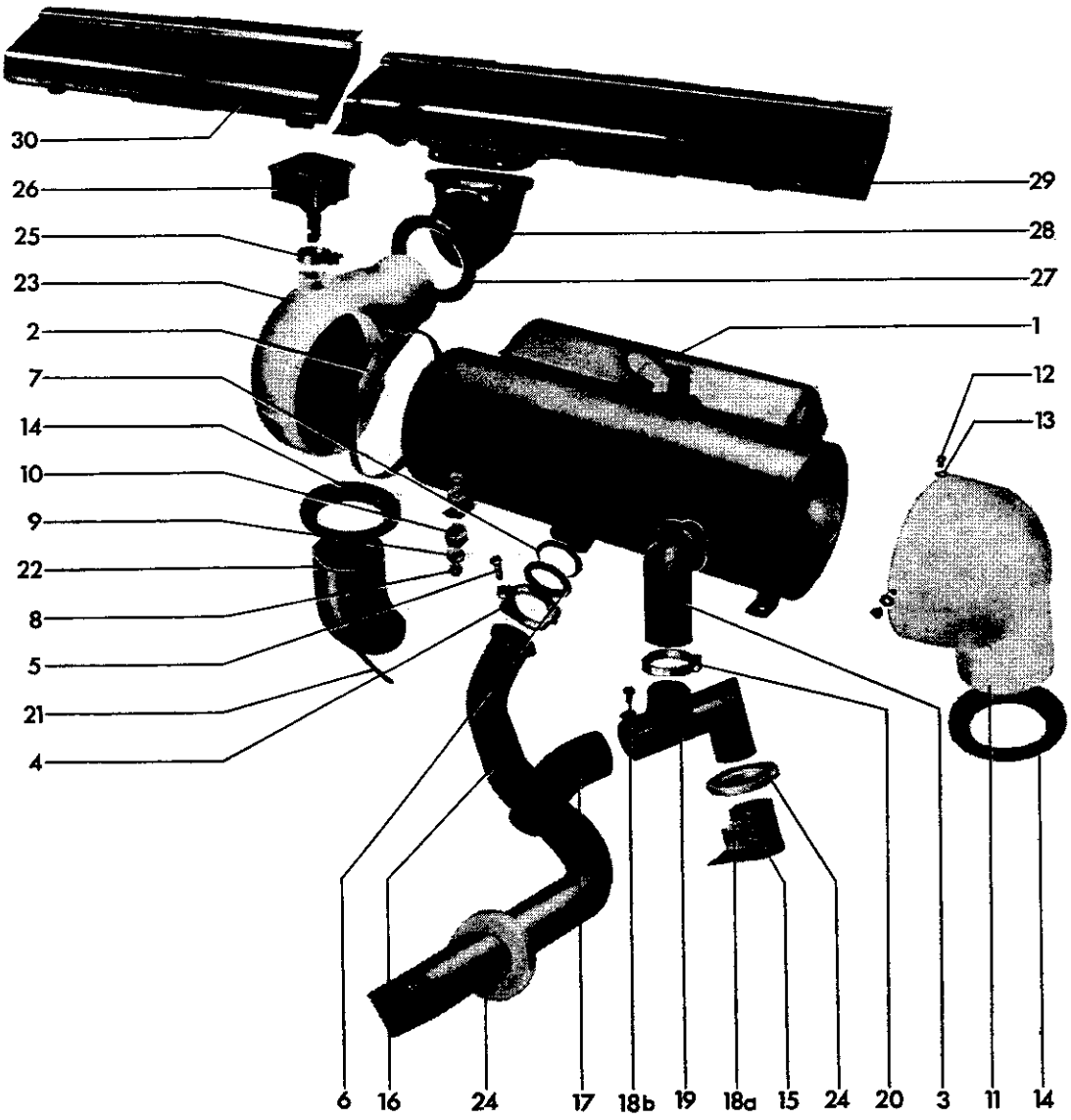

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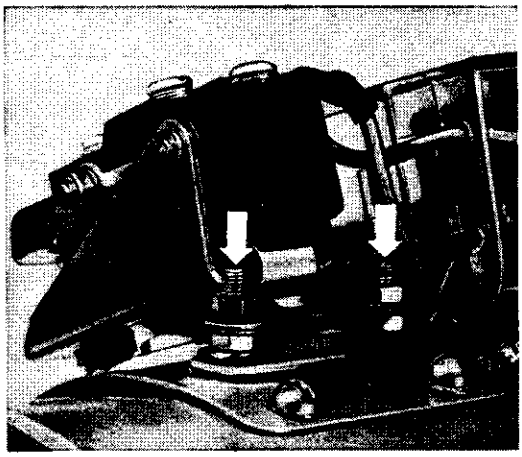
F 3.4 Heater and Warm Air Duct

No.	Designation	Qty.	Note when removing	Note when installing	Special instructions see
1	Heater	1	remove nut and spring washers under luggage pan	axial fan must not contact heater casing	F 3.5/1
2	Clamp	1		ensure clamp is tight	
3	Combustion air pipe elbow	1	can be pulled out	the shoulder must seal the casing hole sufficiently	
4	Exhaust pipe clamp	1		ensure clamp is tight	
5	Screw M 6×35	1			
6	Conical seal	1	attached to heater pipe		
7	Exhaust pipe seal	1		replace damaged seals ensure good sealing	
8	Nut M 6	8			
9	Spring washer B 6	8			
10	Bonded rubber mounting	4		make sure that thread is tight in rubber	
11	Circulating air pipe	1	after removing heater detach intake pipe	before installing the heater attach the intake pipe. The intake pipe must be vertical and face downward	
12	Fillister head screw AM 5×11	4			
13	Spring washer A 5.3	4			
14	Seal	2		the groove is pressed into the luggage pan (lip downward)	
15	Intake pipe	1		before installing, check seal in luggage pan for tightness	
16	Exhaust pipe	1		before installing, check seal for damage and tightness	
17	Combustion air pipe hose	1			
18	a – Fillister head screw Bz 3.9×6.5 b – Fillister head screw Bz 4.8×9.5	2 1			
19	Combustion air intake pipe	1		before installing, check seal for damage and tightness	
20	Clamp	1		check for tightness	
21	Bowden cable linkage	1			
22	Outlet for footwell	1			
23	Warm air pipe	1	first disconnect linkage (21), then lift out	push into seal	
24	Seal for exhaust pipe and intake pipe	2	check for damage	press in from wheel housing	
25	Clamp	1			
26	Temperature regulating switch	1	lift out vertically		
27	Warm air pipe seal	1			
28	Elbow	1			
29	Warm air duct, left	1			
30	Warm air duct, right	1			

Overheating switch

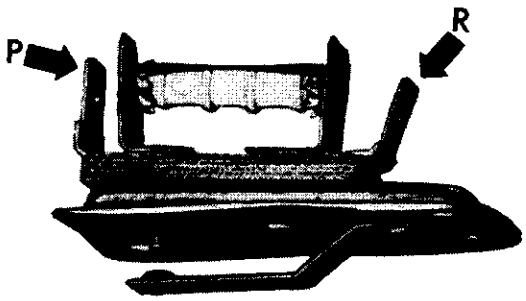
Type 2 up to chassis No. 211 2 276 560, July 1971

The connections (arrows) may be interchanged at installation without causing damage to the heater.



Type 1/Model 181
Type 2 from chassis No. 212 2 000 001, August 1971

Do **not** interchange wires.



P – from metering pump (connection on adjusting srew)

R – from relay

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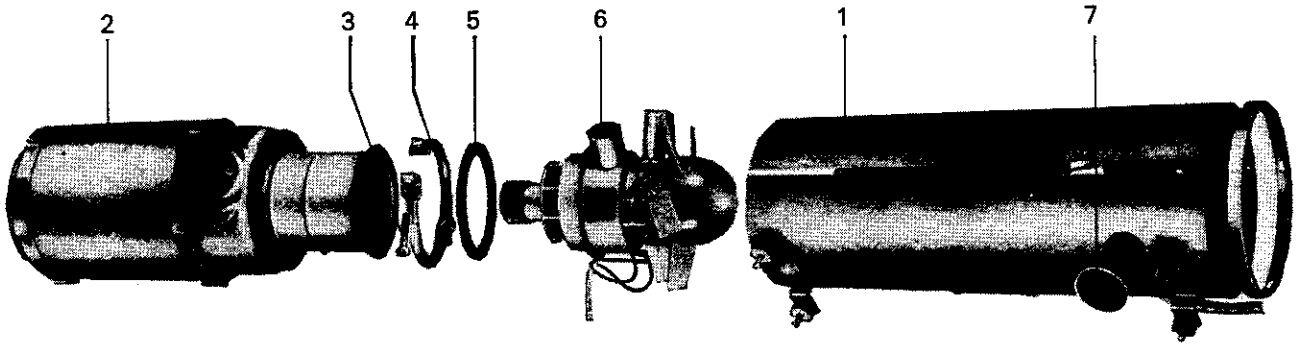
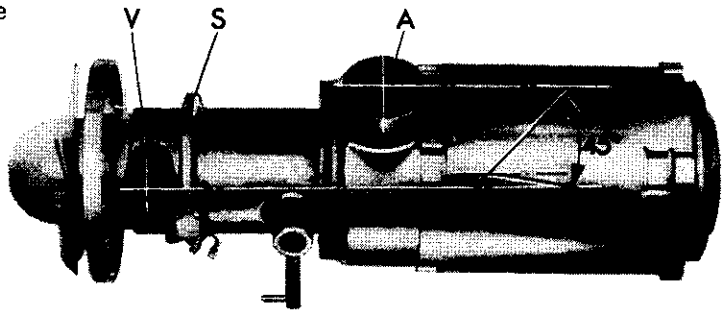


No.	Description	Qty.	Note when removing	Note when installing	Special instructions see
1	Housing	1	pull housing apart and lift housing off heat exchanger	pull combustion air blower wires through hole in housing; pull housing apart and slide over heat exchanger; ensure that fan does not rub on housing; tighten four round head screws	
2	Heat exchanger	1	remove deposits		
3	Screw	1		screw must not be tightened until heater is assembled; first secure housing to heat exchanger then insert screwdriver trough hole with grommet and tighten screw; due to this work sequence, screw must face combustion air intake pipe	
4	Clamp	1		jaws of clamp must align with exhaust pipe connection	
5	Seal	1		replace damaged seal	
6	Combustion air blower motor	1	do not tilt when lifting off	combustion air blower motor must be able to be turned with the heat exchanger until combustion air intake pipe is aligned with housing hole by turning	
7	Plug	1		after tightening clamp, plug hole	

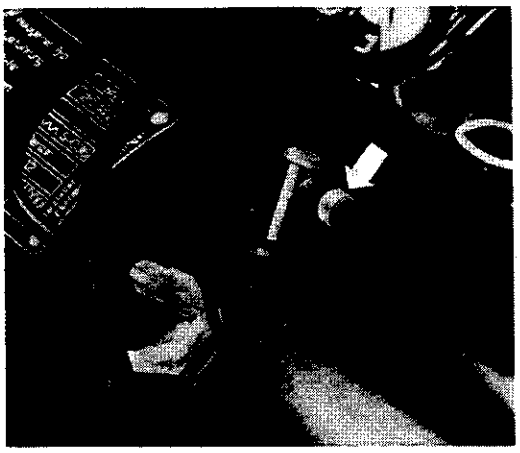
Installation instructions

a – The combustion air blower must be attached to the heat exchanger so that the combustion air connection (V) is offset 45° to the right from the exhaust connection (A).

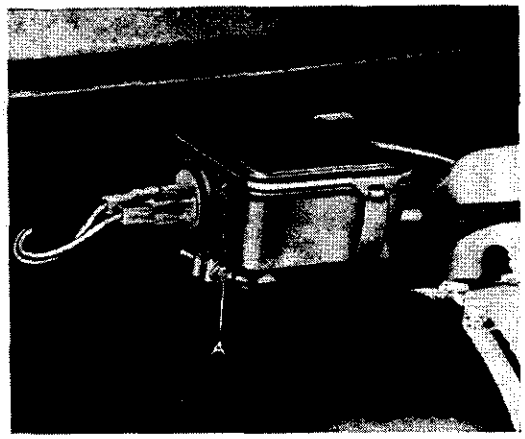


V – combustion air connection
S – clamp
A – exhaust connection

b – The fuel hose must be secured on the pipe with a clamp (arrow).



Temperature regulating switch

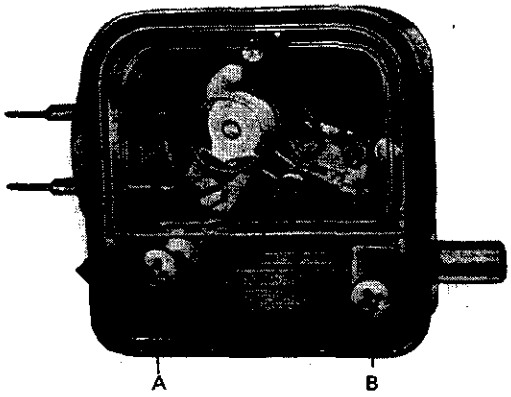


A – clamp

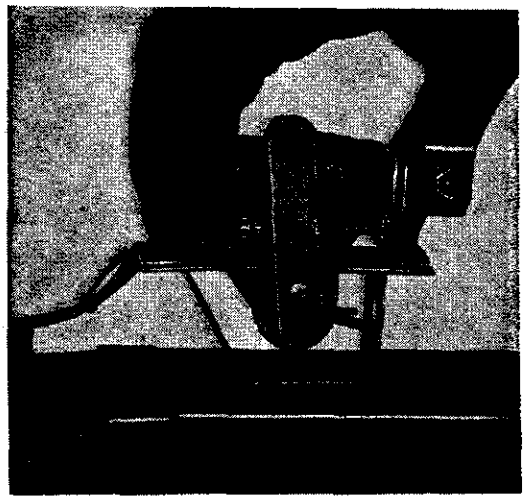
Type 1/Model 181

Do not touch the bimetal spiral spring

The linkage is lubricated with special oil. Therefore always keep the linkage clean; otherwise the switch will not operate within the adjusted limits.



A – inner cable clamping screw
B – outer cable securing screw

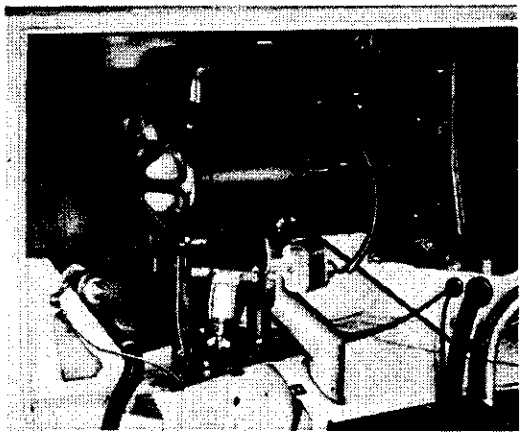


Type 2

The temperature regulating switch can be removed only, after the complete heater is removed from the vehicle.

Relay

Type 2



Removing

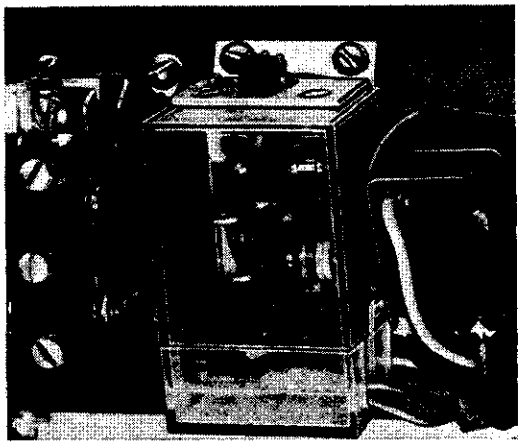
1 – Disconnect battery ground strap.
2 – Disconnect wires on relay and remove relay.

Installing

Ensure that wires are connected according to wiring diagram (see F 3.1/4).

Safety switch

Type 1/Model 181 and Type 2



Removing

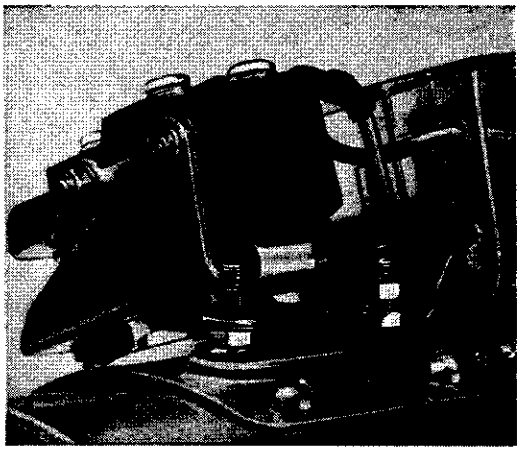
1 – Disconnect battery ground strap.
2 – Detach heater and swing slightly toward front.
3 – Remove two round head screws holding the switch.

Installing

1 – Connect wires according to wiring diagram (see F 3.1/4).
2 – Install heater.
3 – Connect battery ground strap and check operation of heater.

Flame switch

Type 1/Model 181 and Type 2



Removing

1 – Disconnect battery ground strap.
2 – Remove heater (see F 3.4).
3 – Disconnect three wire leads, each locked with two lock washers.
4 – Back off flame switch union nut with 12 mm open-end wrench, then turn switch to pull it out vertically (if necessary use solvent).

Installing

1 – Carefully insert flame switch into combustion chamber and tighten union nut. The hole in the heater housing is covered with the plug.
2 – Connect wires according to wiring diagram (see F 3.1).
3 – Install heater (see F 3.4).
4 – Connect battery ground strap and check operation of heater.

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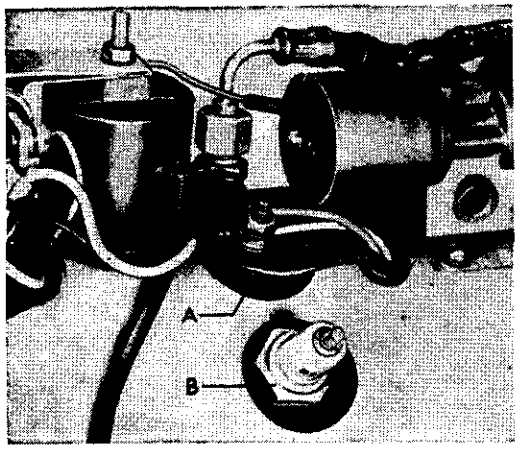


A – glow plug
B – spark plug

Glow plug / spark plug

Type 2

up to chassis No. 211 2 276 560, July 1971.

Removing

1 – Disconnect spark plug connector from spark plug. Remove glow plug terminal nut using an 8 mm open-end wrench.

2 – Remove spark plug and glow plug with a 21 mm socket wrench.

Installing

Install plugs. Make sure that two lock washers are used for glow plug.

Pressure regulator and solenoid valve

Removing

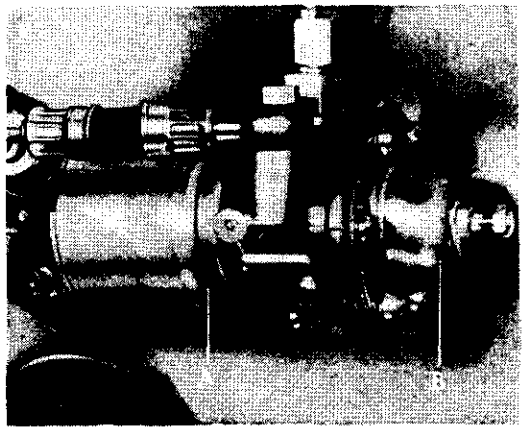
1 – Disconnect battery ground strap.

2 – Disconnect cable of solenoid valve from terminal 5.

3 – Disconnect fuel line between jet and pressure regulator at regulator. The gland nut can be backed off with a 12 mm open-end wrench.

4 – Fuel line between pump and pressure regulator is disconnected at fuel pump while counterholding with a 14 mm open-end wrench. Catch leaking fuel.

5 – Remove four round head screws and washers. Take solenoid valve and pressure regulator off heater.
The lead for the ground wire is secured by two round head screws.



A – Solenoid valve
B – Pressure regulator

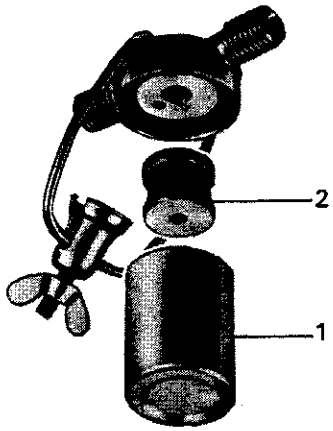
Installing

1 – Secure pressure regulator and solenoid valve with four round head screws and washers. Use two of the screws for securing the lead for the ground wire.

2 – Connect fuel lines. Hold locknut on fuel pump with a 14 mm open-end wrench.

3 – Connect solenoid valve wire to terminal 5. Connect battery ground strap and check operation of heater.

Filter



1 – Filter housing
2 – Filter screen

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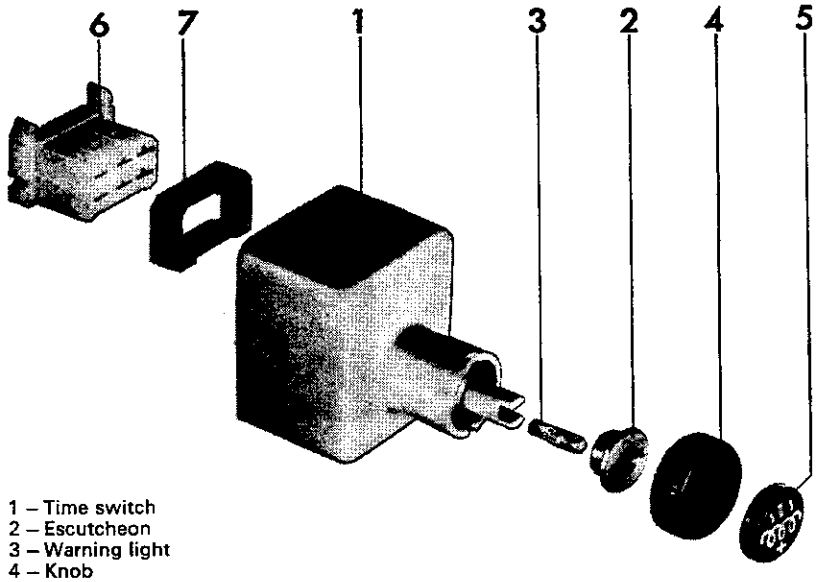


1 – Time switch
2 – Escutcheon
3 – Warning light
4 – Knob
5 – Lens
6 – Plug
7 – Plug frame

Time switch

Removing

1 – Disconnect battery ground strap.

2 – Pull knob off and take out bulb.

3 – Remove self tapping screw in instrument panel insert and open the insert.

4 – Disconnect wires at switch.

5 – Unscrew escutcheon with special wrench VW 674/1 and pull switch out.

Installing

1 – Secure escutcheon to time switch in instrument panel insert with special wrench VW 674/1.

2 – Connect wires according to wiring diagram (see F 3.1/3).

3 – Connect battery ground strap and check operation of heater.

Pressure regulator and solenoid valve

Type 2

Removing

1 – Disconnect battery ground strap.

2 – Disconnect wire of solenoid valve from terminal 5.

3 – Disconnect fuel line between jet and pressure regulator at regulator. The gland nut can be backed off with a 12 mm open-end wrench.

4 – Fuel line between pump and pressure regulator is disconnected at fuel pump while counterholding with a 14 mm open-end wrench. Catch leaking fuel.

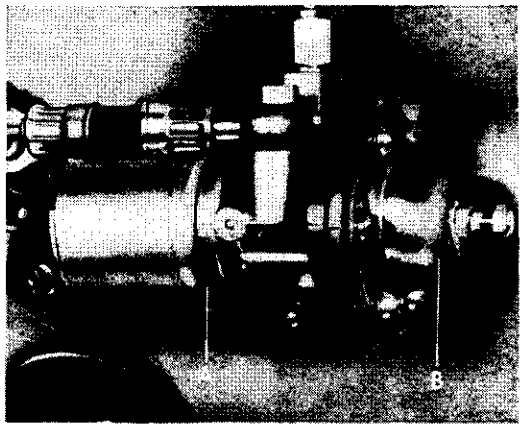
5 – Remove four round head screws and washers. Take solenoid valve and pressure regulator off heater.
The lead for the ground wire is secured by two round head screws.

Installing

1 – Secure pressure regulator and solenoid valve with four round head screws and washers. Use two of the screws for securing the lead for the ground wire.

2 – Connect fuel lines. Hold locknut on fuel pump with a 14 mm open-end wrench.

3 – Connect wires according to wiring diagram. Connect battery ground strap and check operation of heater.



A – solenoid valve
B – pressure regulator

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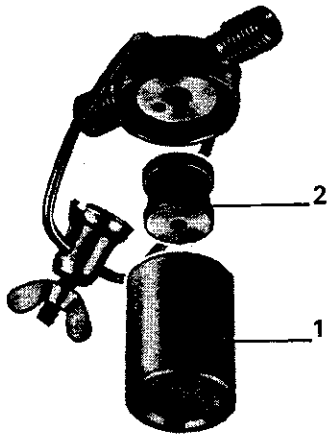
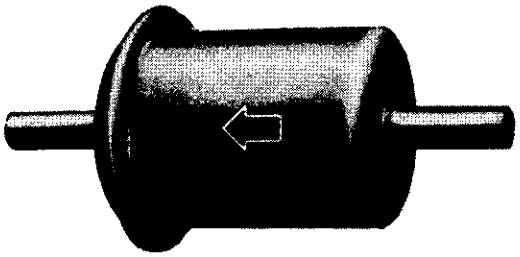


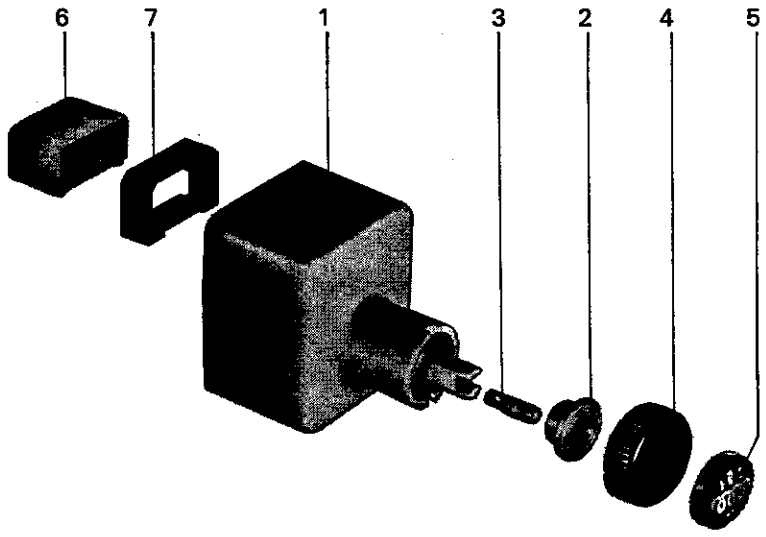
1 – filter housing
2 – filter screen

Filter

Ensure that the filter is installed properly. The arrow on the housing shows the direction of flow.



Time switch

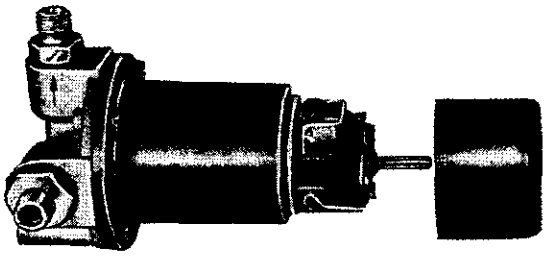


1 – time switch
2 – escutcheon
3 – warning light
4 – knob
5 – lens
6 – plug
7 – plug frame

Fuel pump

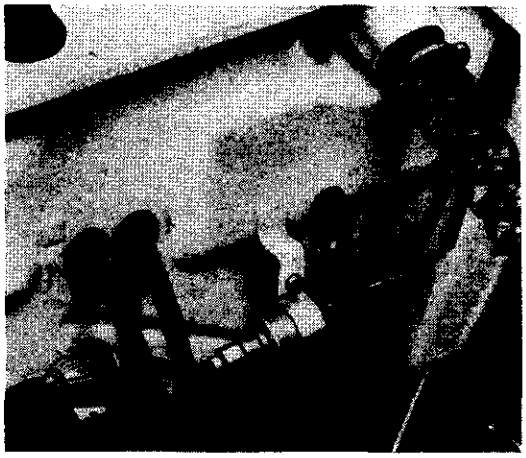
(Diaphragm pump)

Install pump so that pressure connection (with arrow) is vertical. After installation it may become necessary to bleed the pump. This is done by loosening union nut of pressure side and filling outlet union with a few drops of fuel and tightening union nut again.



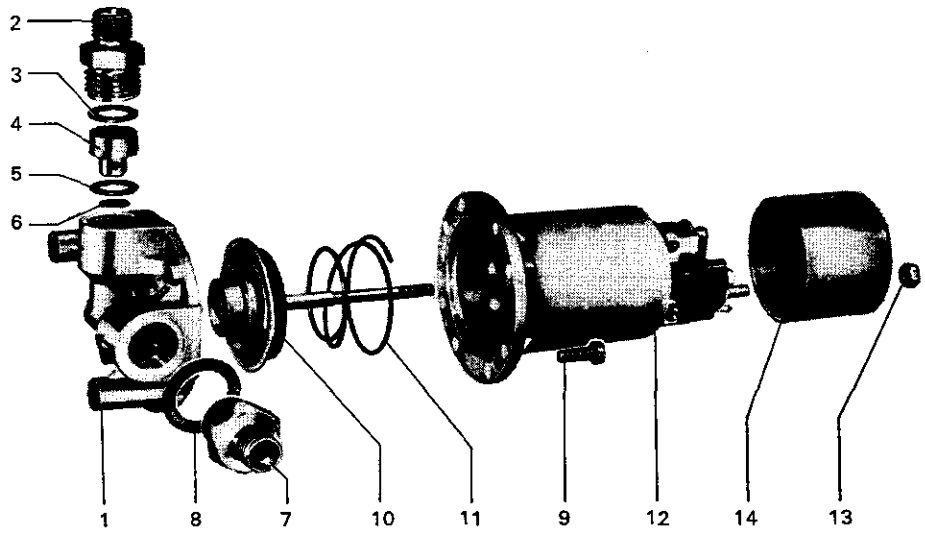
Metering pump

Always make sure that pump is installed horizontally. Otherwise the quantity of fuel delivered will change.



(Installation in Type 1/Model 181)

Fuel pump



No.	Description	Qty.	Note when disassembling	Note when assembling	Special instructions see
1	Pump body	1		pump must be installed in vehicle with outlet union at top (arrow points outward)	F 3.5/2
2	Outlet union (pressure side)	1	12 mm wrench; look for damage; spherical surface must be smooth; outlet union has smaller drilling and is smaller across flats than intake union	if pump clatters, unscrew union nut and moisten outlet union with fuel; when assembling, ensure that inlet union and outlet union are not mistaken	F 3.3/2
3	Seal	1			
4	Pressure valve	1	make sure valve is not dirty		
5	Seal	1			
6	Suction valve	1	if pump clatters after moistening with fuel, suction valve is tilted and jammed	ensure that suction valve is in correct position	F 3.3/2
7	Inlet union	1	17 mm wrench; look for damage; spherical surface must be smooth; intake union has larger drilling and is larger across flats than outlet union		F 3.6/1
8	Seal	1			
9	Screw	4			

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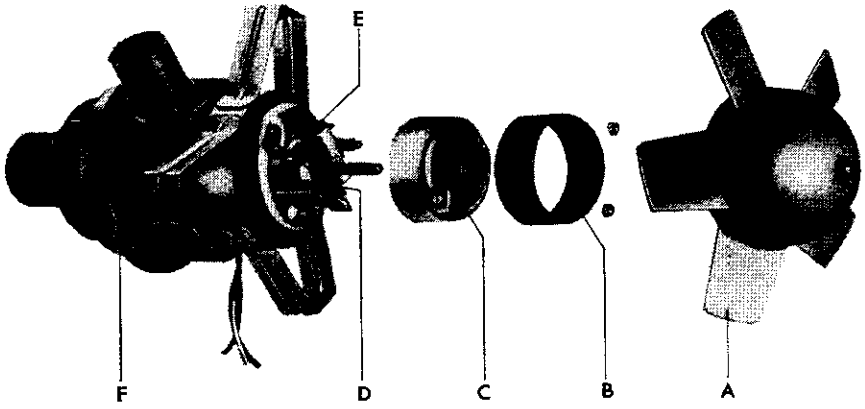
No.	Description	Qty.	Note when		Special instructions see
			disassembling	assembling	
10	Diaphragm unit	1	unscrew counter-clockwise	delivery quantity adjustment: screw diaphragm unit in as far as possible, then back off 2½ turns; the diaphragm also acts as seal between pump and winding housing, therefore make sure that the diaphragm is correctly positioned	F 3.3/2
11	Spring	1		ensure that spring is correctly installed	
12	Winding housing	1	vent hole must not be blocked	pump and winding housings as screwed together so that vent hole is opposite outlet union	F 3.3/2
13	Nut	2			
14	Bakelite cap	1			

Disassembling and assembling combustion air blower

The breaker points in the combustion air blower are replaceable so that the complete blower assembly does not have to be replaced.



A – Fan
C – Cover
E – Condenser
B – Seal
D – Breaker points
F – Blower motor

1 – Screw an M 4 screw into hole in center of fan and press off.

2 – Remove seal and take cover off.

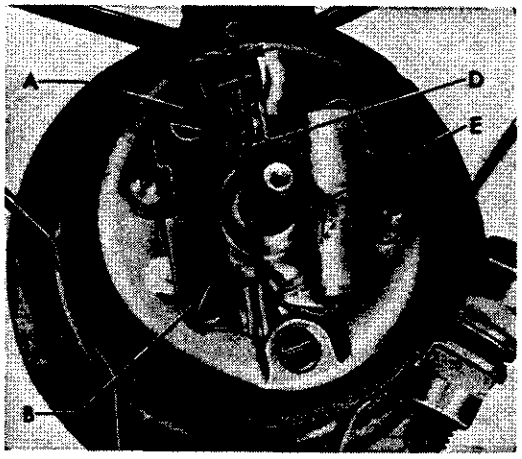
3 – Unsolder the condenser and wire to ignition coil at breaker points.

4 – Remove securing screw and clamp screw and take breaker points out.

5 – Install new breaker points so that projection in contact carrier is pretensioned against end plate.

6 – Turn cam on motor shaft against insulating strip and set breaker point gap to .014–.02 in. (0.35–0.5 mm). Tighten securing screw and clamping screw and seal with paint. The contact pressure should be about 180 grams.

7 – Lubricate cam and insulating strip with multi-purpose grease. Grease must not contact the breaker point surfaces.



A – Securing screw
B – Clamping screw
C – Gap of 0.14–.02 in. (0.35–0.5 mm)
D – Projection on contact carrier
E – Cam and insulating strip

8 – Solder condenser and cable to ignition coil. The connecting cable between condenser and breaker points must have a gap of at least .08 in. (2 mm) between end plate, condenser clamp and cover. It is advisable to replace the condenser when replacing the breaker points.

9 – When assembling, ensure that the seal covers the joint between cover and motor.

Testing:

Warning

When using the following test procedure, disconnect wires to fuel pump and glow plug (see F 3.3/1).

Insert a screw into spark plug connector and hold screw about 7 mm (.3 in.) from ground at a motor speed of 5,000 rpm. A continuous spark must jump to ground.

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Section H
Transmission
Rear
Suspension

General data	1584 ccm (96.6 cu in.) engine

Performance

Engine output DIN	48 PS at 4000 rpm
Engine output SAE net	46 bhp at 4000 rpm
Maximum torque DIN	10.2 mkg at 2000 rpm
Maximum torque SAE net	72 lb ft at 2000 rpm
Maximum speed	72 mph
Hill climbing ability (with two occupants on good reads)	
1st gear	approx. 41.5 %
2nd gear	approx. 21.5 %
3rd gear	approx. 12 %
4th gear	approx. 7.2 %

Dimensions and weights

Wheelbase	2400 mm (94.5 in.)
Track, rear	1385 mm (54.5 in.)
Rear axle load (unladen):	530 kg (1166 lbs)
Gross rear axle load	800 kg (1760 lbs)

Transmission ratios (and number of teeth)

1st gear	3.78 (9:34)
2nd gear	2.06 (17:35)
3rd gear	1.26 (23:29)
4th gear	0.93 (58:54)
Reverse	3.79 (12:17 x 15:40)

Final drive ratios (and number of teeth)	4.125 (8:33)

Oil capacity

Transmission and final drive	
Initial filling	6.3 US pt. (5.3 Imp. pt.)
At changes	5.3 US pt. (4.4 Imp. pt.)
	Hypoid transmission oil SAE 80/90 (MIL-L-2105 B specification)

Code letters

Stamped in front of transmission number	AV

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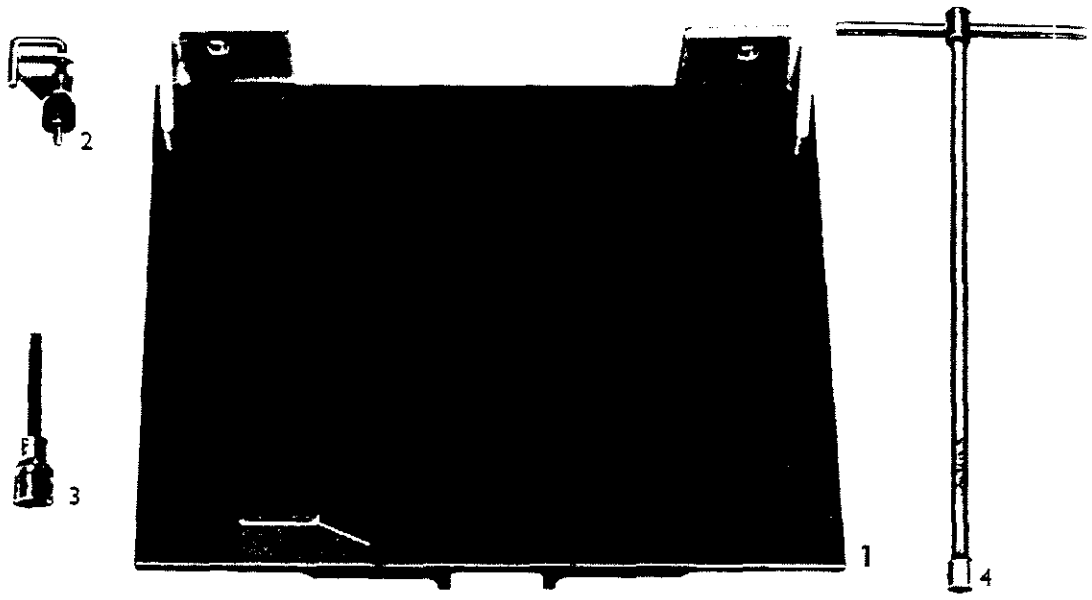
Location	Description	Thread	Grade	mkg	lb ft
Transmission and final drive					
Engine/transmission	nut	M 10 x 1.5	8 G	3.0	22
Bearing retainer	nut	M 10 x 1.5	10 K	5.0	36
Transmission/housing	retaining nut	M 80 x 1	Ca 35	22.0*)	160*)
Gear carrier/housing	nut	M 8 x 1.25	6 G	2.0	14
Final drive covers	nut	M 8 x 1.25	8 G	3.0	22
Shift housing/gear carrier	nut	M 7 x 1	6 G	1.5	11
Tapered roller bearing/pinion	round nut	M 35 x 1.5	C 35 N	20.0	144
Ring gear	bolt	M 10 x 1.5	10 K	6.0	43
Selector shaft/fork	bolt	M 8 x 1.25	C 45 KN	2.5	18
Support/reverse lever	nut	M 10 x 1.5	8 G	3.5	25
Bushing/clutch operating shaft	lock bolt	M 6 x 1	8 G	1.0	7
Oil filler hole	plug	M 24 x 1.5	M b K 6	2.0	14
Oil drain hole	magnetic plug	M 24 x 1.5	M b K 6	2.0	14
Rear axle					
Rear wheel or axle shaft	slotted nut	M 24 x 1.5	C 45 KN	35.0	253
Spring plate	nut	M 12 x 1.5	10 K	11.0	80
Control arm	socket head screw	M 14 x 1.5	C 45	12.0	87
Wheel on brake drum	bolt	M 12 x 1.5	CK 35	10.0	72
Spring plate cover	bolt	M 10 x 1.5	8 G	3.5	25
Shock absorber/control arm	nut	M 12 x 1.5	8 G	6.0	43
Shock absorber/frame	nut	M 12 x 1.5	8 G	6.0	43
Bearing cover/wheel bearing	bolt	M 10 x 1.5	8 G	6.0	43
Transmission mounting					
Drive shaft	socket head screw	8 x 1.25	10 K	4.5	32
Transmission carrier/frame	fitted bolt	M 18 x 1.5	8 G	23.0	166
Front transmission mounting/frame	nut	M 10 x 1.5	10 K	3.5	25
Front transmission mounting/shift housing	nut	M 10 x 1.5	8 G	3.5	25
Transmission carrier/rear bonded rubber mounting	nut	M 8 x 1.25	6 G	2.0	14
Rear bonded rubber mounting/ transmission housing	nut	M 8 x 1.25	6 G	2.0	14

*) tighten to 22.0 mkg (160 lb ft), loosen, tighten finally to 22.0 mkg (160 lb ft)



No.	Description	Tool No.	Remarks
1	Engine adapter	VW 612/2	
2	Clamp for fuel hose	—	
3	Multi-point socket wrench	US 1038	100 mm (4.0 in.) long
4	T-handle wrench	VW 114	

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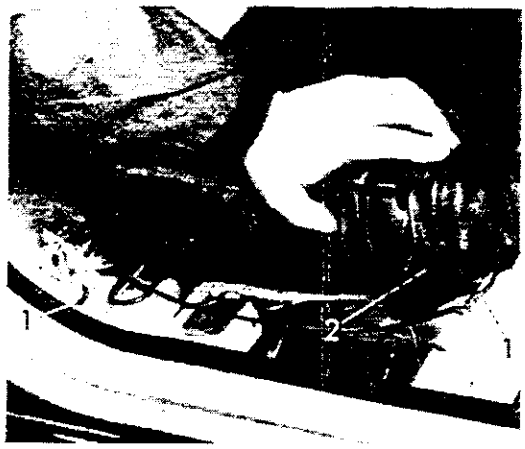


Fig. 1

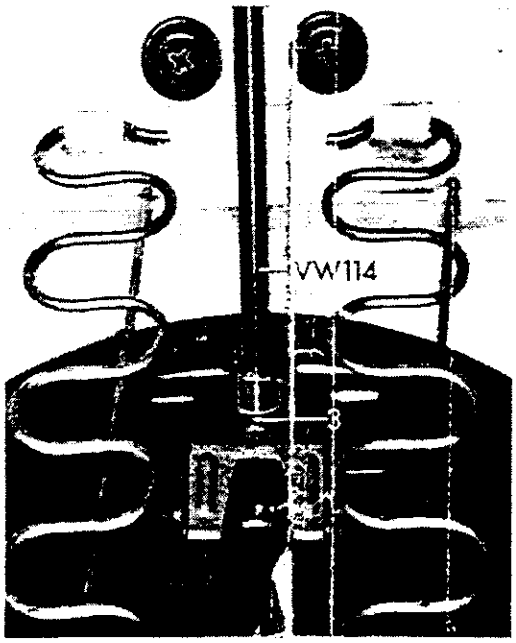


Fig. 2

Fig. 3

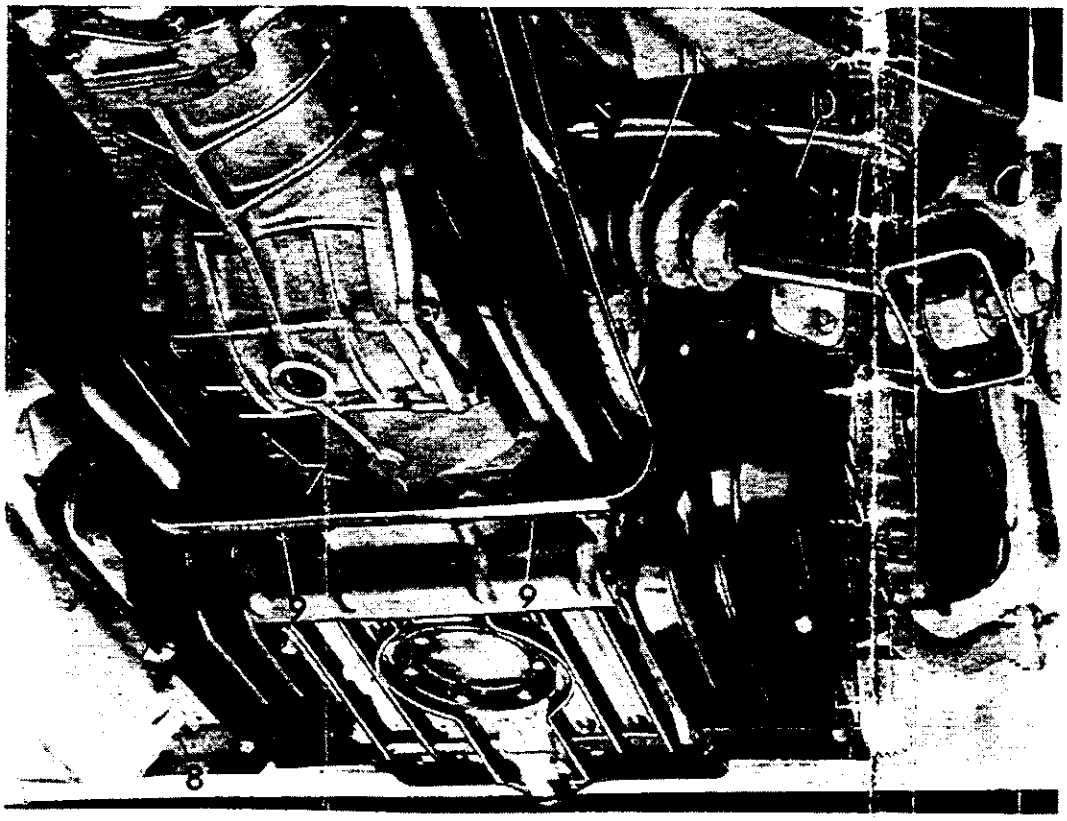


Fig. 4

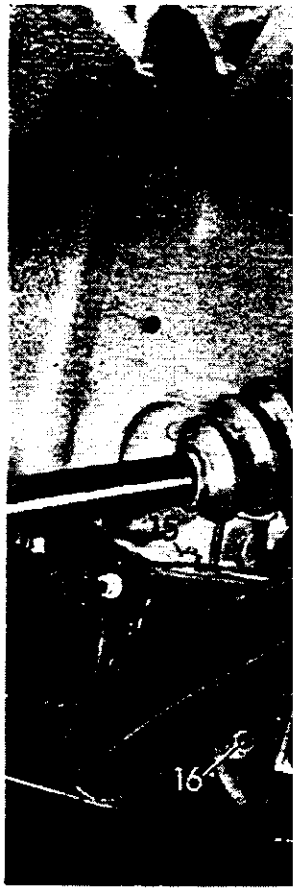
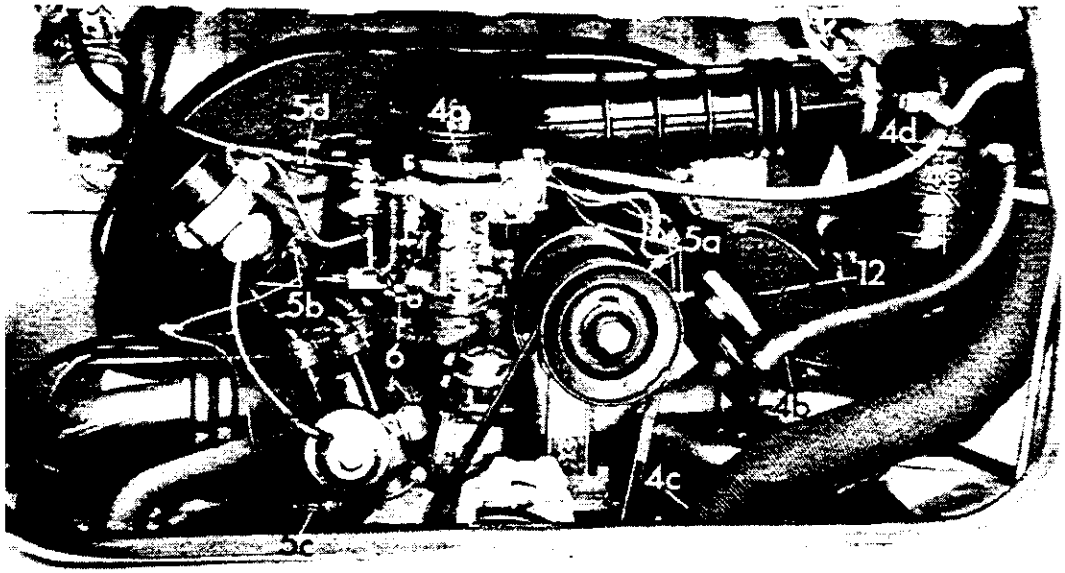
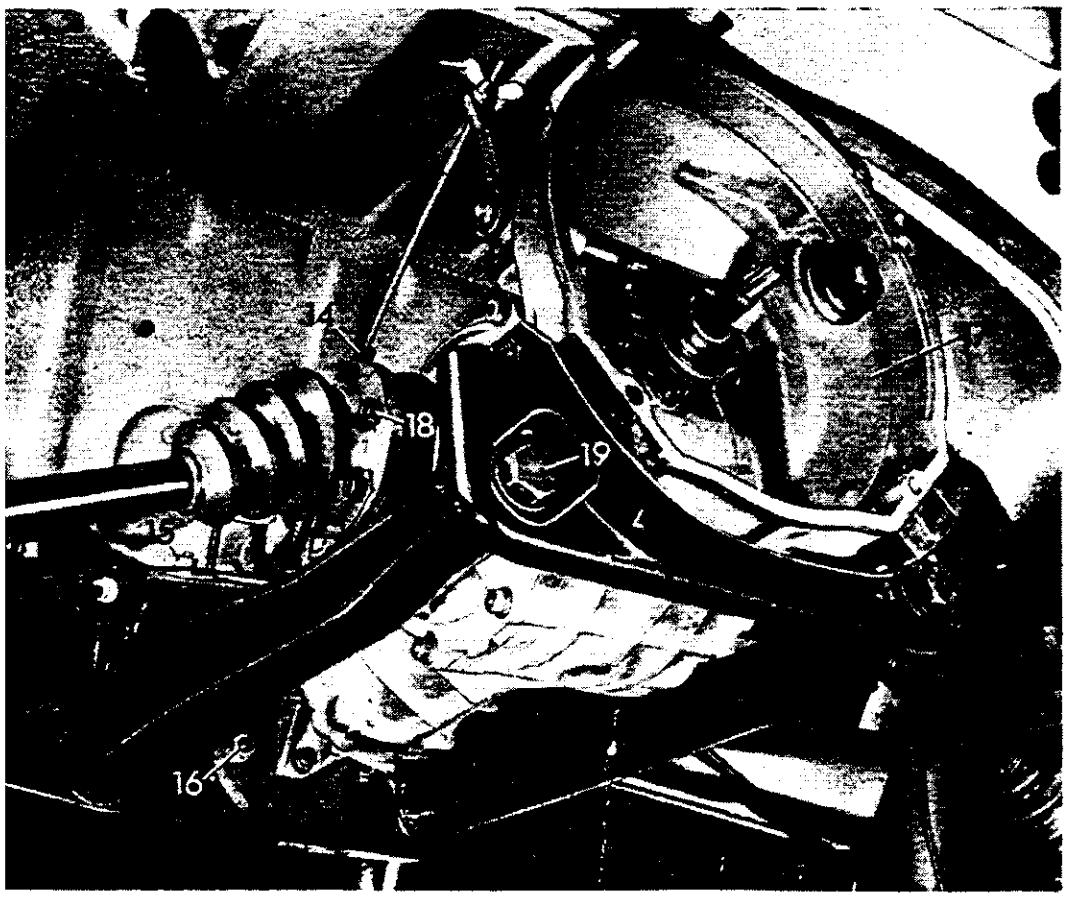


Fig. 5

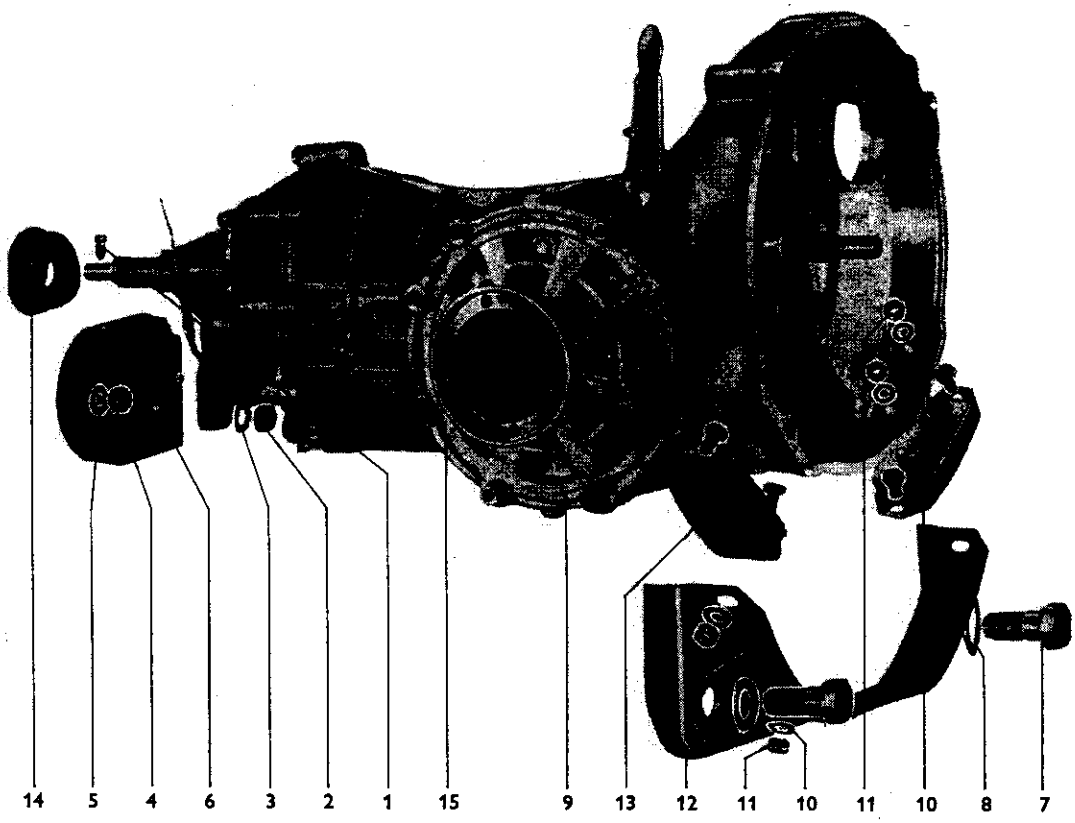


ig. 3

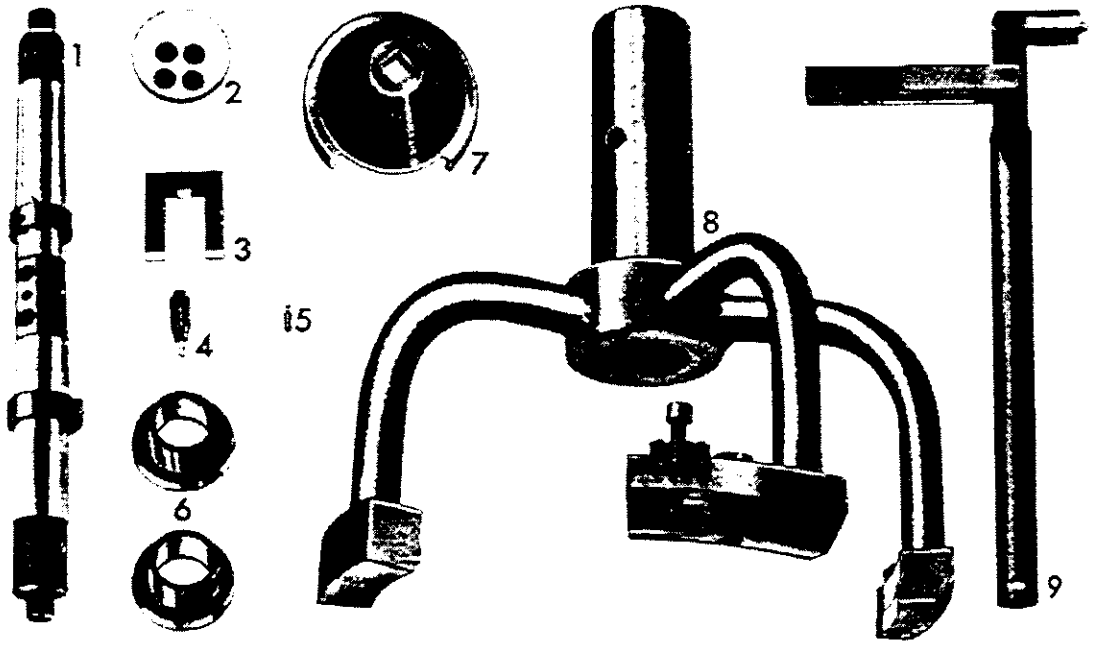


ig. 5

No.	Description	Qty.	Note when removing	Note when installing	Special instructions see
1	Rear seat	1	unhook springs		Fig. 1
2	Battery ground strap	1	disconnect	connect	Fig. 1
3	Square headed bolt	1	loosen with VW 114	tighten with VW 114	Fig. 2
4	Oil bath air cleaner	1	remove	install	Fig. 3
	a) clamp	1	loosen	tighten	
	b) breather hose	1	pull off	install	
	c) preheating hose	1	pull off	install	
	d) vacuum hose	1	pull off	install	
	e) clamp	1	loosen	tighten	
5	Electrical wiring				Fig. 3
	a) on generator	4	disconnect	connect	
	b) on ignition coil	2	disconnect	connect	
	c) oil pressure switch	1	disconnect	connect	
	d) backup light	1	disconnect	connect	
6	Accelerator cable	1	disconnect	to adjust, depress gas pedal all way down. Pull cable all way back and clamp on throttle lever 1 mm (0.04 in.) before full throttle position	Fig. 3
7	Nut of engine mounting bolt	2	loosen	tight to 3.0 mkg (20 lb ft)	Fig. 4
8	Clamp for tail pipe	2	loosen and remove pipes	install pipes and tighten	Fig. 4
9	Protection plate bolts	2	remove	tighten nuts to 2.0 mkg (14 lb ft)	Fig. 4
10	Fuel hose	1	pull off and plug with VW 647	install	Fig. 4
11	Nut of engine mounting bolt	1	loosen	tighten to 3.0 mkg (20 lb ft)	Fig. 4
12	Nut of engine mounting bolt	1	loosen and remove engine with adapter VW 612/2	tighten to 3.0 mkg (20 lb ft)	Fig. 3
13	Clutch adjusting nut	1	remove	install and adjust to correct clutch pedal play	Fig. 5
14	Clutch cable guide tube bracket	1	remove	tighten nuts to 3.0 mkg (20 lb ft)	Fig. 5
15	Transmission ground strap	1	remove	tighten nuts to 3.0 mkg (20 lb ft)	Fig. 5
16	Nuts for bonded rubber mounting	2	remove	tighten to 3.5 mkg (23 lb ft)	Fig. 5
17	Nuts of starter terminal	1	remove and detach starter		Fig. 5
18	Socket head bolts of drive shafts	12	remove	tighten to 4.5 mkg (33 lb ft)	Fig. 5
19	Bolts of transmission carrier	2	remove	tighten to 23.0 mkg (166 lb ft)	Fig. 5



No.	Description	Qty.	Note when removing	Note when installing	Special instructions see
1	Square head bolt	1	remove with VW 114	lock with wire	
2	Nut	2		tighten to 3.5 mkg (23 lb ft)	
3	Lock washer	2			
4	Nut	2		tighten to 3.5 mkg (23 lb ft)	
5	Lock washer	2			
6	Bonded rubber mounting	1			
7	Bolt	2		tighten to 23 mkg (166 lb ft)	
8	Lock washer	2			
9	Bolt	4		tighten to 2.0 mkg (14 lb ft)	
10	Lock washer	8			
11	Nut	8		tighten to 2.0 mkg (14 lb ft)	
12	Transmission carrier	1			
13	Bonded rubber mounting	2			
14	Bellows	1			
15	Transmission	1			



No.	Description	Special Tool	Remarks
1	Universal measuring bar	VW 385/1	
2	Measuring plate	VW 385/17	
3	Setting gauge	VW 385/9	
4	Measuring pin	VW 385/14	
5	Dial indicator extension	VW 385/15	
6	Centering disc (2)	VW 385/2	
7	Socket	VW 381/14	
8	Holding fixture	VW 307 a	
9	Lever	VW 296	

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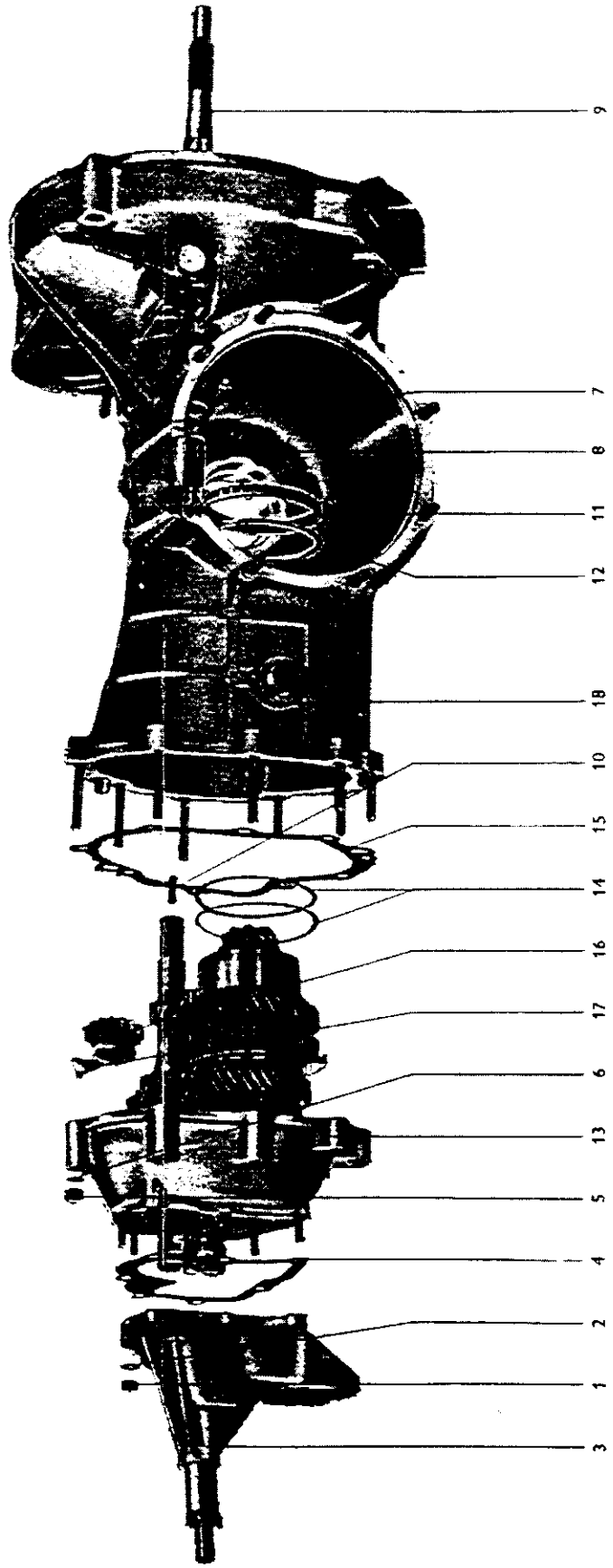
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Note: Before the gear train can be removed, the differential must be removed, (see H 5.1/11)

No.	Description	Qty.	Note when disassembling	assembling	Special instructions see
1	Nut M 7 x 1	7	loosen	tighten to 1.5 mkg (10 lb ft)	
2	Spring washer	7			
3	Shift housing	1	detach	when installing make sure that inner shift lever is positioned correctly	Fig. 4 H 3.1/15-1
4	Gasket, shift housing	1		replace	
5	Nut	9	loosen	tighten to 2.0 mkg (14 lb ft)	
6	Spring washer	9			
7	Circlip	1	remove	replace	
8	Reverse sliding gear	1			
9	Drive shaft rear	1	unscrew front and rear part of drive shaft	screw the two parts together as far as possible first and then loosen until the splines for reverse sliding gear are in line.	Fig. 1
10	Stud M 6	1			
11	Retaining nut	1	loosen with VW 381/14; If the double tapered roller bearing or/and the transmission housing must be replaced the position of the drive pinion in the transmission case must be determined before removing. On installation make sure that the drive pinion is in the same position as determined before.	tighten with VW 381/14 to 22.0 mkg (160 lb ft), loosen, tighten finally to 22.0 mkg (160 lb ft)	Fig. 3
12	Shim	1			
13	Gear carrier, assembly	1	press out with VW 296	align the double tapered roller bearing first to housing, then drive on drive pinion by using a plastic hammer. When doing this, turn the reverse gear shaft, so that the gear can slide on the splines of the shaft.	Fig. 2
14	Shims "Ss"	x	note thickness	measure again if necessary	
15	Gasket	1		replace	
16	Reverse gear on drive pinion	1		lubricate lighly	
17	Shift fork	1			
18	Transmission case	1	if case is to be replaced, first determine position of drive pinion in case	if replacing case adjust drive pinion and ring gear	H 3.1/13

Disassembling

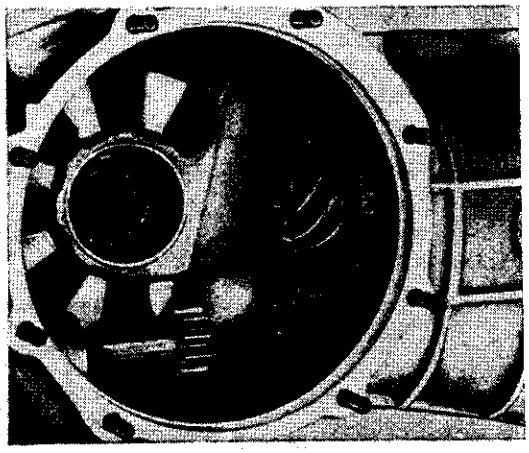


Fig. 1

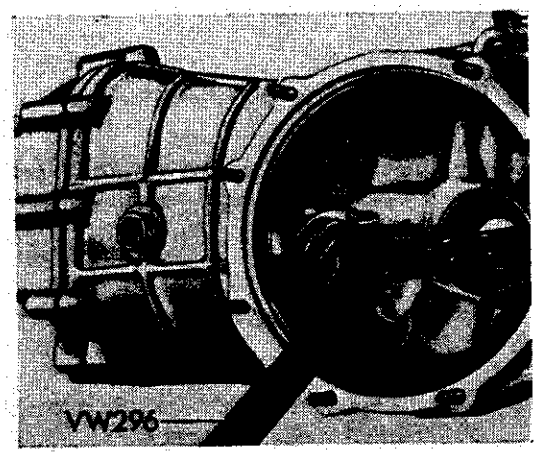


Fig. 2

Assembling

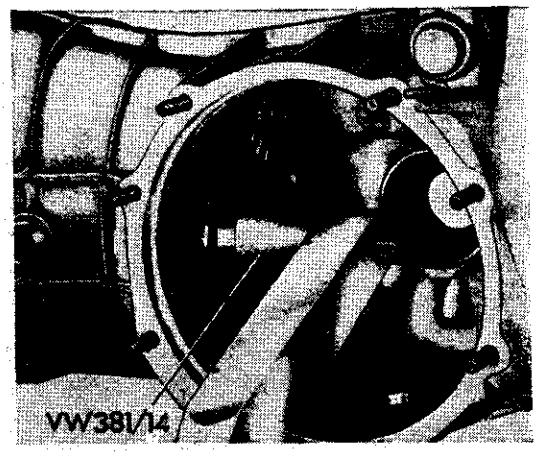


Fig. 3

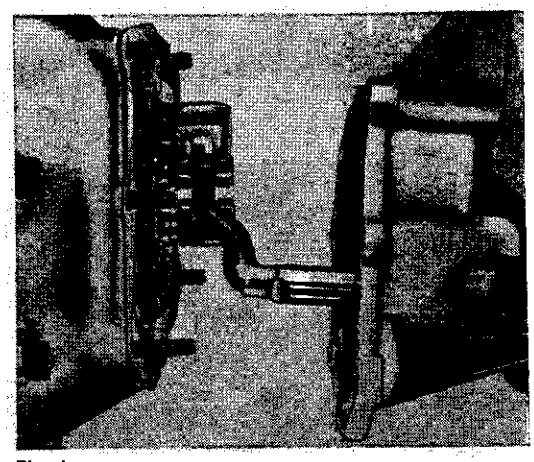


Fig. 4

Determining position of drive pinion

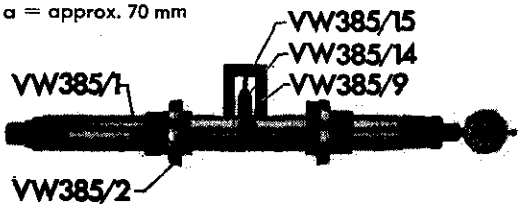
This operation is necessary if the dimension "r" is not marked on the ring gear and the double tapered roller bearing or transmission case must be replaced.

If the drive pinion and ring gear must be replaced adjust according to instructions as given in H 5.1/13.

1 - Disassemble transmission without removing drive pinion.

2 - Set the ring on the universal measuring bar VW 385/1 to dimension "a".

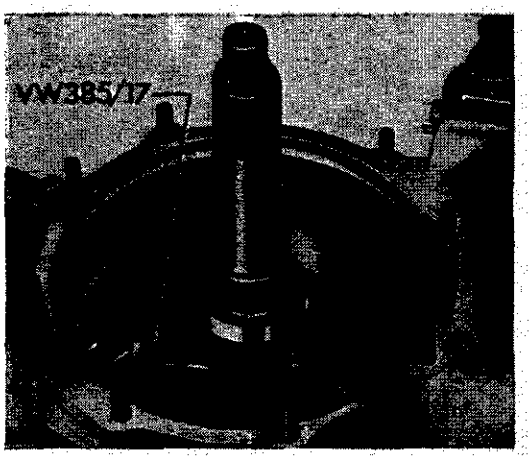
a = approx. 70 mm



3 - Place setting gauge VW 385/9 (Ro = 58.70 mm) on the bar and zero dial indicator (3 mm range) with 1 mm preload.

Note

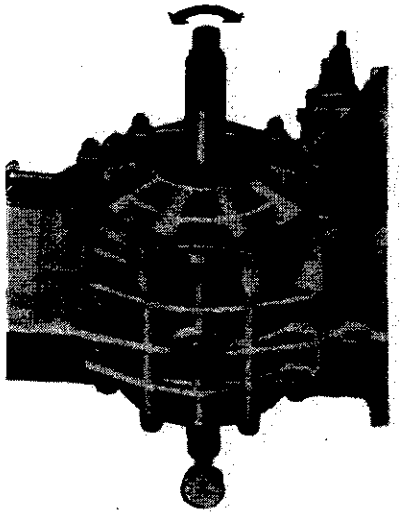
Move the sliding ring back to the stop.



4 - Place measuring plate VW 385/17 on end of drive pinion and insert universal measuring bar.

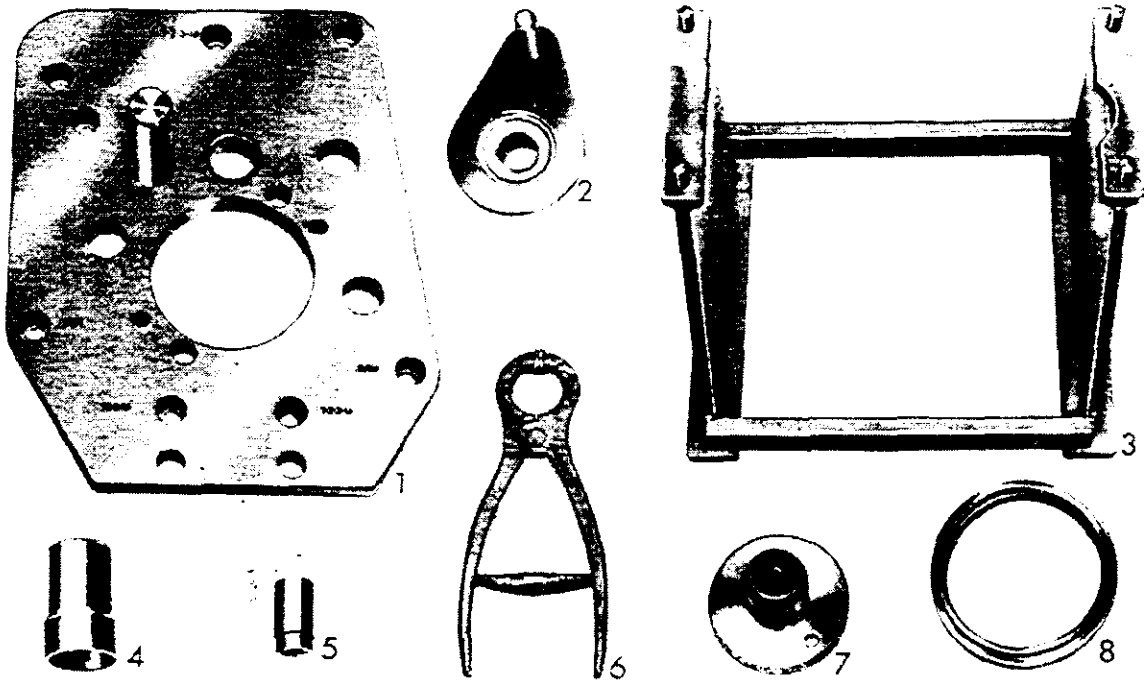
5 - Install cover, tighten nuts to correct torque.

6 - Push the setting ring of the second centering disc outward until the bar can just be turned by hand.

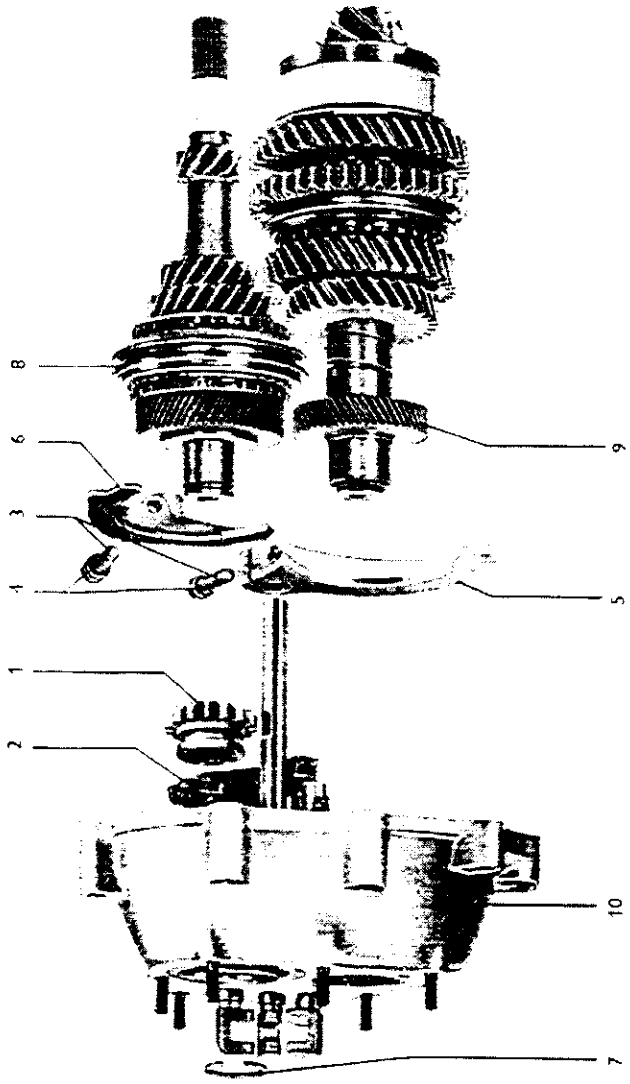


7 - Turn the bar until the dial indicator pin contacts the measuring plate on the drive pinion and the dial indicator pointer reaches the return point.

8 - Note the determined dimension. When assembling the transmission (especially after replacement of double tapered roller bearing or case), the drive pinion position must be within ± 0.04 mm (0.001 in.) of the determined dimension.



No.	Description	Special Tool	Remarks
1	Setting appliance	VW 294 b	
2	Crank	VW 294	
3	Support	VW 456	
4	Adapter	VW 454	
5	Arbor	VW 434	
6	Circlip pliers	VW 161 a	
7	Thrust disc	VW 412	
8	Retaining ring	VW 294 a/10	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No.	Description	Qty.	Note when disassembling	Note when assembling	Special instructions see
1	Reverse sliding gear	1		oil when installing	H 3.1/8-2
2	Shifting fork	1			
3	Bolt	2	loosen	tighten to 2.5 mkg (18 lb ft)	
4	Spring washer B 6	2			
5	Shifting fork 1st/2nd gear	1	pull selector shaft back, remove fork and shift in neutral	adjust with VW 294 b	Fig. 2 H 3.1/9-4
6	Shifting fork 3rd/4th gear	1	slide off selector shaft	adjust with VW 294 b	H 3.1/9-3
7	Circlip	1	remove with VW 161 a	install with VW 161 a squeeze all around with waterpump pliers for proper seating.	H 3.1/9-3 Fig. 1 Fig. 3
8	Drive shaft, assembly	1	press out of gear carrier with VW 412, VW 434 and VW 456. When doing this, guide the shaft and drive pinion carefully to avoid damage to the teeth. Also make sure that the shifting fork for 3rd/4th gear does not jam.	press in with VW 412, VW 454 and VW 401. Guide shaft and drive pinion carefully to avoid damage to the teeth. Also make sure that the 3rd/4th gear shift fork is positioned correctly.	H 3.1/9-3 Fig. 3 Fig. 4
9	Drive pinion, assembly	1			
10	Gear carrier	1			

Removing

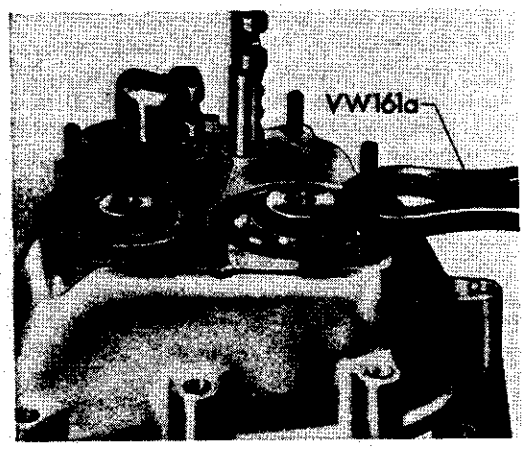


Fig. 1

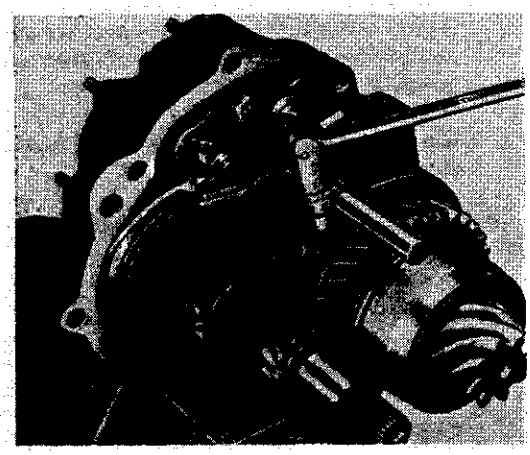


Fig. 2

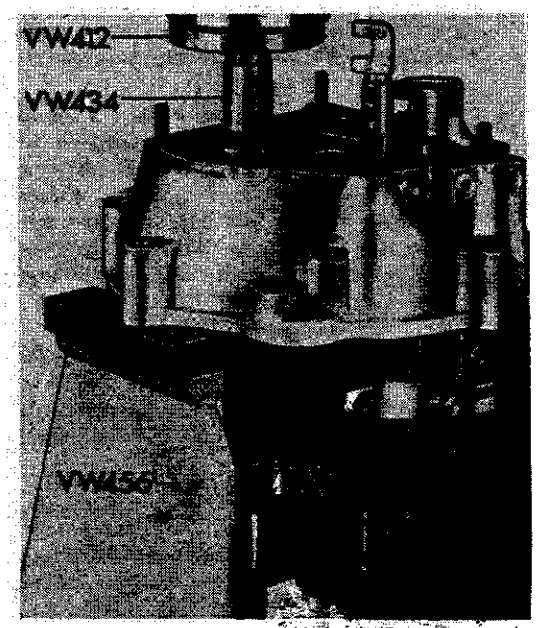


Fig. 3

Installing

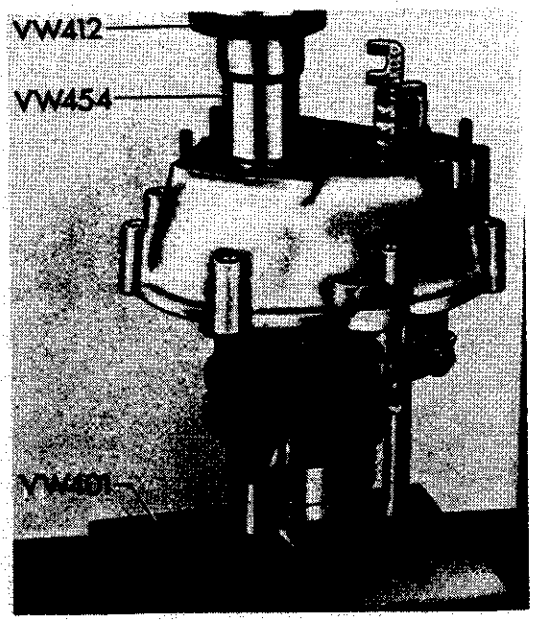


Fig. 4

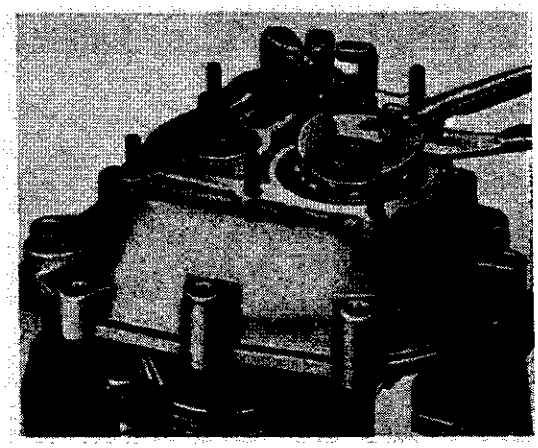
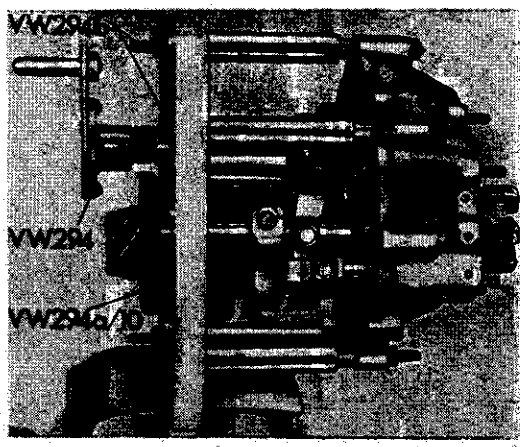


Fig. 5

1 - The shift forks can only be adjusted properly with the setting appliance VW 294b. The pinion and drive shaft must be fitted in the appliance in exactly the same position as they will later be in the transmission case. To achieve this, the setting shim "S 3" for the axial location of the pinion must be determined before and installed in the appliance. The paper gasket must not be used between the gearshift housing and the spacer sleeves of the appliance.



2 - Install gear carrier assembly without **gasket,** drive pinion with **shim,** drive shaft, and reverse gear with four nuts in appliance VW 294b. Tighten retaining ring VW 294a/10 on drive pinion head.

Caution

The shift fork for 1st/2nd gears (wider fork) is installed with the profile towards the gear carrier. The profile of the 3rd/4th gear fork, however, is away from the gear carrier.

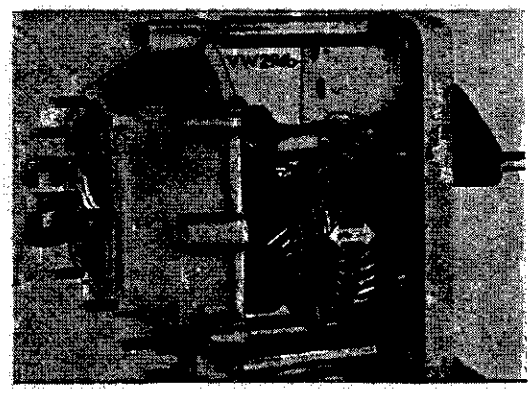
3 - Install shift fork for 1st/2nd gear and tighten clamp bolt.

4 - Locate lower selector shaft (for 1st/2nd gear) in the notch for 2nd gear. Slide operating sleeve with fork over the coupling teeth until it is against the 2nd gear.

Centralize the shift fork in the groove in the operating sleeve and tighten clamp bolt.

Caution

The shift forks must not rub or exert pressure on the sides of the groove in the operating sleeve when in neutral or when a gear is engaged. **There must always be clearance.**



5 - Select 1st/2nd gears and neutral several times while turning the transmission and check clearance between shift fork and operating sleeve in each position. If necessary, alter the shift fork position until there is the same clearance between fork and groove in both end positions. Tighten clamp bolt to 2.5 mkg (18 ft lb).

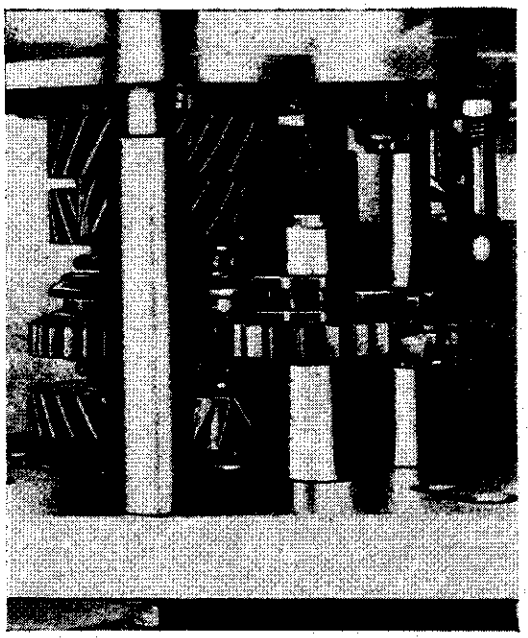
6 - Locate upper selector shaft (for 3rd/4th gears) in the notch for 3rd gear. Adjust fork for 3rd/4th gears in the same way as for 1st/2nd gear. Tighten clamp bolt to 2.5 mkg (18 ft lb).

Caution

For a correct adjustment of 3rd and 4th gears the ball bearing in the gear carrier must be pressed in fully.

7 - Adjust the reverse gear shift fork so that the sliding gear engages fully with the reverse gear of the drive pinion.

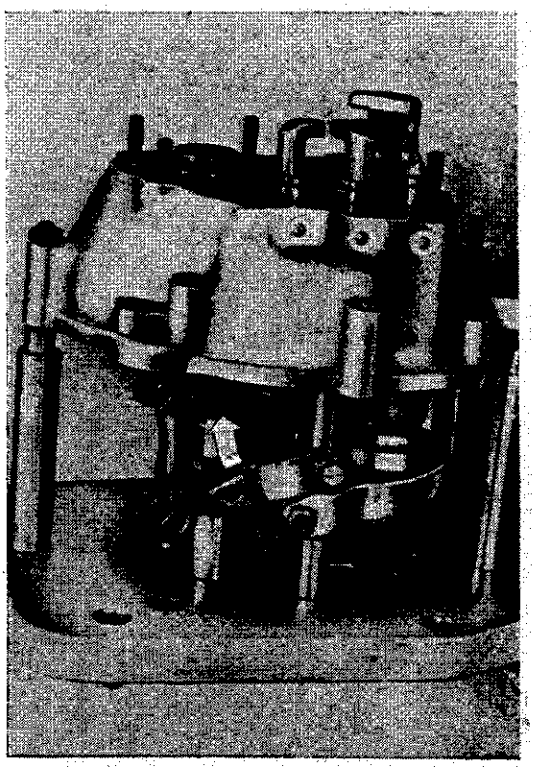
Tighten the bolt in the relay lever guide to 2 mkg (14 ft lb).



Caution

When adjusting the reverse sliding gear, make sure that there is no axial play at the shift fork.

If necessary, loosen support for relay lever and press relay lever in direction of sliding gear (arrow) until only the running clearance remains.



8 - Engage 2nd gear and check clearance of gear and operating sleeve of 1st/2nd gear and 3rd gear on drive shaft. Rectify if necessary.

9 - Check selector shaft interlock. **When a gear is engaged it must not be possible to engage another gear.** The selector shafts are all interlocked one against the other.

Assembling

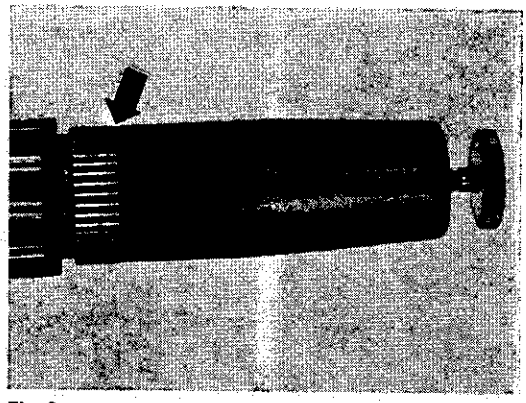


Fig. 3

Slide sleeve over the shaft until it contacts the splines for the synchronizer hub (arrow). This may involve screwing out the knurled thumb screw.

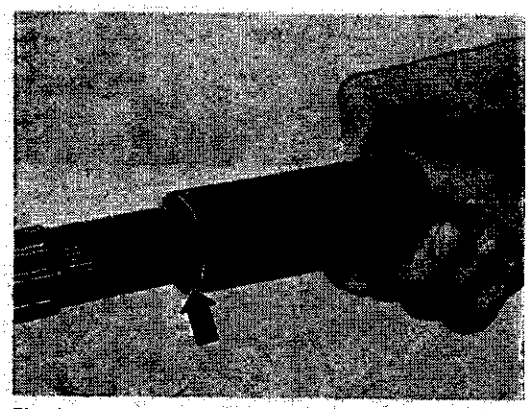


Fig. 4

Place a new circlip into recess of tube and push it along the sleeve and over the splines with the tube until it snaps into the groove.

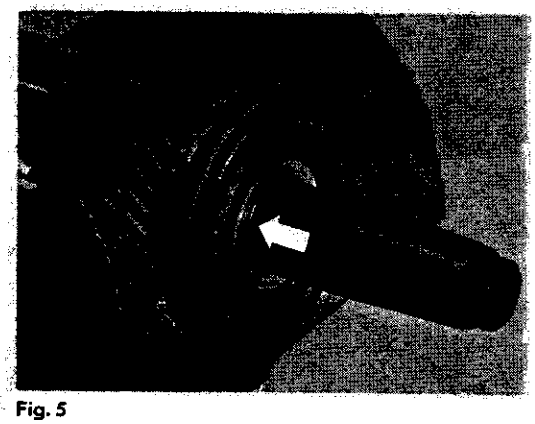


Fig. 5

Slide sleeve over shaft again and screw in the knurled thumb screw until the groove for the circlip is exposed (arrow). Push second circlip on with tube until it engages.

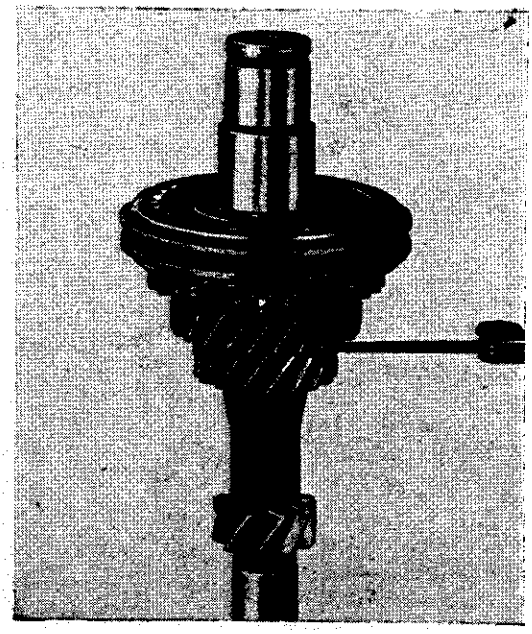


Fig. 6

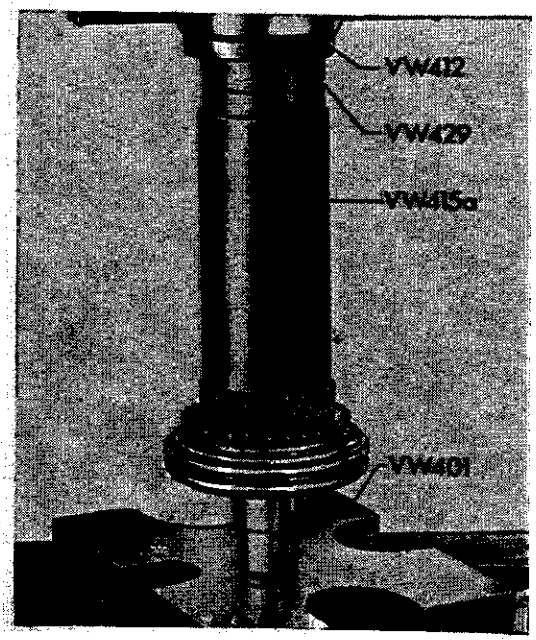
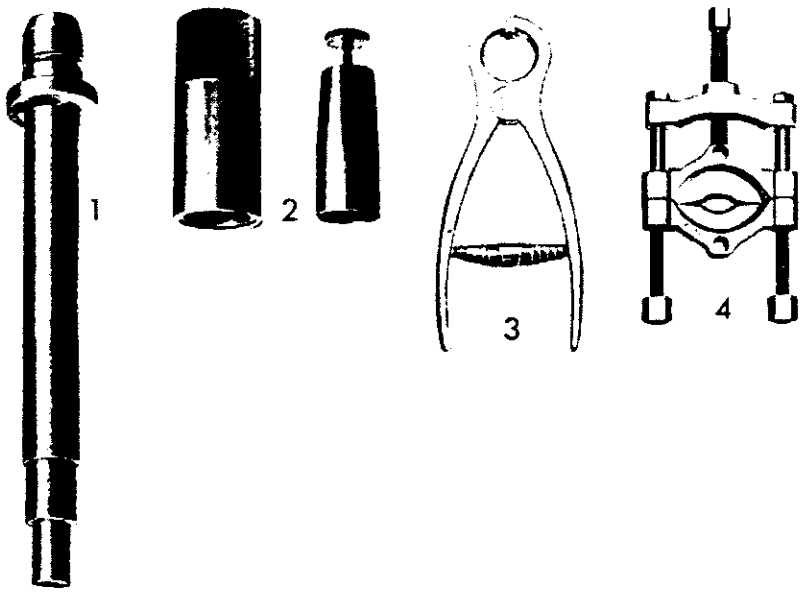


Fig. 7

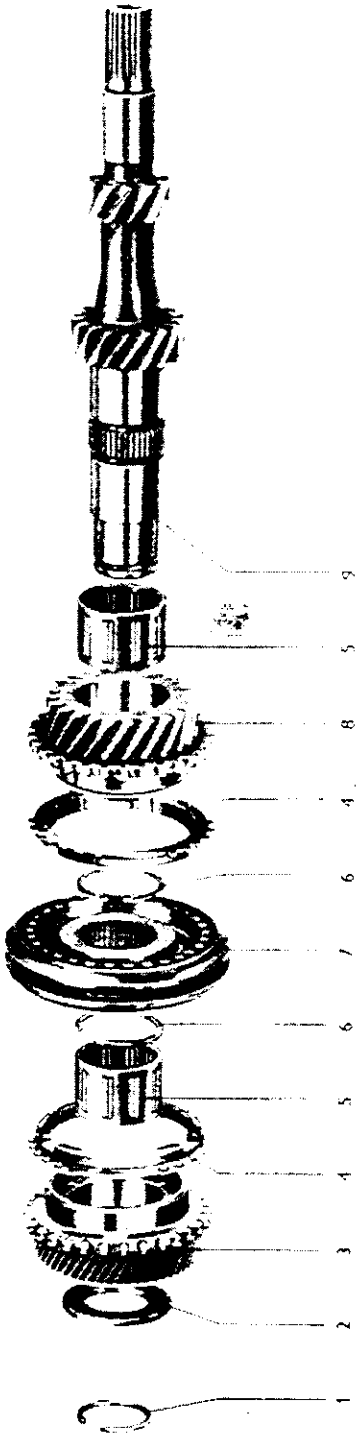


No.	Description	Special Tool	Remarks
1	Punch	VW 408	
2	Assembling tool	VW 284	
3	Circlip pliers	VW 161 a	
4	Separating tool	US 4439	

Disassembling

Fig. 1

Fig. 2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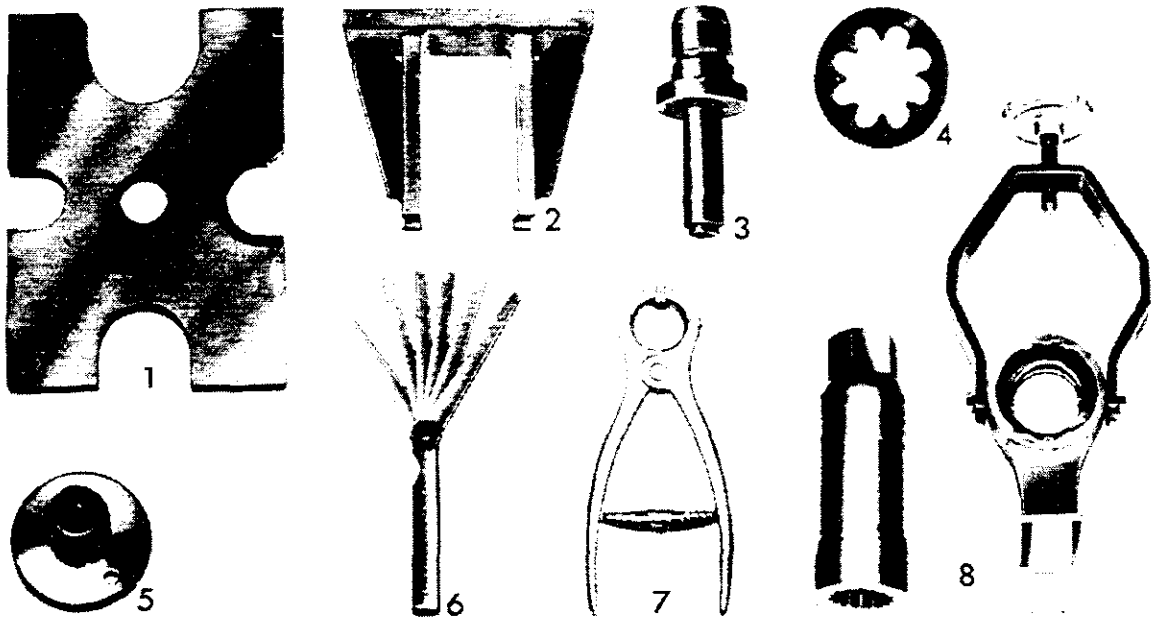
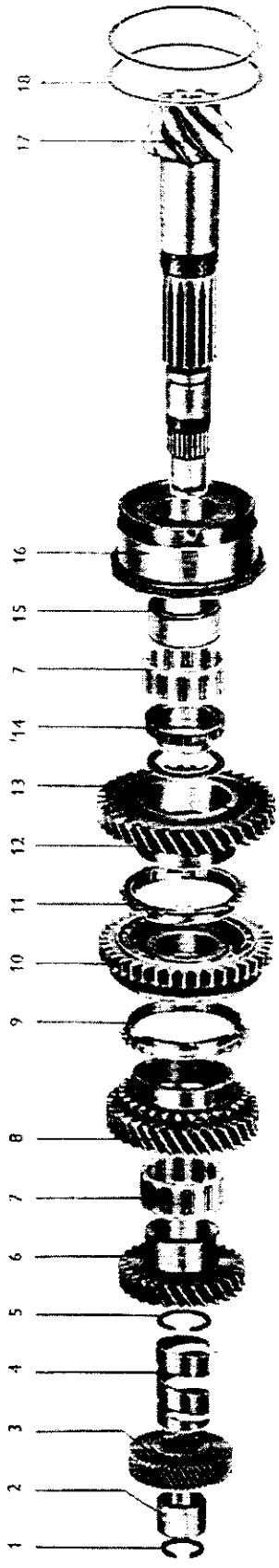
No.	Description	Qty.	Note when removing	Note when installing	Special instructions see
1	Circlip	1	with VW 161 a	squeeze with waterpump pliers for proper seating	
2	Thrust washer, 4th gear	1	check for scoring	warm up	Fig. 1
3	4th gear	1	use VW 408 a and separating tool	replace only as a set	Fig. 1
4	Synchronizer ring, 3rd and 4th gear	2		check for wear	
5	Needle bearing, 3rd and 4th gear	2		use only slotted cages with needles in pairs	
6	Circlip	2	with VW 161 a	with VW 284 check clearance between 2nd and 3rd gear. If clearance is less then 0,15 mm (0.006 in.) press 3rd gear carefully with VW 401, VW 412, VW 415 a and VW 429	Fig. 2 Fig. 3 Fig. 4 Fig. 5 Fig. 6 Fig. 7
7	Synchronizer hub, assembly	1	press off with 3rd gear together	the groove in the hub faces 4th gear the groove in the splines must faces the 3rd gear	
8	3rd gear teeth of gear for Type 1/sedans and Type 3 smaller than teeth of gear for Type 1/Model 181	1	press off with VW 401 and VW 411 together with synchronizer	replace only as a set	3.2/12
9	Drive shaft, front	1			



No.	Description	Special Tool	Remarks
1	Thrust plate	VW 401	
2	Removal device	VW 460/3	
3	Punch	VW 409	
4	Thrust ring	VW 449 f	
5	Punch	VW 412	
6	Feeler gauge	—	
7	Circlip pliers	VW 161 a	
8	Holding fixture	VW 293	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No.	Description	Qty.	Note when disassembling	assembling	Special instructions see
1	Circlip	1	press 4th gear down with VW 460 3 and remove with VW 161 a	install inner race-heated up to about 100 C (212 F) — first and press 4th gear down with VW 460 3. Use VW 161 a.	Fig. 1 Fig. 10 Fig. 11
2	Inner race	1	press off with 4th gear together, use VW 401 and VW 408 a	heat to about 100 C (212 F) and press on with VW 401, VW 412, VW 422	Fig. 2 Fig. 11
3	4th gear	1	press off with inner race together	replace only as a set. The hub must face 4th gear	Fig. 2
4	Spacer spring	1			
5	Circlip, 3rd gear	1	use VW 161 a	use VW 161 a, adjust axial play to 0,1—0,25 mm (0.004—0.010 in.), use feeler gauge	Fig. 9
6	3rd gear teeth of gear for Type 1/sedan and Type 3 smaller than teeth of gear for Type 1/Model 181	1		replace only as a set	
7	Needle cage for 1st and 2nd gear	2			
8	2nd gear	1		replace only as a set if teeth are damaged	
9	Synchronizer stop ring 2nd gear	1		check for wear. Ring has 3 notches around the outer diameter. Do not interchange with synchronizer stop ring for 1st gear.	
10	Synchronizer hub 1st and 2nd gear	1		the hub and the groove must face 2nd gear	
11	Synchronizer stop ring 1st gear	1		check for wear. Do not interchange with ring for 2nd gear.	
12	1st gear	1		replace only as a set if teeth are damaged	
13	Spacer washer	x		adjust axial play to 0.1—0.25 mm (0.004—0.010 in.), use feeler gauge	Fig. 8
14	Round nut	1	loosen with VW 293	replace, tighten in VW 293 to 20.0 mkg (145 lb ft), peen shoulder. Install in transmission case, tighten nut of double tapered roller bearing and check turning torque of bearing.	Fig. 6 H 5.1/13 Fig. 7
15	Inner race	1	press off together with double tapered roller bearing	heat to install, press in position	
16	Double tapered roller bearing	1	press off with VW 401, VW 409 and VW 449 **Note** On gear set — ratio 8:31 — press double tapered roller bearing off **without** using VW 449 f. Use separating tool to press ring off when replacing the bearing, determine first	heat to install, press into position Install in transmission case, tighten nut and check turning torque of bearing. position of drive pinion into transmission case and note. To perform this check it is necessary to install the pinion with the "old" bearing in the case. Also check turning torque.	Fig. 3 Fig. 4 Fig. 5 H 3.1 8
17	Drive pinion	1		replace drive pinion and ring gear only as a set, if a new drive pinion is installed a new adjustment is necessary	H 5.1 13
18	Shim "S"	x	note thickness	install correct shim	

Disassembling and assembling drive pinion Types 1 and 3 from November 1972

Disassembling

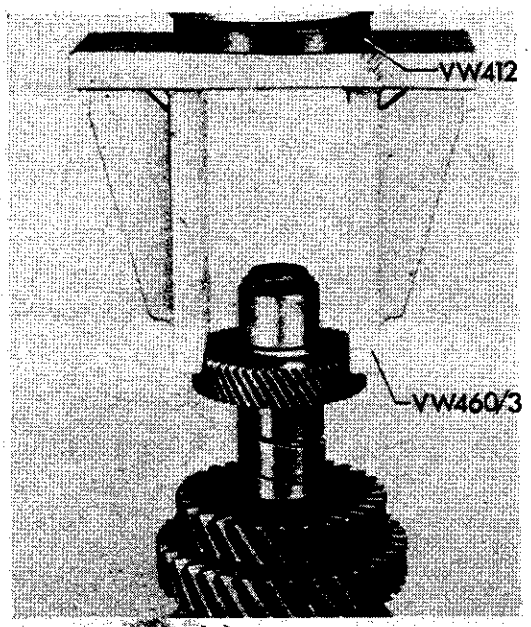


Fig. 1

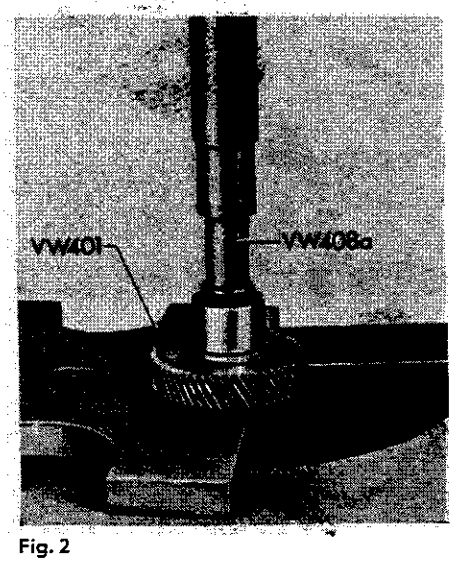


Fig. 2

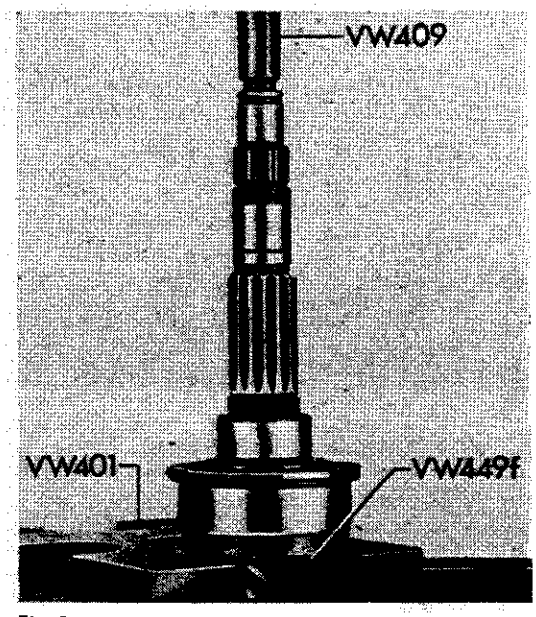


Fig. 3

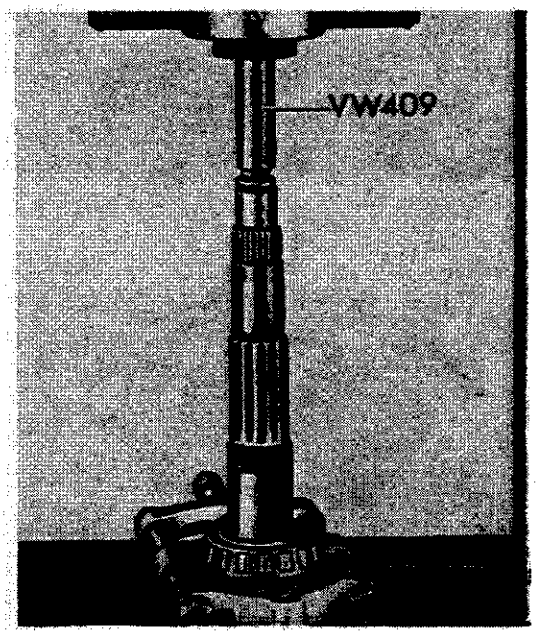


Fig. 4

H 11th Supplement (USA) Printed in Germany 4. 73

Assembling

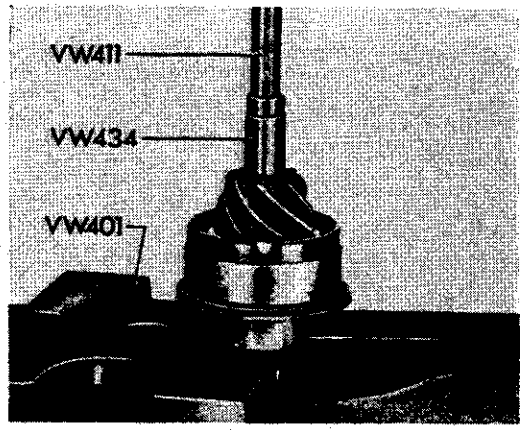


Fig. 5

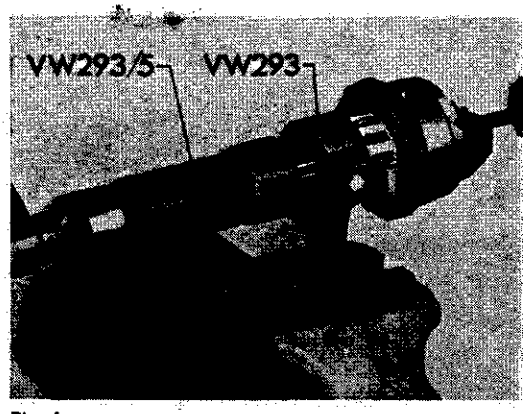


Fig. 6

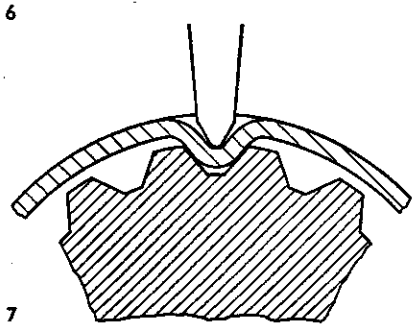


Fig. 7

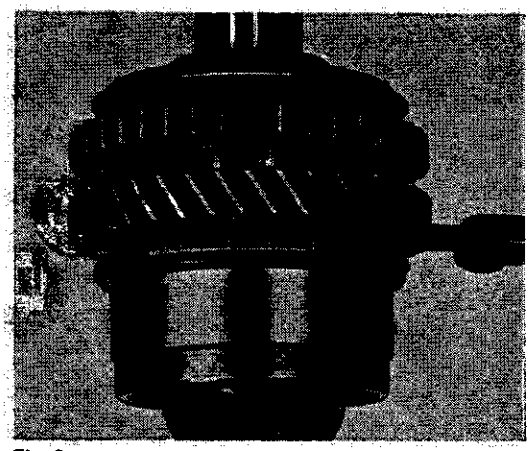


Fig. 8

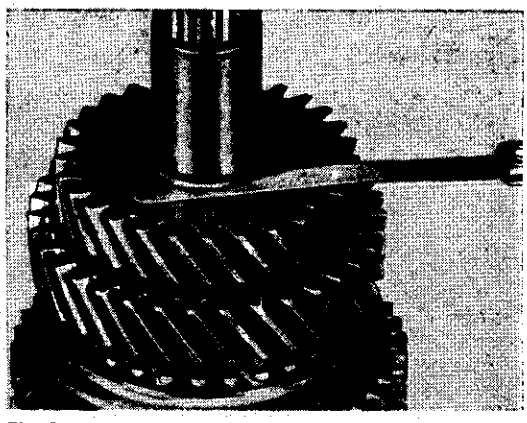


Fig. 9

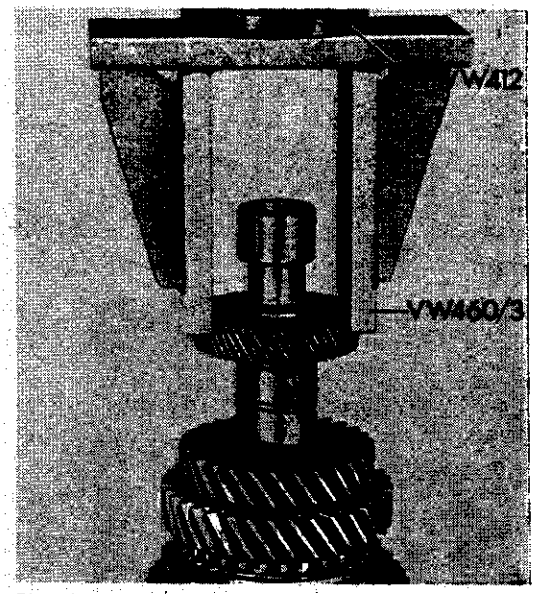


Fig. 10

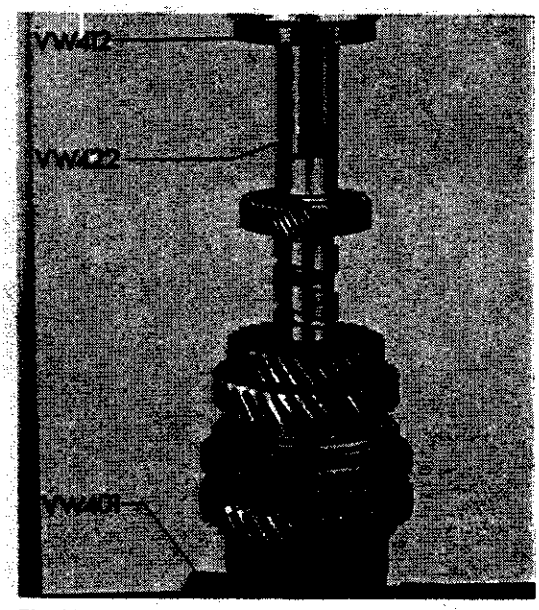
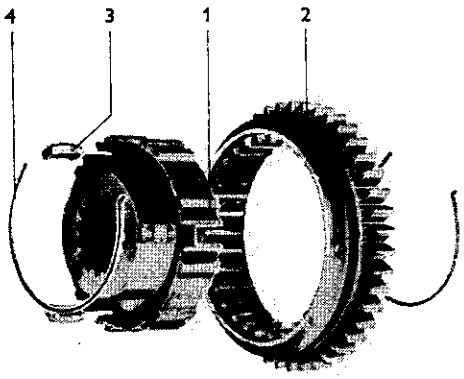
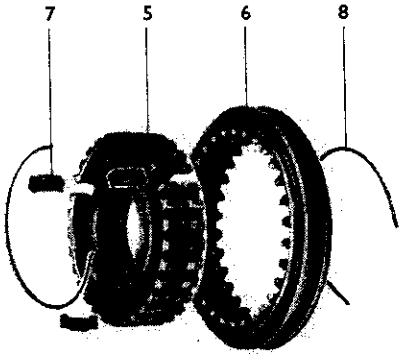


Fig. 11





No.	Description	Qty.	Note when disassembling	Note when assembling	Special instructions see
1	Synchronizer hub, 3rd and 4th gear	1		the side with the groove all around must be on 3rd gear side	Fig. 4
2	Operating sleeve, 3rd and 4th gear	1		the side with the groove all around must be on 4th gear side	Fig. 4
3	Synchronizer key, 3rd and 4th gear	3		note difference of keys for 1st and 2nd gear	
4	Synchronizer key spring 3rd and 4th gear	2		install 120° offset, check tension, the spring ends must fit right over the keys	Fig. 3 Fig. 1
5	Synchronizer hub, 1st and 2nd gear	1		the wider hub is on the 2nd gear side	
6	Operating sleeve, 1st and 2nd gear	1		the slot for the shift fork must be on the 2nd gear side	
7	Synchronizer key, 1st and 2nd gear	3		note difference of keys for 3rd and 4th gear	
8	Synchronizer key spring, 3rd and 4th gear	2		install 120° offset, check tension, the spring ends must fit right over the keys	Fig. 3 Fig. 1

Disassembling and assembling synchronizer units Types 1 and 3 from November 1972
Type 1/Model 181

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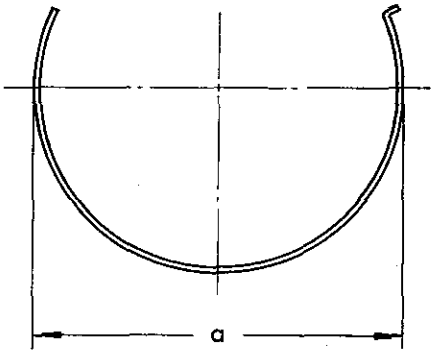


Fig. 1

Fig. 2

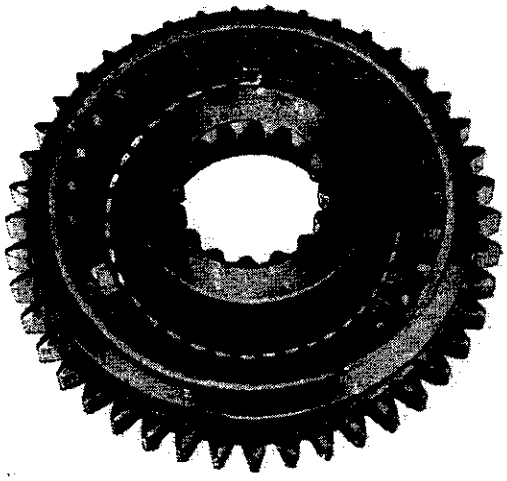


Fig. 3

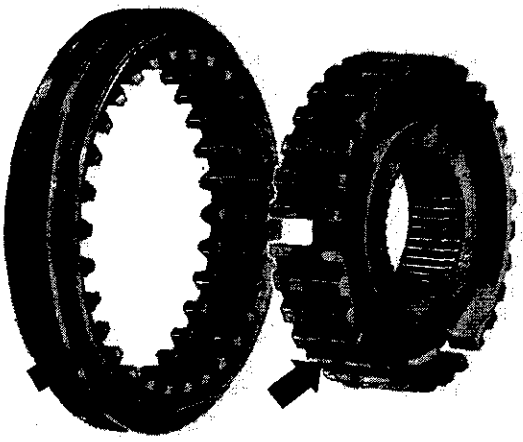


Fig. 4

Checking

Check tension of spring by measuring diameter of unloaded spring. If the following measurements — a — are not obtained, replace.

1st and 2nd gear = 78 mm ± 1 mm diameter (3.070 in. ± 0.04 in.)

3rd and 4th gear = 74 mm ± 1 mm diameter (2.913 in. ± 0.04 in.)

Press synchronizer rings over cones on gears and measure gap "a" with a feeler gauge.

1st and 2nd gear:

new installation: 1.1—1.8 mm (0.043—0.070 in.)
wear limit: 0.6 mm (0.024 in.)

3rd and 4th gear:

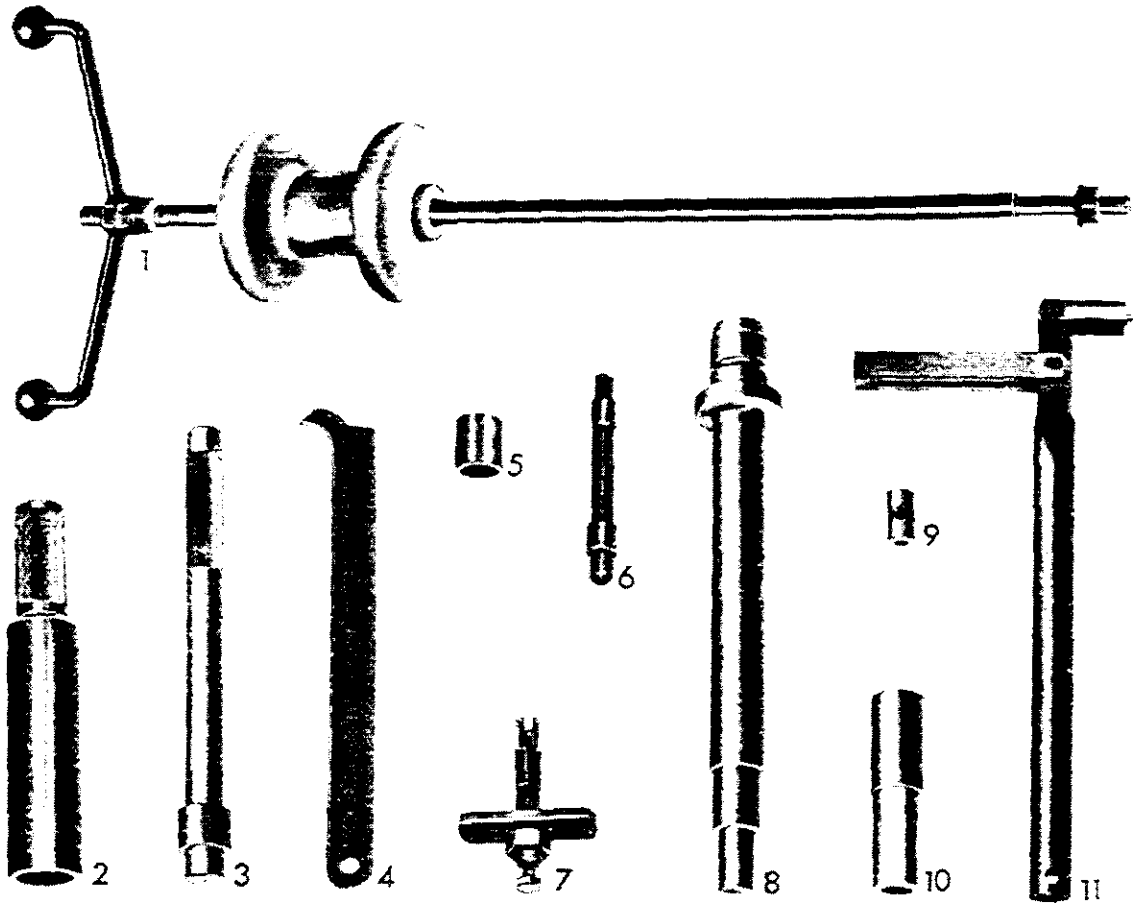
new installation: 1.0—1.9 mm (0.04—0.075 in.)
wear limit: 0.6 mm (0.024 in.)

Assembling

Operating sleeve and synchronizer hub are not matched together and therefore must not be replaced as a set.

To obtain the best possible sliding characteristics and minimum amount of backlash, slide sleeve on hub and check

a - that the two parts slide easily; and
b - that there is no backlash.



No.	Description	Special Tool No.	Remarks
1	Slide hammer	VW 771	
2	Driving sleeve	VW 244 b	
3	Removal tool	VW 295	
4	Removing bar	VW 681	
5	Thrust tube	VW 520	
6	Starter bushing drift	VW 222 a	
7	Starter bushing puller	VW 228 b	
8	Punch	VW 408 a	
9	Removing tool	VW 771/15	
10	Thrust tube	VW 421	
11	Removal tool	VW 296	modified

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No.	Description	Qty.	Note when disassembling	Note when assembling	Special instructions see
1	Spring	2			
2	Spring retainer	2			
3	Release bearing	1		do not wash out, coat Teflon surface with Molykote	
4	Nut M 7	3			
5	Lock washer	3			
6	Centering sleeve	1		remove to replace oil seal	
7	Oil seal, drive shaft	1	use VW 681	drive in with VW 244 b	Fig. 1 Fig. 9
8	Circlip	2			
9	Clutch lever	1			
10	Return spring	1			
11	Spring locating collar	1			
12	Lock bolt	1		14.2 mm (0.559 in.) long	
13	Bushing	2			
14	Sleeve	1			
15	Bushing	1			
16	Washer	1			
17	Clutch operating shaft	1			
18	Bushing, operating shaft	1	use VW 771, VW 771/15 and puller	drive in with VW 408	Fig. 2 Fig. 8
19	Bushing, starter shaft	1	pull out with VW 228 b	drive in with 222 a	Fig. 3 Fig. 7
20	Circlip, reverse gear shaft	1			
21	Reverse gear shaft, assembly	1 1	drive out with plastic hammer	press in with VW 296	Fig. 5
22	Circlip, needle bearing	1			
23	Needle bearing, main drive shaft	1	press out with VW 295 and VW 421	drive in with VW 295 and VW 520	Fig. 4 Fig. 6
24	Oil fill plug	1			
25	Oil drain plug	1			
26	Bonded rubber mounting	2			
27	Transmission case	1			

Disassembling

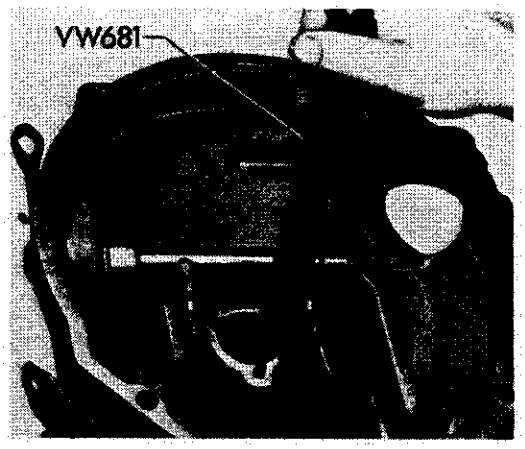


Fig. 1

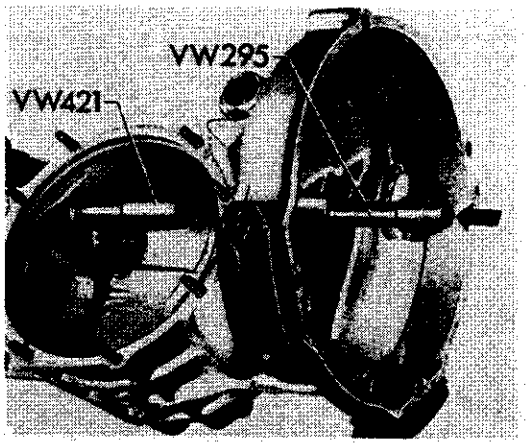


Fig. 4

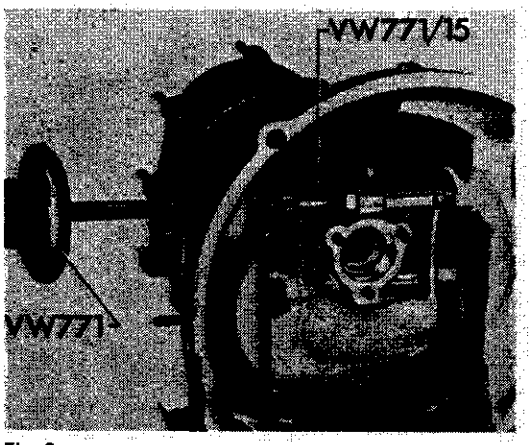


Fig. 2

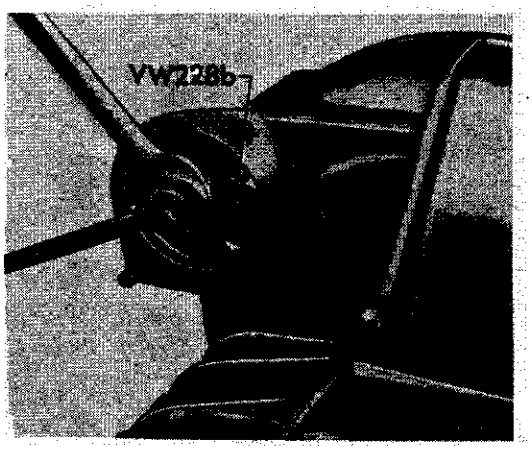


Fig. 3

Assembling

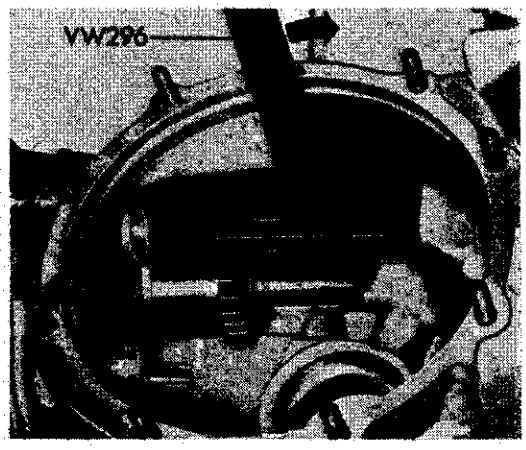


Fig. 5

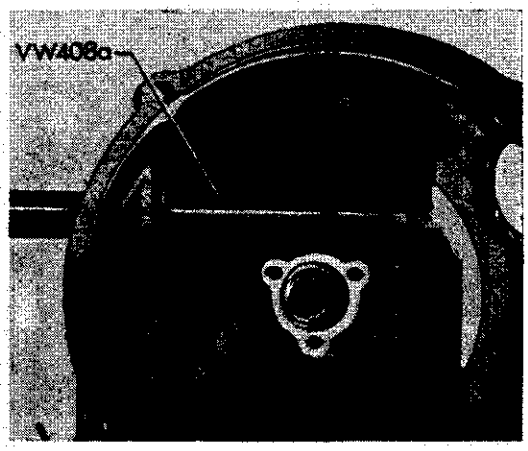


Fig. 8

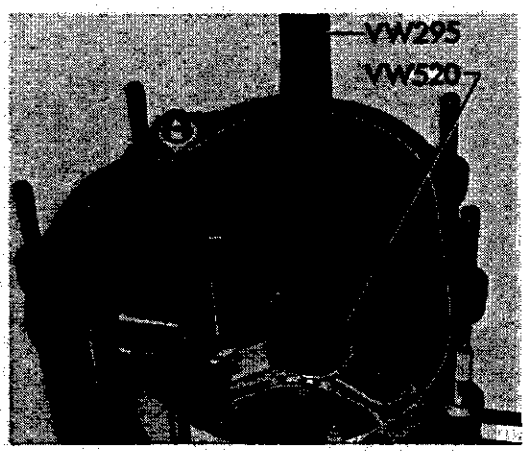


Fig. 6

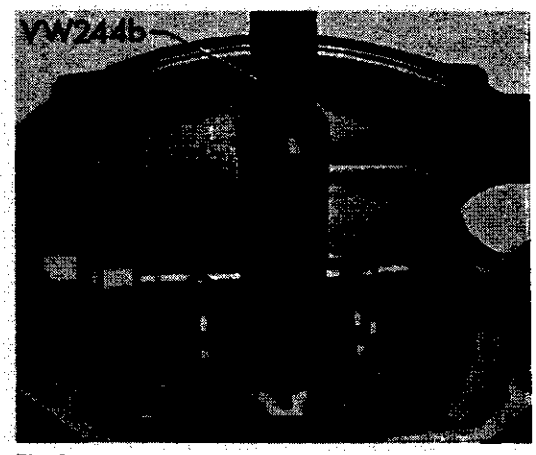


Fig. 9

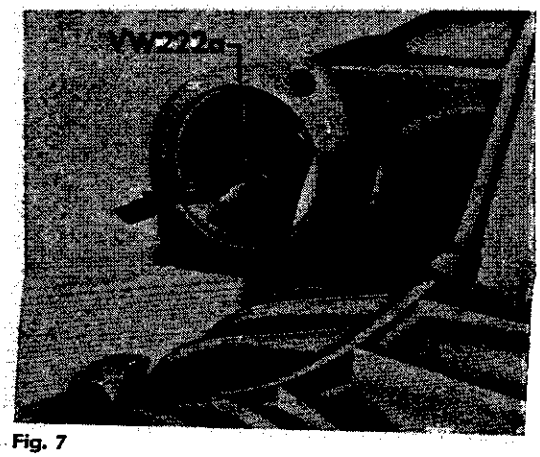
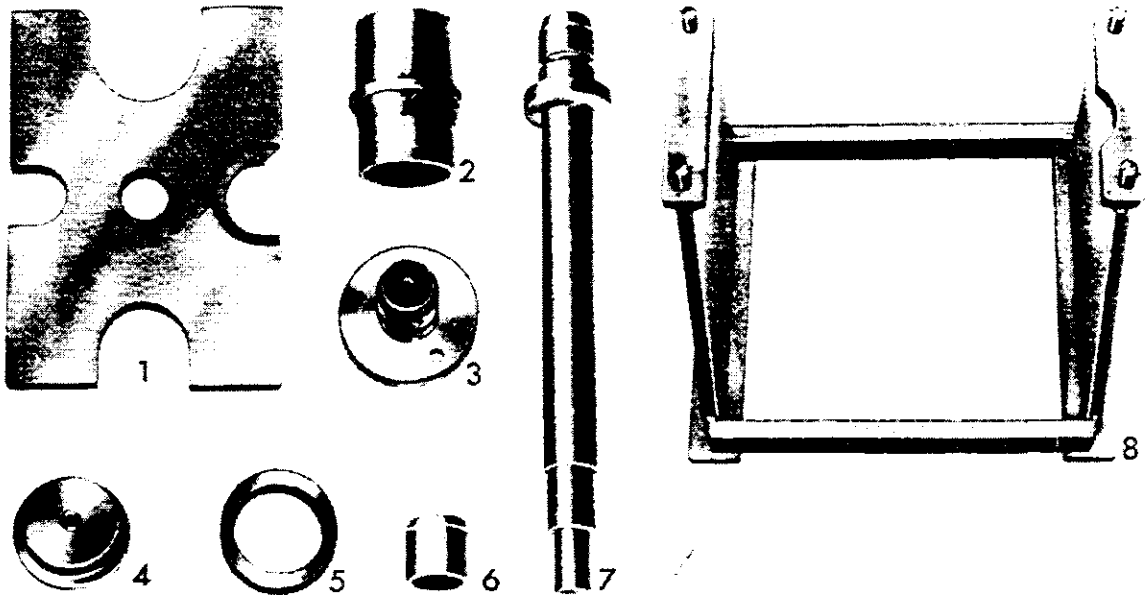
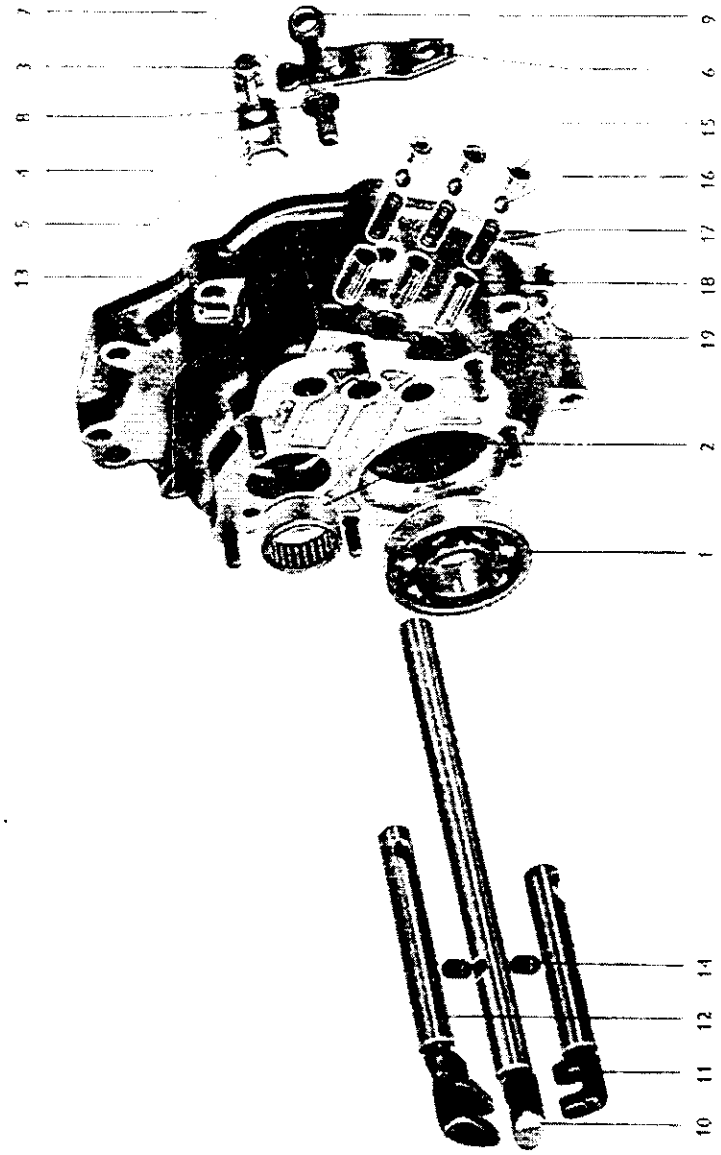


Fig. 7



No.	Description	Special Tool	Remarks
1	Thrust plate	VW 401	
2	Thrust piece	VW 473	
3	Thrust disc	VW 412	
4	Thrust plate	VW 447 i	
5	Thrust ring	VW 429	
6	Thrust piece	VW 463 4	
7	Punch	VW 408 a	
8	Support	VW 456	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No.	Description	Qty.	Note when disassembling	assembling	Special instructions see
1	Bearing, drive shaft	1	press out with VW 401, VW 408 a and VW 473	press in with VW 401, VW 429, VW 447 i, VW 456	Fig. 1 Fig. 6
2	Needle bearing, drive pinion	1	press out with VW 408 and VW 463 4	press in with VW 412, VW 456 and VW 463 4	Fig. 2 Fig. 7
3	Bolt	1		tighten to 2.0 mkg (14 lb ft)	
4	Retaining washer	1			
5	Guide plate	1			
6	Relay lever	1			
7	Nut M 10	1		tighten to 3.5 mkg (25 lb ft)	
8	Spring washer B 10	1			
9	Support, relay lever	1		adjust	Fig. 5
10	Selector shaft, 1st and 2nd gear	1		force required to overcome the detent ball 15—20 kg (33—44 lbs)	Fig. 4
11	Selector shaft, 3rd and 4th gear	1		force required to overcome the detent ball 15—20 kg (33—44 lbs)	Fig. 4
12	Selector shaft, reverse gear	1		force required to overcome the detent ball 15—20 kg (33—44 lbs)	Fig. 4
13	Plug	1	cut thread, pull out with a bolt	press in	Fig. 3
14	Interlock plunger	2		check operation of plungers by engaging a gear, the adjacent selector shaft must be blocked	
15	Plug	3	cut thread, pull out with a bolt	press in	Fig. 3
16	Ball, detent	3		press down with screw-driver before installing selector shaft	
17	Spring, detent	3		23—25 mm (0.905—0.984 in.) unloaded	
18	Slotted bushing	3			
19	Gear carrier	1			

Disassembling

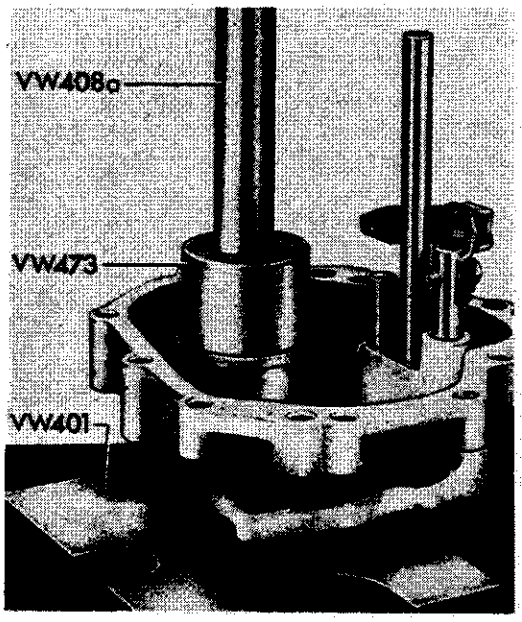


Fig. 1

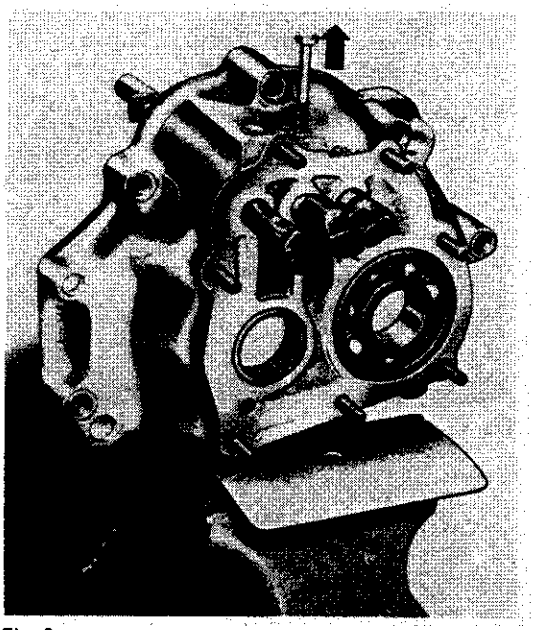


Fig. 3

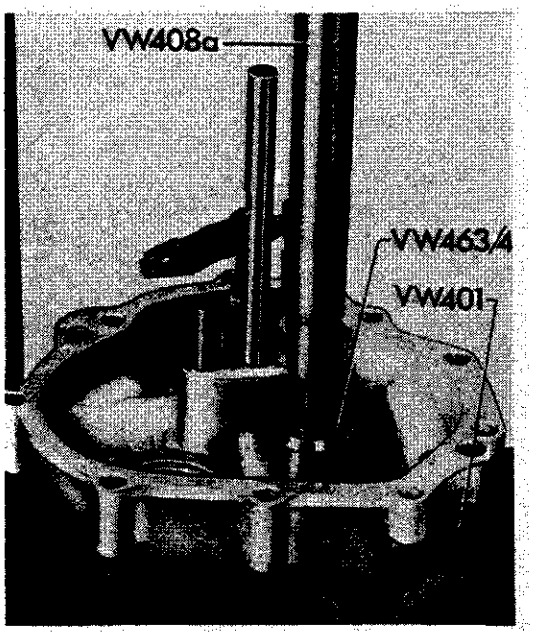


Fig. 2

Assembling

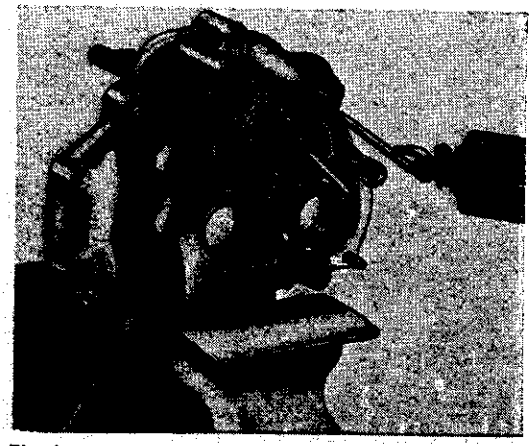


Fig. 4

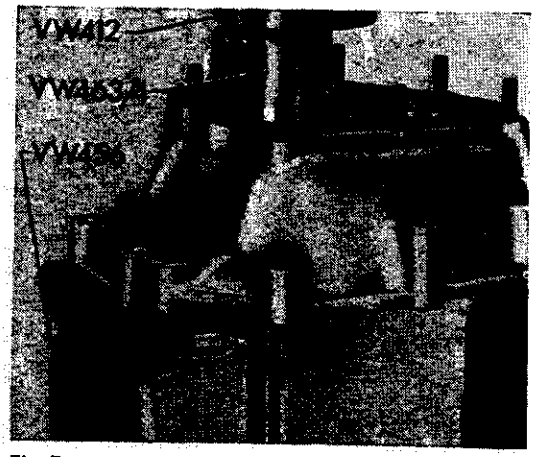


Fig. 7

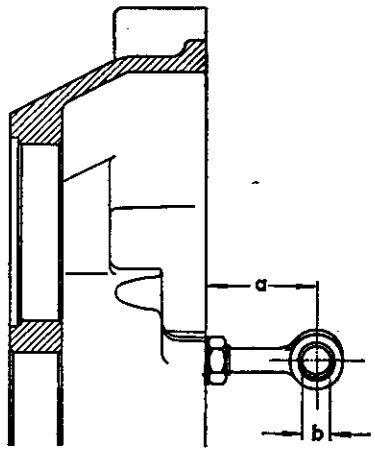


Fig. 5

a = 43,4 ± 0.4 mm (1.707 ± 0.015 in.)
b = 10.0 mm (0.393 in.)

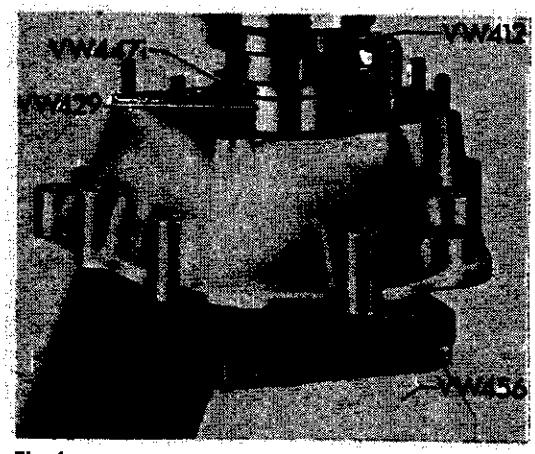
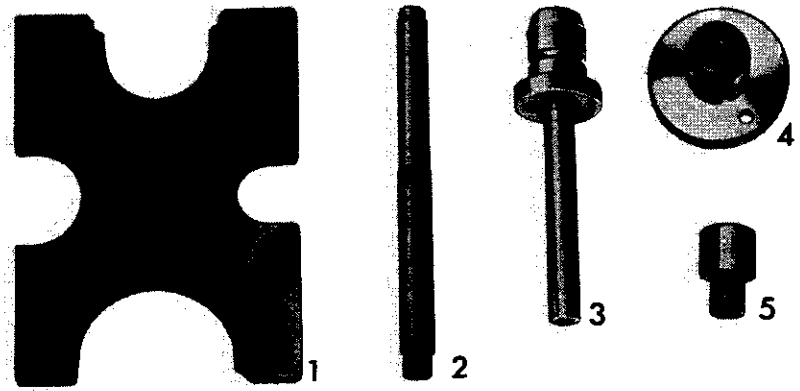
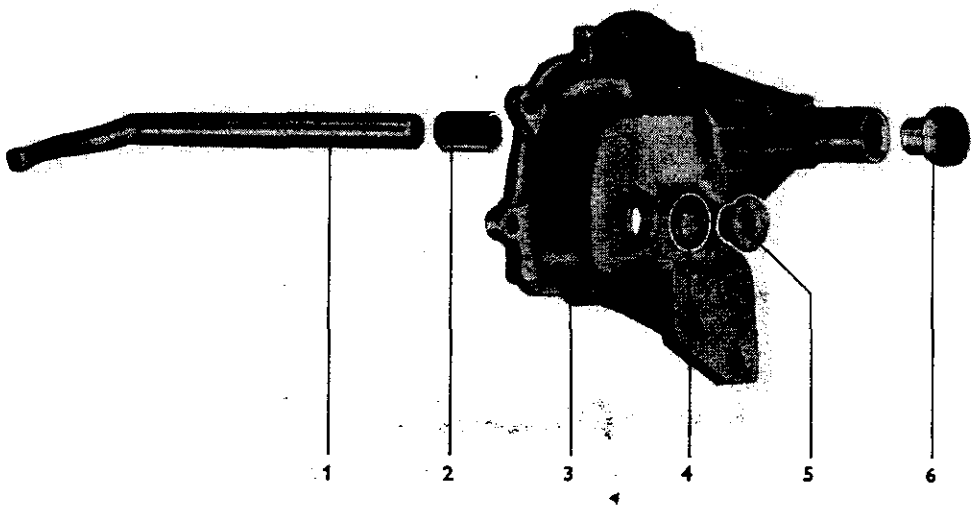


Fig. 6



c

No.	Description	Special Tool	Remarks
1	Thrust plate	VW 402	
2	Guide pin (shouldered)	VW 439	
3	Punch	VW 411	
4	Thrust disc	VW 412	
5	Thrust pad	VW 431	



No.	Description	Qty.	Note when disassembling	Note when assembling	Special instructions see
1	Inner shift lever	1		coat with transmission oil when installing	
2	Bushing	1		press in with VW 412 and VW 439	Fig. 3
3	Shift housing	1			
4	Sealing washer	1			
5	Plug	1		tighten to 2.5 mkg (18 lb ft)	
6	Bushing with seal	1	twist out with water-pump pliers	press in with VW 402, VW 411 and VW 431	Fig. 1 Fig. 2

Disassembling and assembling shift housing Types 1 and 3 from November 1972
Type 1/Model 181

Disassembling

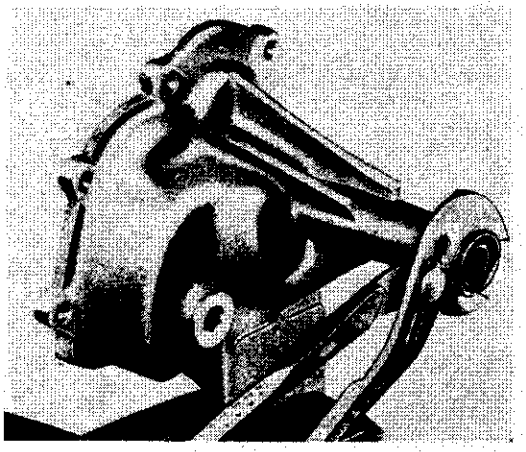


Fig. 1

Assembling

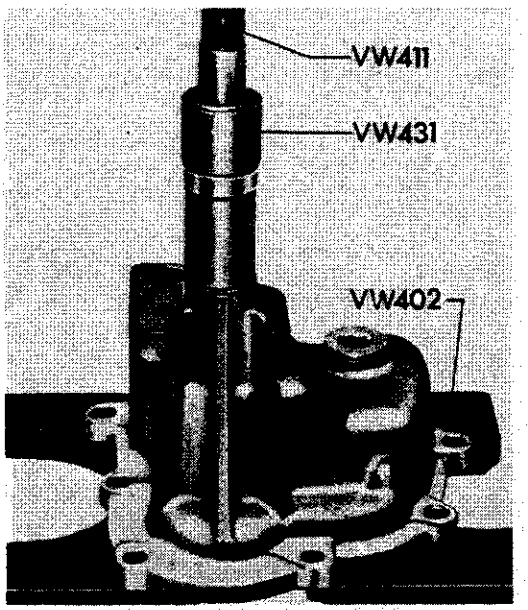


Fig. 2

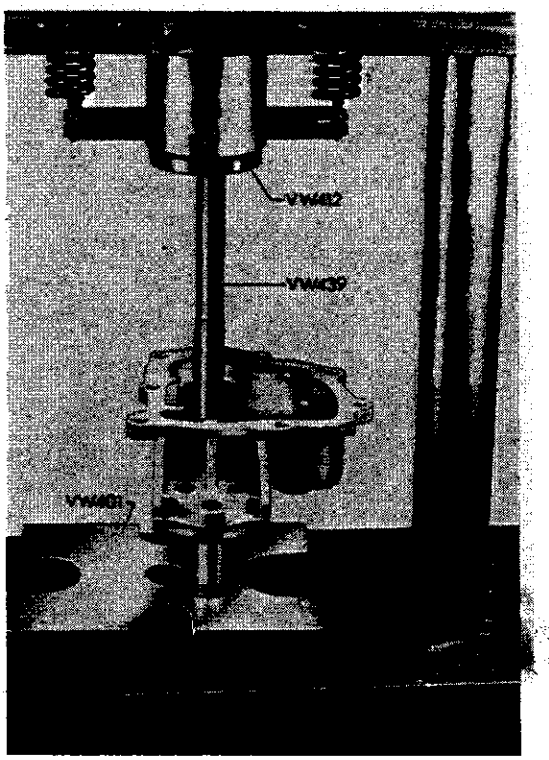
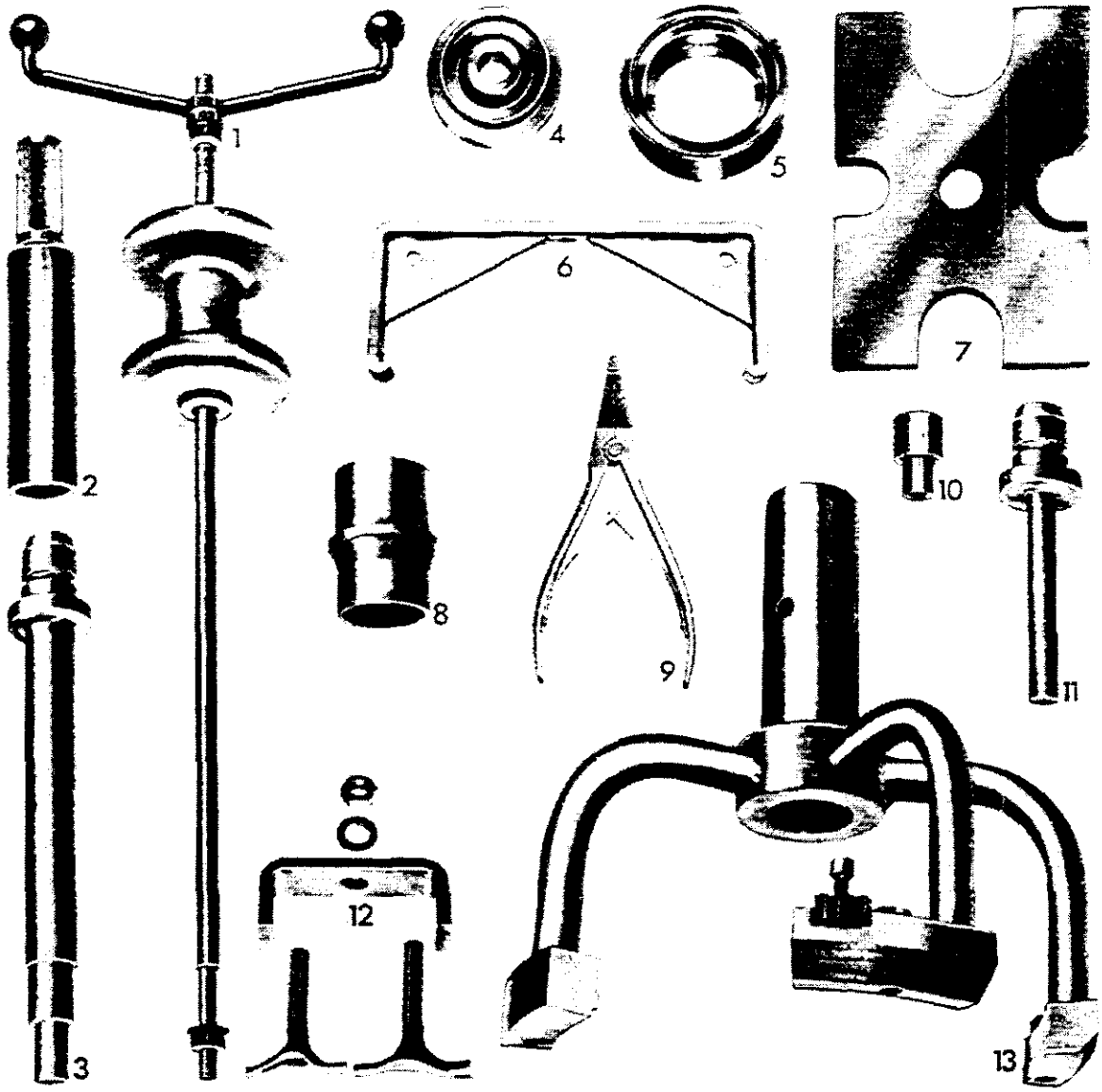
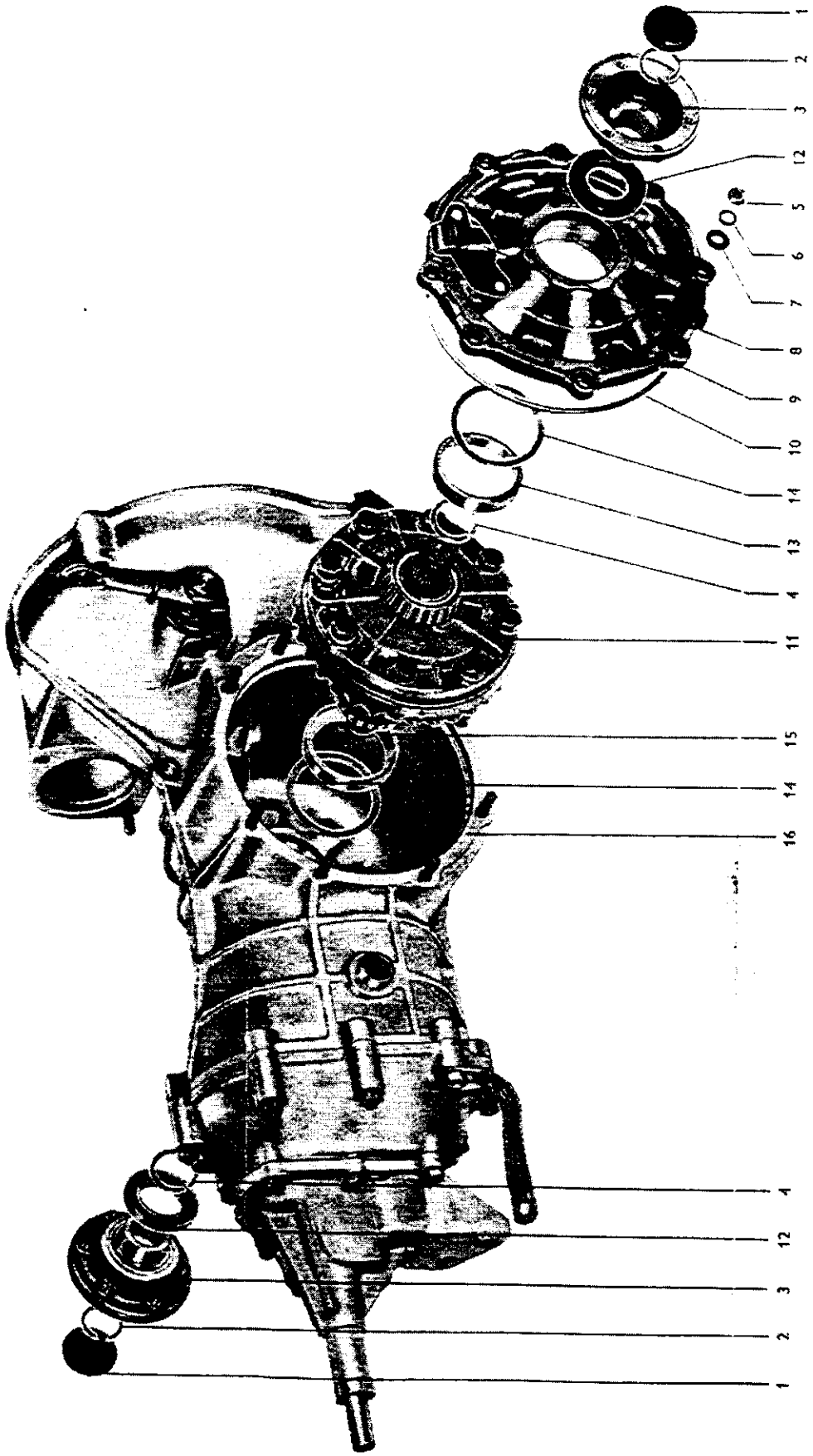


Fig. 3



No.	Description	Special Tool	Remarks
1	Slide hammer	VW 771	
2	Driving sleeve	VW 244 b	
3	Punch	VW 408 a	
4	Thrust pad	VW 442	
5	Thrust ring	VW 459.1	
6	Multi-purpose tool	VW 771/22	
7	Thrust plate	VW 401	
8	Thrust piece	VW 473	
9	Circlip pliers	—	flate nose
10	Thrust pad	VW 431	
11	Punch	VW 411	
12	Oil pump extractor	VW 201	(set of 3)
13	Holding fixture	VW 307 a	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No.	Description	Qty.	Note when removing	Note when installing	Special instructions see
1	Cap	2	pierce with a screw driver and pry it out	drive in with VW 244b	Fig. 7
2	Circlip	2		replace, if necessary, lift the differential side gear and press the flange down at the same time with puller VW 201 and an M 10 bolt to squeeze the wavy spacer washer together until the circlip fits properly in groove.	Fig. 6
3	Flange	2	pry off		Fig. 1
4	Spacer ring	2		replace if play at flange	
5	Nut M 8	8		tighten to 3 mkg (22 lb ft)	
6	Spring washer	8			
7	Washer	8			
8	Bracket	1			
9	Cover, final drive	1	pull off with VW 771 and VW 771/22		Fig. 2
10	O-ring	1		replace	
11	Differential, assembly	1		lubricate tapered roller bearings with Hypoid oil only	5.1/5
12	Oil seal	2	pry out	press in with VW 401, VW 408a and VW 442	Fig. 5
13	Outer race, tapered roller bearing	2	press out VW 401, VW 411, VW 431, VW 459/1 and VW 473	press in with VW 401, VW 411, VW 431, VW 459/1 and VW 473, (do not forget shims)	Fig. 3 Fig. 4
14	Shim "S_1"	x	note thickness (do not interchange with "S_2")	measure	H 5.1/12 H 5.1/14
15	Shim "S_2"	x	note thickness do not interchange with "S_1")	measure	H 5.1/12 H 5.1/14
16	Transmission case	1			

Removing

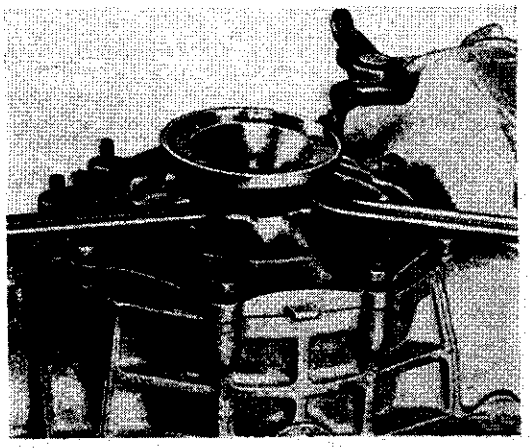

Fig. 1

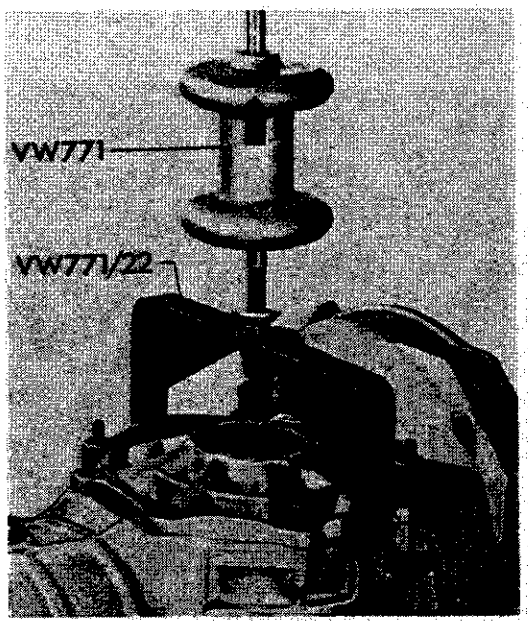

Fig. 2

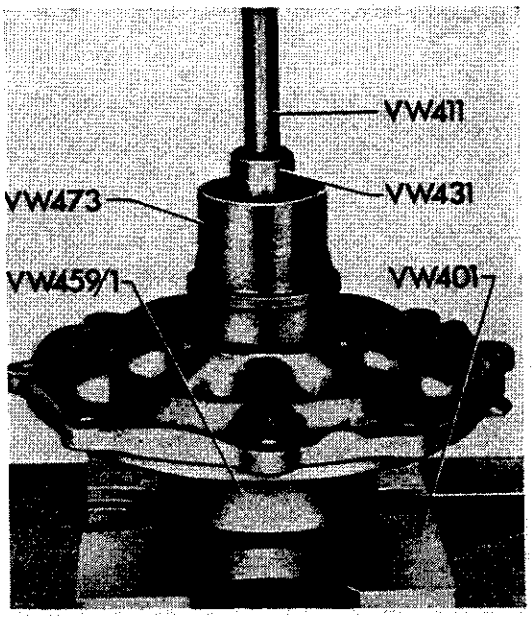

Fig. 3

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Removing

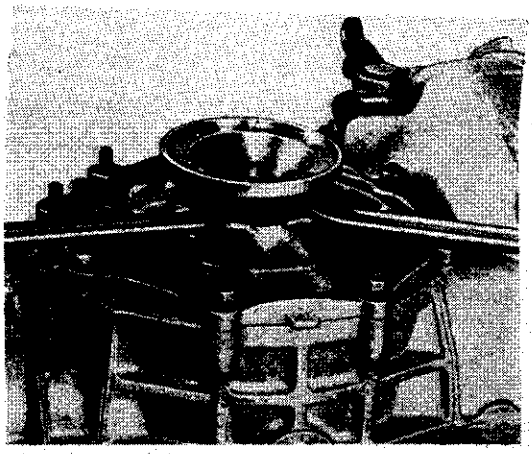


Fig. 1

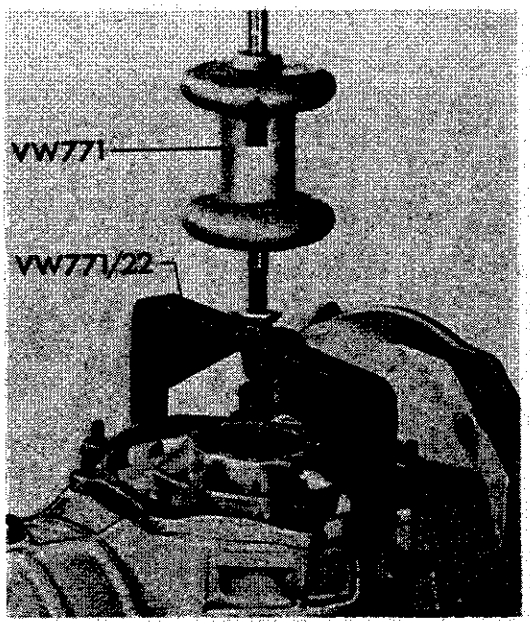


Fig. 2

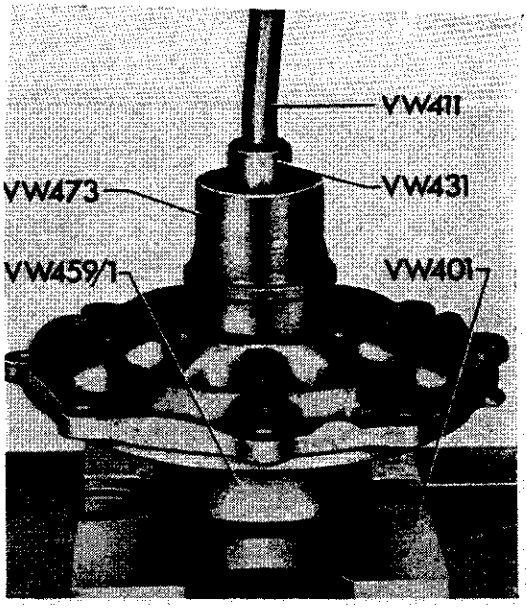
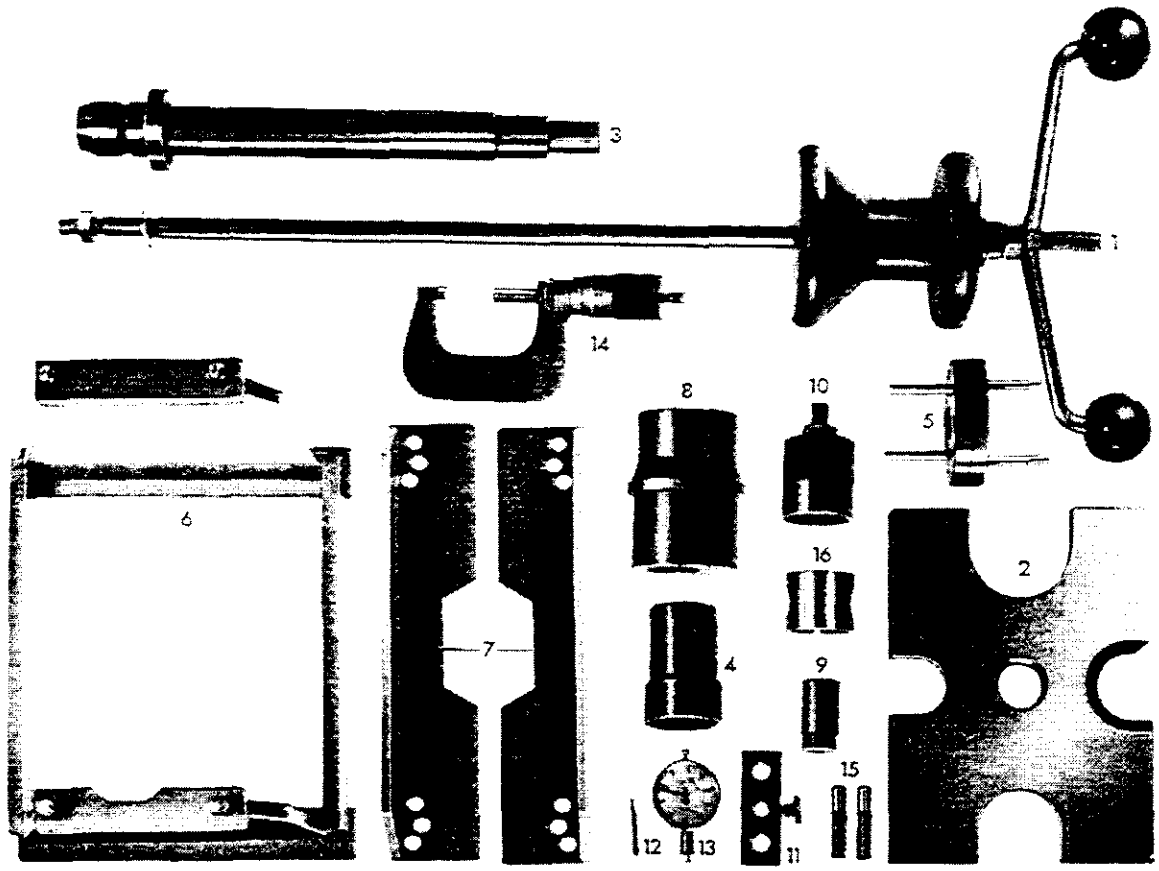
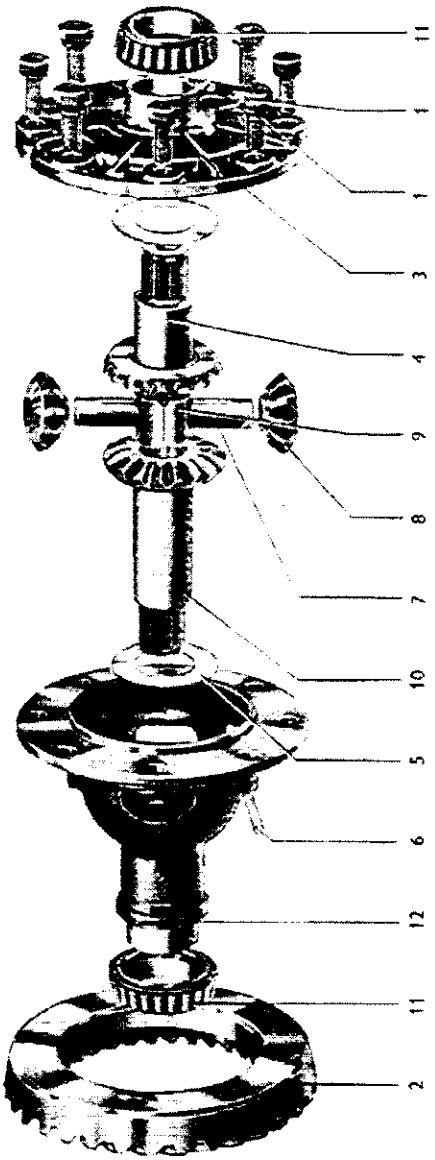


Fig. 3



No.	Description	Special Tool	Remarks
1	Multi-purpose tool	VW 771	
2	Plate	VW 401	
3	Punch	VW 408 a	
4	Punch	VW 454	
5	Punch	VW 458	
6	Support	VW 456	
7	Support bars	VW 457/1 – 2	
8	Punch	VW 473	
9	Punch	VW 434	
10	Clamping sleeve	VW 382/3	
11	Measuring bar	VW 383/8	
12	Dial indicator extension	VW 299/3	28 mm long
13	Dial indicator	—	range 3 mm
14	Micrometer	—	range 25—50 mm
15	Centering pins M 9 x 1	—	
16	Measuring sleeve	—	


11
1
1
3
4
9
8
7
10
5
6
12
11
2

No.	Description	Qty.	Note when disassembling	assembling	Special instructions see
1	Bolt with spring washer	8		tighten cross-wise to 6 mkg (43 lb ft), use VW-genuine bolts and spring washers only.	
2	Ring gear	1	drive off with punch	heat to 100 °C (212 °F) and use centering pins	Fig. 1 Fig. 9
3	Cover for differential housing	1	pull off with VW 771	check and/or adjust axial play	Fig. 2 5.1/12-5
4	Differential gear, (short shaft)	1		check for wear, check and/or adjust axial play	5.1/12-5
5	Thrust washer	2		check for wear, check and/or adjust axial play	5.1/12-5
6	Pin for shaft	1	drive out with punch	peen at both ends with center punch	Fig. 8
7	Shaft, differential pinions	1	drive out with punch		Fig. 3
8	Differential pinion	2		check for wear	
9	Spacer sleeve	1		measure sleeve before installing	5.1/12-5
10	Differential gear, (long shaft)	1		check for wear and/or axial play	5.1/12-5
11	Tapered roller bearing, inner race	2	press with VW 401, VW 408 a; VW 454 and VW 458 off cover and with VW 454, VW 457/1 and VW 457/2 off differential housing	heat to 100 °C (212 °F) and press in position; using VW 401, VW 454 and VW 473	Fig. 4 Fig. 5 Fig. 6 Fig. 7
12	Differential housing	1		check thrust faces for wear	5.1/12-5

Disassembling

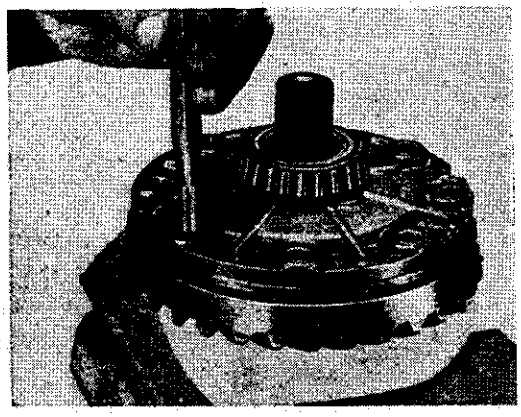


Fig. 1

Fig. 2

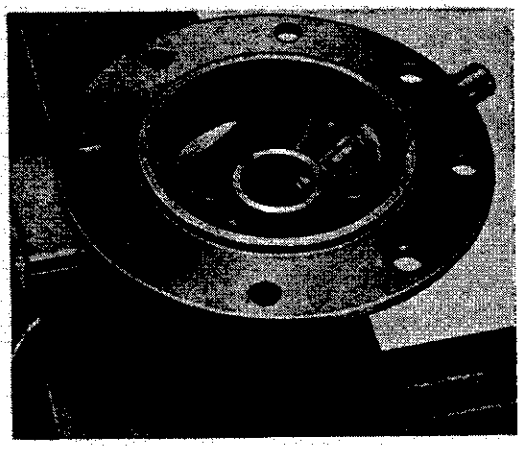


Fig. 3

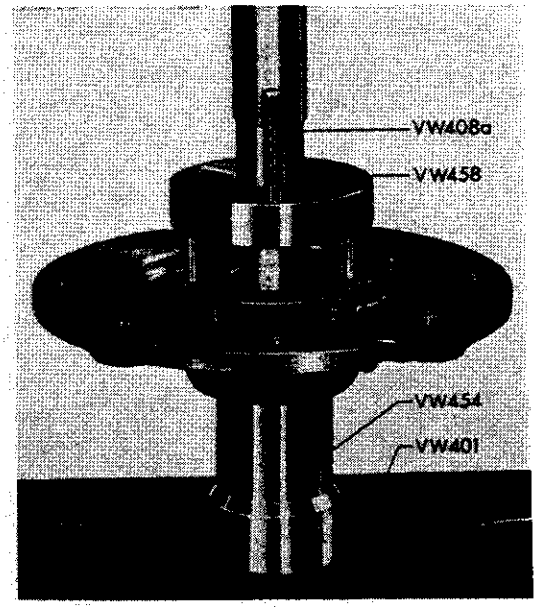


Fig. 4

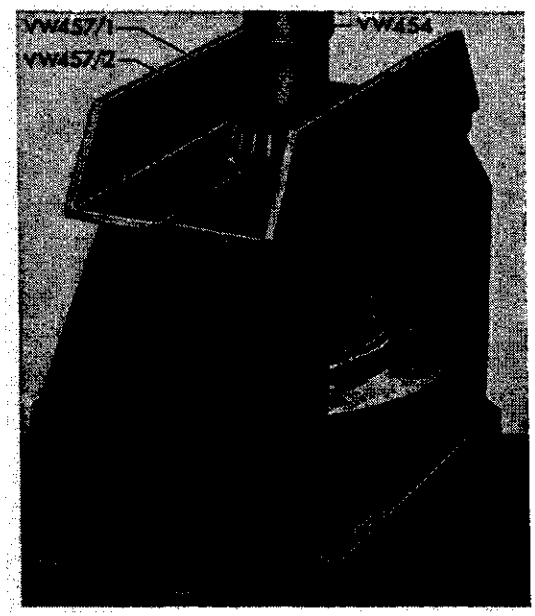


Fig. 5

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Assembling

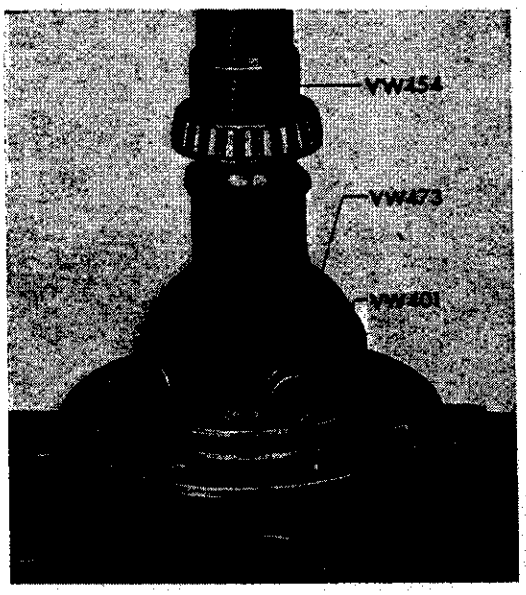


Fig. 6

Fig. 8

Fig. 7

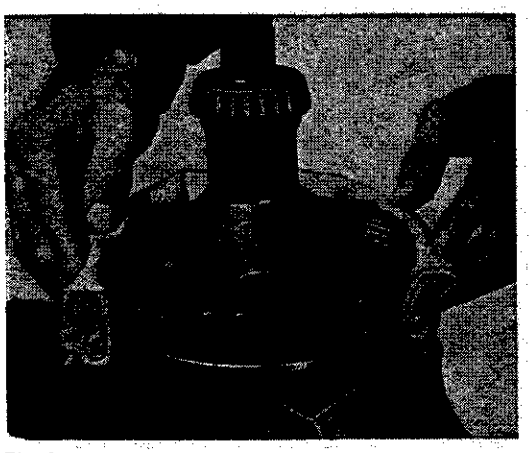
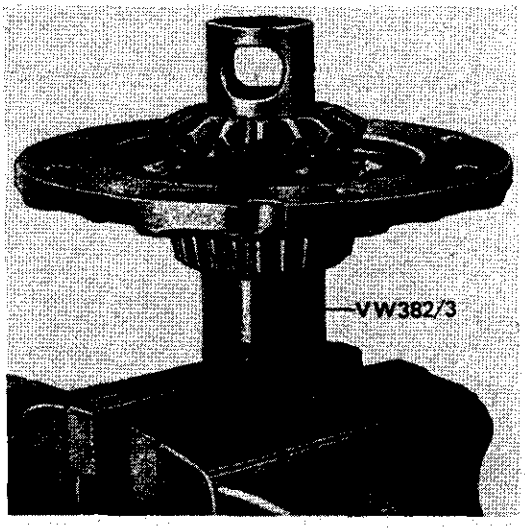


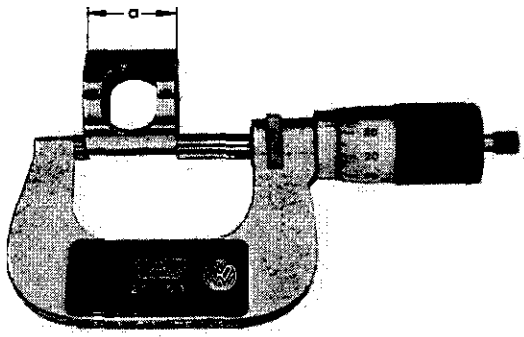
Fig. 9

The spacer sleeve ensures that the backlash between the bevel gears is adequate even when there is axial pressure on the differential side gears. If the housing, the cover, one of the side gears or the spacer sleeve are replaced, the length of the spacer sleeve must be determined again.



1 - Place side gear (short shaft) and **both** thrust washers in the differential cover, attach clamping sleeve VW 382/3 and clamp bevel gear tightly against the cover.

2 - Place side gear (long shaft) in the differential housing.
Measure the shortest spacer sleeve — Part No. 004 517 241 — with a micrometer and mark the size on the sleeve with an electrical marker or similar device. This sleeve should then always be used as a measuring sleeve and kept together with the measuring appliance.



3 - Insert sleeve and mount cover to housing with four M 8 x 20 screws, use washers on the ring gear side.

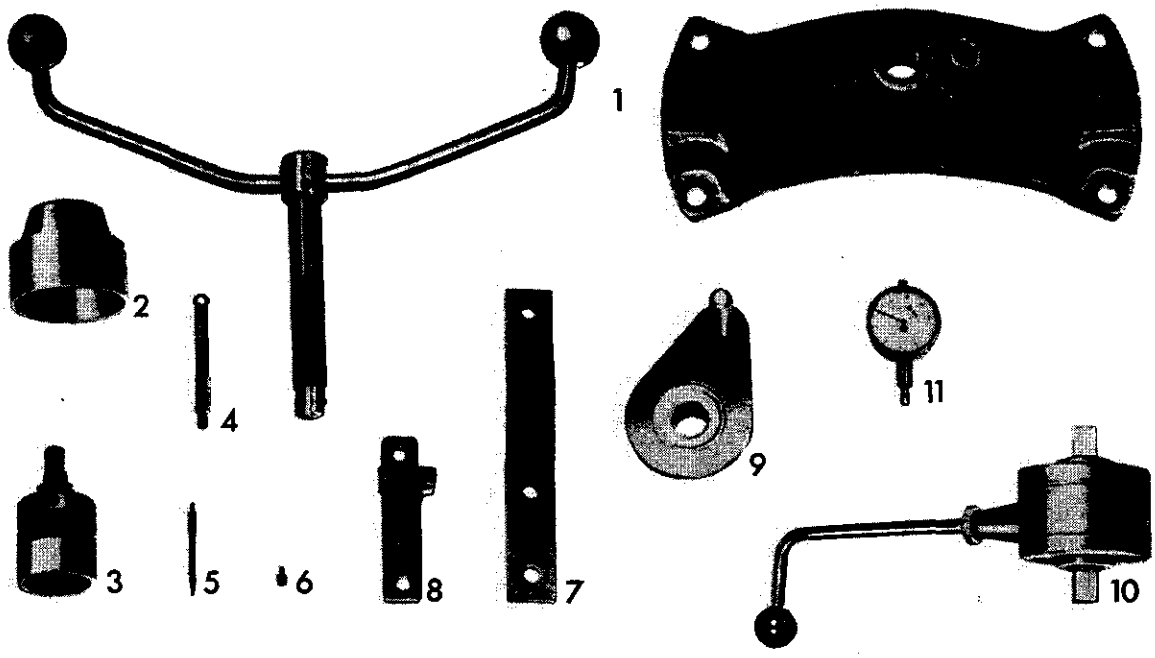
4 - Attach measuring bar VW 383/8 with dial indicator and 28 mm extension (VW 299/3) to the end face of the side gear with an M 10 bolt. The dial indicator extension must contact the edge of the housing neck.

5 - Ascertain axial play by moving the side gear up and down.

6 - Add play measurement to sleeve length. Look up result in table under "x"-range column.
Entries on same line in other column give sleeve length "l" and part number.

"x"-range	Sleeve length "l"	Part No. of sleeve
28.82—28.90	28.85	004 517 241
28.91—28.99	28.94	004 517 242
29.00—29.08	29.03	004 517 243
29.09—29.18	29.12	004 517 244

7 - Take differential apart, remove measuring sleeve, fit correct sleeve as determined, assemble differential again without shaft and recheck the play. If the sleeve has been selected correctly, the axial play, with diferrential assembled, should be
between 0 mm and 0.14 mm.



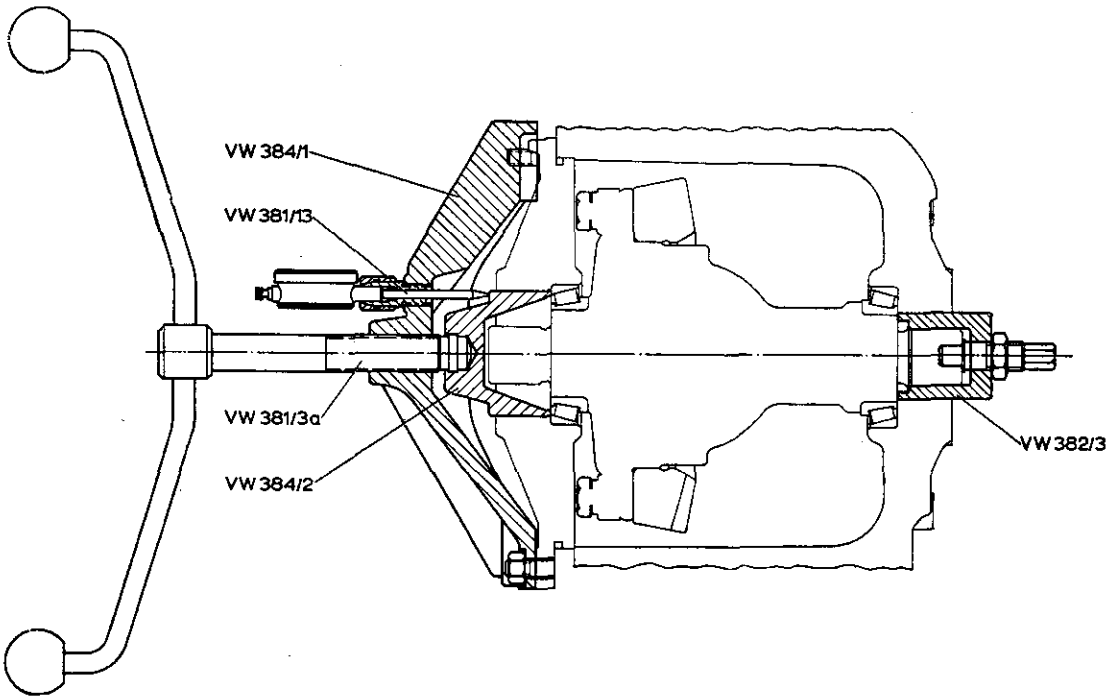
No.	Description	Special Tool	Remarks
1	Setting appliance, rear axle	VW 384/1	
2	Adapter	VW 384/2	
3	Clamping sleeve	VW 382/3	
4	Measuring lever	VW 382/4	
5	Extension (52 mm)	VW 381/13	
6	Extension 6 mm (flat end)	VW 382/10	
7	Pinion retaining bracket	VW 381/11	
8	Indicator bracket	VW 384/3	
9	Crank handle	VW 294 b	
10	Torque gauge	—	0—30 cmkg
11	Dial indicator	—	3 mm range

When adjusting the ring gear and drive pinion always proceed in the following sequence:

A - Measure "S_{total}" — tapered roller bearings preload — (H 5.1/13)

B - Check drive pinion adjustment (H 5.1/14)

C - Check ring gear adjustment — backlash — (H 5.1/15)



A - **Determine thickness of shim "S" — tapered roller bearings preload** — (drive pinion removed)

The ring gear only needs adjusting if parts replaced have a direct influence on the adjustment of the ring gear.

These parts are: gear set, transmission case, differential housing, differential housing cover, final drive covers or tapered roller bearings. Care and cleanliness are essential to ensure satisfactory results.

1 - Remove oil seals and outer race of tapered roller bearings. Take out shims "S_1" and "S_2" and press outer race of tapered roller bearings back into housing and cover (H 5.1/11).

2 - Place differential in transmission case. The ring gear must be on the left side.

Caution

Before installing differential, oil the bearings with hypoid transmission oil. Bearings which are dry or have been lubricated with other oils will give incorrect results.

3 - Install cover on transmission case. Place **setting appliance VW 384/1 and 384/2** on cover and tighten nuts diagonally to correct torque.

Note

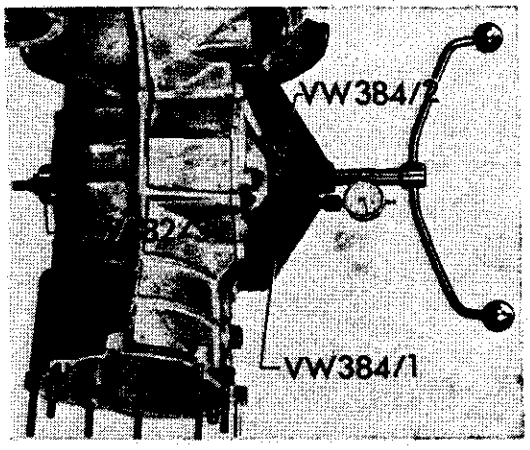
It is advisable to remove the O-rings when carrying out the adjustment.

4 - Fit **clamping sleeve VW 382/3** opposite the ring gear side **without lever VW 382/4.**

5 - Turn transmission so that the ring gear is at the bottom. Turn the spindle of the **setting appliance VW 384/1** carefully until the thrust piece is just touching the bearing outer race without play. Take care that the bearing race is not moved at this stage.

6 - Install **dial indicator** with **extension VW 381/13 (52 mm)** in the **VW 384/1 appliance** and zero indicator with 3 mm preload.

7 - Press the bearing outer race in by turning the spindle until there is no detectable play in the differential bearings.

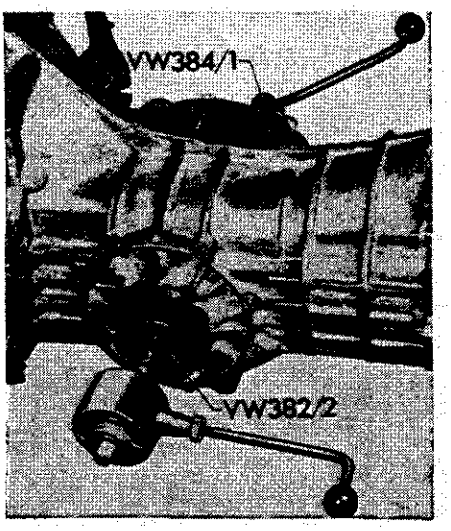


8 - Turn transmission 90°. Place **torque gauge** with a **10 mm socket** on the **clamping sleeve VW 382/3** and turn differential in **both directions** several times.

9 - Tighten spindle to increase the pressure on the bearings until the required preload (turning torque) is obtained.

Note

Increase the torque very slowly and check the reading several times while doing so. If the specified torque is exceeded, the side cover must be removed, the bearing race pressed back to the original position again and the adjustment repeated.



The turning torque should be as follows:

new bearings	used bearings*
30—35 cmkg (27—31 in. lb)	3—7 cmkg (3—6 in. lb)

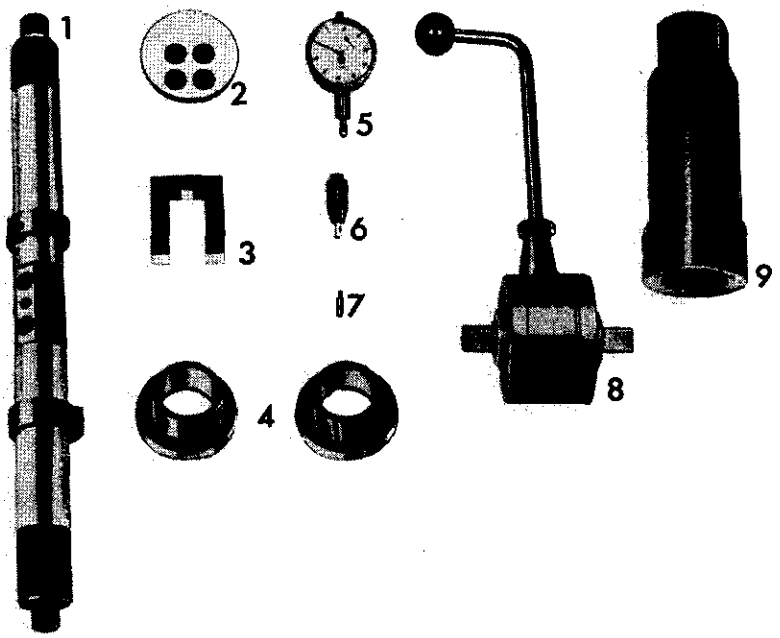
* used more than 30 miles

10 - Take dial indicator reading (red figures). This figure should be noted as the dimension for the total shim thickness "S". It can be from 0.95—2.10 mm.

Example: "S_{total}" = 1.65 mm.

11 - Remove cover and differential. Press bearing race until fully seated again in right cover.

12 - Install transmission with the shim "S_S" as determined (see Adjusting drive pinion — H 5.1/14).



No.	Description	Special Tool	Remarks
1	Universal measuring bar	VW 385/1	
2	Measuring plate	VW 385/17	
3	Setting gauge	VW 385/9	
4	Centering disc (2)	VW 385/2	
5	Dial indicator	—	range 0—3.0 mm
6	Measuring pin	VW 385/14	
7	Dial indicator extension	VW 385/15	
8	Torque gauge	—	
9	Socket wrench	VW 293	

B - Adjust drive pinion

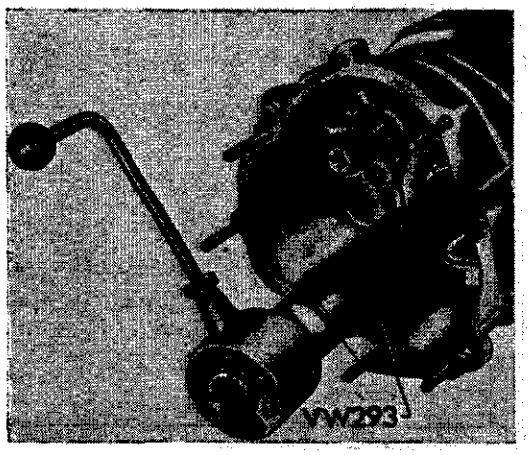
Proceed as described when the drive pinion and ring gear have been replaced. If the double tapered roller bearing and/or the transmission case were replaced proceed as described in H 3.1/8.

1 - Assemble drive pinion up to needle bearing for 1st gear. Tighten round nut to correct torque but do not lock it.

2 - Place pre-assembled drive pinion in transmission case without shim "S_3". Tighten bearing retaining nut to correct torque.

Note

To align the drive pinion in the housing, it is advisable to install the gear carrier.



Measuring preload (turning torque)

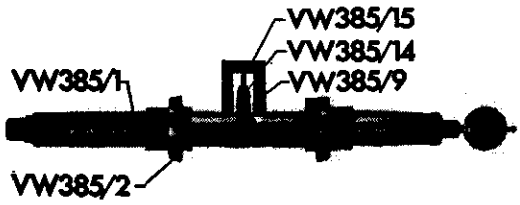
3 - Check double tapered roller bearing preload, using a torque gauge, adapter VW 293 and 32 mm socket.

Caution

Before installing the drive pinion, lubricate bearings with hypoid oil. If checked dry or lubricated with any other oil, the test results will be inaccurate.

	new bearings	used bearings*)
Turning torque	6—21 cmkg (5—18 in. lb)	3—7 cmkg (3—6 in. lb)

*) Used more than 30 miles



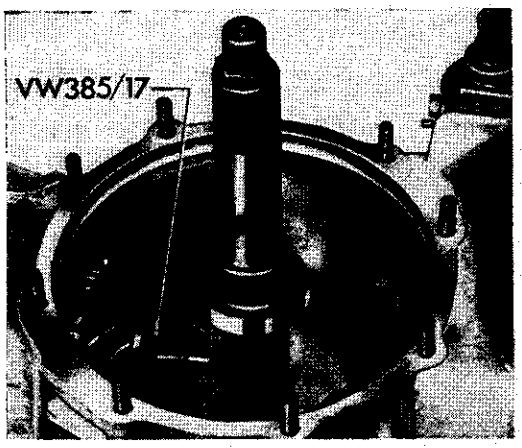
Determine dimension "e"

1 - Set the ring on the universal bar VW 385/1 to dimension a = 70 mm.

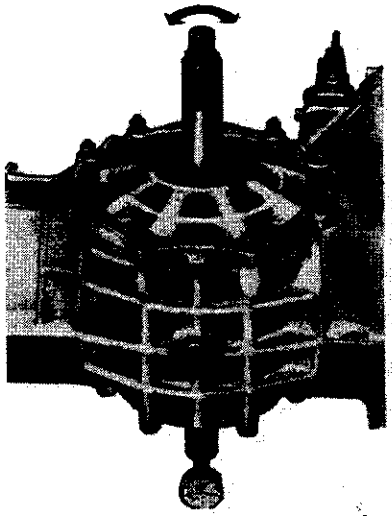
2 - Assemble universal measuring bar as shown and place setting gauge VW 385/9 (Ro = 58.70 mm) on the bar and zero dial indicator (3 mm range) with 1 mm preload.

Note

Move the sliding ring back to the stop.



3 - Attach measuring plate VW 385/17 to end of drive pinion, remove setting gauge from universal measuring bar and place bar in transmission case.



4 - Install cover and tighten nuts **to correct torque.**

5 - Push the setting ring of the second centering disc outward until the bar can just be turned by hand.

6 - Turn the bar until the dial indicator pin contacts the measuring plate on the drive pinion and the pointer of the dial indicator reaches the return point.

7 - Note the reading for dimension "e" and determine thickness of shims using the following formula:

S_3 nominal = e + r

For example:

e = 0.48 mm
+ r = 0.38 mm
S_3 nominal = 0.86 mm

.23
.35
.58

Select shim according to table:

Shim thickness	Part No.
0.15	001 311 391
0.20	001 311 392
0.30	001 311 393
0.40	001 311 394
0.50	001 311 395
0.60	001 311 396
0.70	001 311 397
0.80	001 311 398
0.90	001 311 399

8 - Install pinion with the measured shim and check the measurement.

Note

If the "S_3" shim has been selected correctly the dial indicator reading should now show the deviation "r" marked on the drive pinion within a tolerance of ± 0.04 mm.

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C - **Adjusting backlash**

1 - Press out tapered roller bearing outer race. Insert shims "S_{total}" (example 1.65 mm) and press outer race back in.

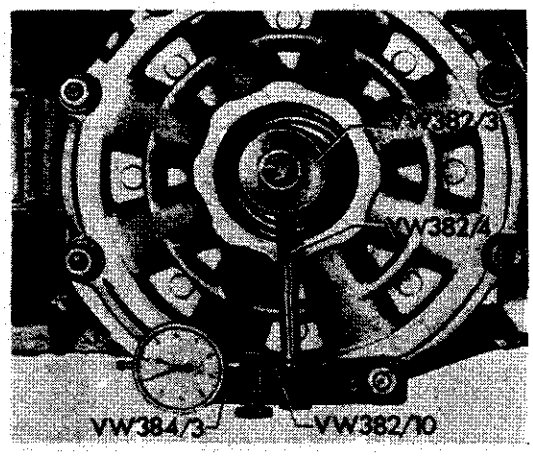
2 - Install rear part of drive shaft. Place differential in housing with **clamping sleeve VW 382/3** attached. Install final drive cover. **Mount dial indicator holder VW 384/3.** Tighten nuts diagonally to the correct torque.

3 - Attach pinion **retaining bracket VW 381/11** on the gear carrier and tighten nuts by hand.

4 - Attach **lever VW 382/4** into **clamping sleeve VW 382/3.** Install **dial indicator** (3 mm range) with **extension VW 382/10** (6 mm) in the dial indicator holder so that edge of the clamping cylinder on the indicator is flush with edge of holder.

5 - Turn ring gear with **crank handle VW 294** until the **lever VW 382/4** is touching the dial indicator pin. Then turn carefully until indicator has **a preload of 1.5 mm.**

Do not damage the dial indicator.



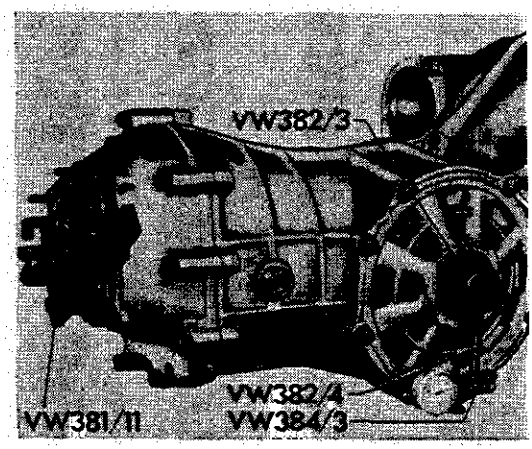
6 - Block pinion in this position with **retaining bracket VW 381/11.**

7 - Turn ring gear as far it will go and set dial indicator to zero. Turn ring gear in other direction and read off **backlash "Svo".** Note the measurement.

8 - Loosen lock nut in clamping sleeve on differential and nuts of pinion retaining bracket. Turn ring gear and take three further readings at intervals of 90°. Add the readings together and find average.

Note

If the readings obtained in this check vary by more than 0.06 mm from one another, there is something wrong with the installation of the ring gear or with the gear set itself. Check assembling steps and replace gear set if necessary.



Backlash Svo mean	Shim thickness mm	Backlash Svo mean	Shim thickness mm
0.20	0.00	0.70	0.50
0.21	0.01	0.71	0.51
0.22	0.02	0.72	0.52
0.23	0.03	0.73	0.53
0.24	0.04	0.74	0.54
0.25	0.05	0.75	0.55
0.26	0.06	0.76	0.56
0.27	0.07	0.77	0.57
0.28	0.08	0.78	0.58
0.29	0.09	0.79	0.59
0.30	0.10	0.80	0.60
0.31	0.11	0.81	0.61
0.32	0.12	0.82	0.62
0.33	0.13	0.83	0.63
0.34	0.14	0.84	0.64
0.35	0.15	0.85	0,65
0.36	0.16	0.86	0.66
0.37	0.17	0.87	0.67
0.38	0.18	0.88	0.68
0.39	0.19	0.89	0.69
0.40	0.20	0.90	0.70
0.41	0.21	0.91	0.71
0.42	0.22	0.92	0.72
0.43	0.23	0.93	0.73
0.44	0.24	0.94	0.74
0.45	0.25	0.95	0.75
0.46	0.26	0.96	0.76
0.47	0.27	0.97	0.77
0.48	0.28	0.98	0.78
0.49	0.29	0.99	0.79
0.50	0.30	1.00	0.80
0.51	0.31	1.01	0.81
0.52	0.32	1.02	0.82
0.53	0.33	1.03	0.83
0.54	0.34	1.04	0.84
0.55	0.35	1.05	0.85
0.56	0.36	1.06	0.86
0.57	0.37	1.07	0.87
0.58	0.38	1.08	0.88
0.59	0.39	1.09	0.89
0.60	0.40	1.10	0.90
0.61	0.41	1.11	0.91
0.62	0.42	1.12	0.92
0.63	0.43	1.13	0.93
0.64	0.44	1.14	0.94
0.65	0.45	1.15	0.95
0.66	0.46	1.16	0.96
0.67	0.47	1.17	0.97
0.68	0.48	1.18	0.98
0.69	0.49	1.19	0.99
0.70	0.50	1.20	1.00

Finding "Svo mean"

Example:

1st reading	= 1.10
+ 2nd reading	= 1.12
+ 3rd reading	= 1.13
+ 4th reading	= 1.11
	Total = 4.46

The maximum difference between the four readings is 1.13 — 1.10 = 0.03 mm

Svo mean = Svo total : 4
= 4.46 : 4
= 1.115
= 1.12

9 - Determine the thickness of S_1 shim (ring gear side). The thickness for S_1 shim can be determined from the backlash Svo mean as follows:

a) From table

For an Svo mean figure of **1.12** the table shows a shim "S_1" thickness of **0.92 mm.**

b) By calculation

Product of "Svo mean" and correction factor "w":

Svo mean × w

— ring gear lift "h":

— h

This gives us the following simple formula:

$$S_1 = \text{Svo mean} \times w - h$$

In this formula:

S_1 = Thickness of shim on ring gear side

Svo mean = Mean measured backlash with shims on opposite side of ring gear

w = Correction factor

h = Axial ring gear lift from no-play mesh position to mean backlash position.

In our example:

$S_1 = 1.12$ mm × 1 — 0.20 mm

$S_1 = 0.92$ mm

10 - Determine thickness of S_2 shim (opposite ring gear). Under "Adjusting tapered roller bearings", a value of 1.65 mm was obtained for the required total shim thickness "S". S_2 is obtained from the difference between "S" and S_1 as follows:

S_2 = "S" — S_1

$S_2 = 1.65$ mm — 0.92 mm

$S_2 = 0.73$ mm

11 - Install S_1 shim on ring gear side and S_2 on other side.

12 - Install differential with **clamping sleeve VW 382/3** attached. Install cover without oil seal but with O-ring.

13 - Check blacklash. It must be measured at four points 90° apart and should be:

Svo = 0.15 to 0.25 mm

Note

The individual readings must not differ from one another by **more than 0.05 mm.**

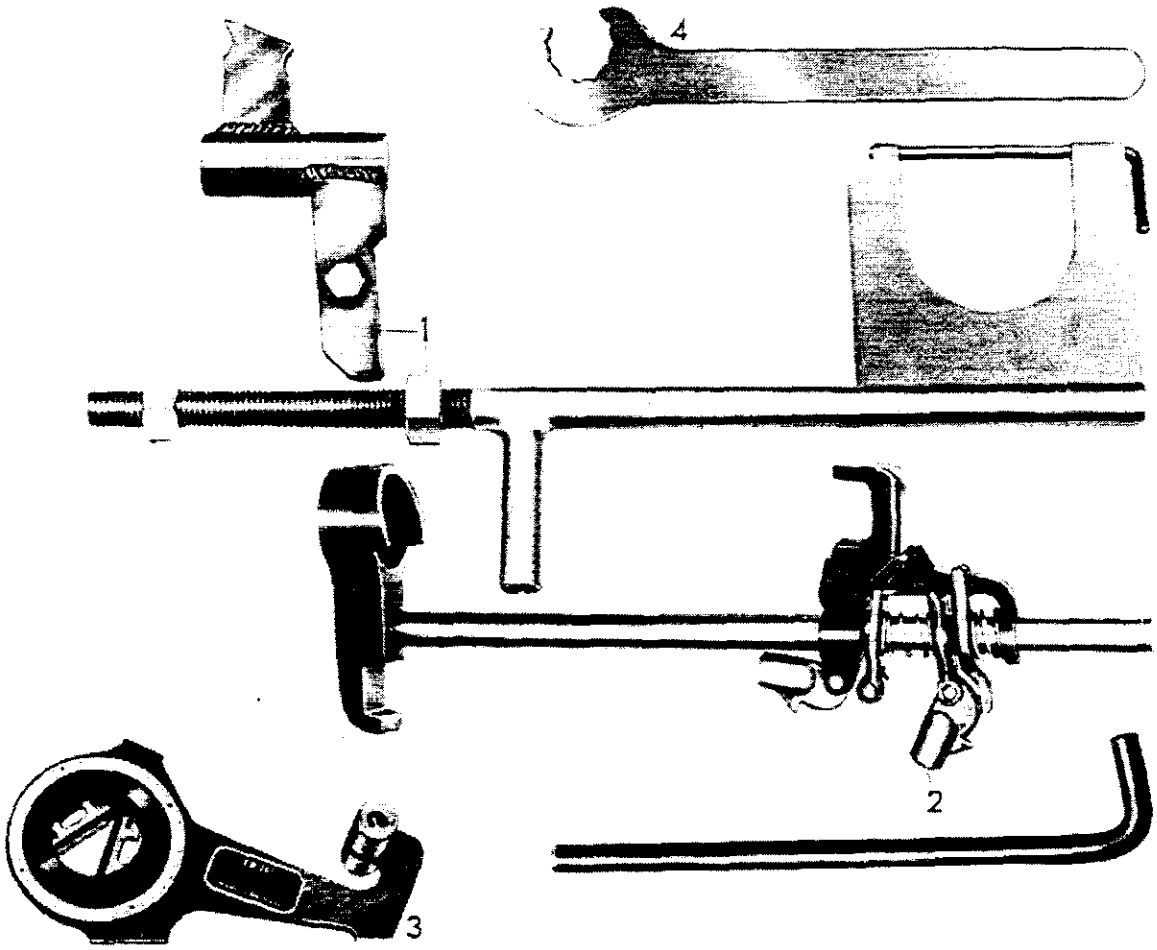
14 - Remove sleeve VW 382/3. Press oil seal into cover with tube VW 415a and assemble transmission.
See "Removing and installing differential" (H 5.1/11).

Gear set	Correction factor "w"	Lift "h"
G 833/835	1	0.20
K 833	1	0.20
K 835	1.10	0.22

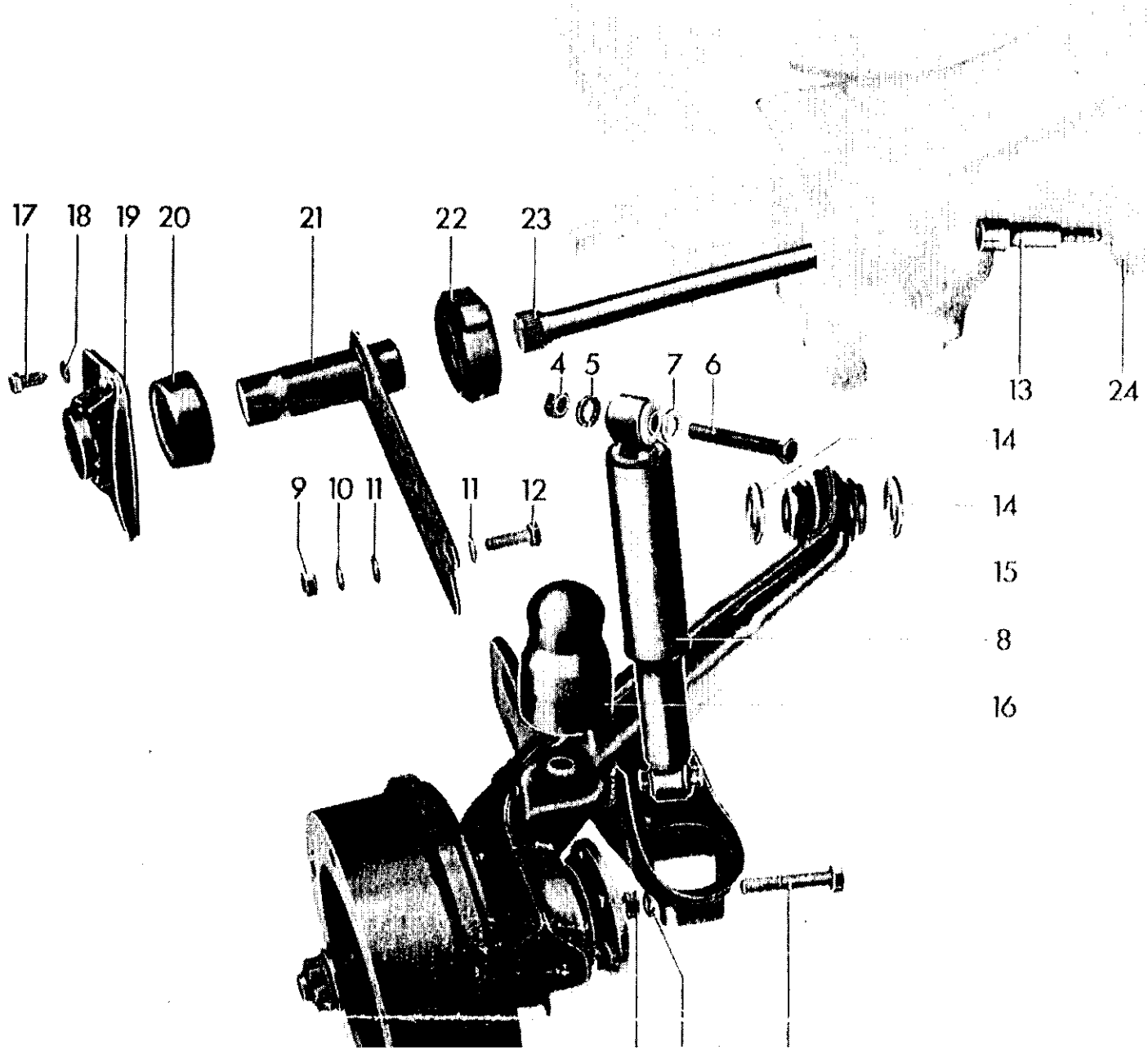
Shim No.	Part No.	Thickness
1	113 517 201 A	0.15
2	113 517 202 A	0.20
3	113 517 203 A	0.30
4	113 517 204 A	0.40
5	113 517 205 A	0.50
6	113 517 206 A	0.60
7	113 517 207 A	0.70
8	113 517 208 A	0.80
9	113 517 209 A	0.90
10	113 517 210 A	1.00
11	113 517 211 A	1.20

nominal shim thickness as found for S_1 or S_2	Shim thickness	Shim No.
0.28—0.32	0.30	3
0.33—0.37	0.35	1+2
0.38—0.42	0.40	4
0.43—0.47	0.45	1+3
0.48—0.52	0.50	5
0.53—0.57	0.55	1+4
0.58—0.62	0.60	6
0.63—0.67	0.65	1+5
0.68—0.72	0.70	7
0.73—0.77	0.75	1+6
0.78—0.82	0.80	8
0.83—0.87	0.85	1+7
0.88—0.92	0.90	9
0.93—0.97	0.95	1+8
0.98—1.02	1.00	10
1.03—1.07	1.05	1+9
1.08—1.12	1.10	2+9
1.13—1.17	1.15	1+10
1.18—1.22	1.20	11
1.23—1.27	1.25	1+5+6
1.28—1.32	1.30	3+10

The shims should be measured **carefully at several points** with a micrometer. Check shims for burrs or damage.



No.	Description	Special Tool	Remarks
1	Tensioner	US 4437	
2	Tensioner	VW 655 3	
3	Protractor	VW 261	
4	Special wrench	VW 179	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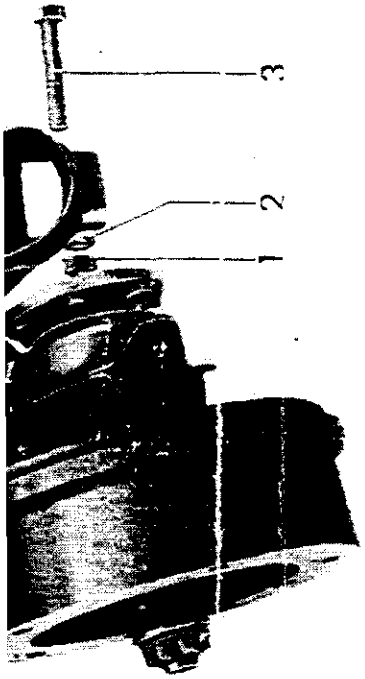


No.	Description	Qty.	Note when removing	Note when installing	Special instructions see
1	Nut M 12, galvanized	1		tighten to 6 mkg (43 lb ft)	
2	Spring washer, galvanized	1			
3	Bolt M 12 x 70, galvanized	1			
4	Nut M 12	1		tighten to 6 mkg (43 lb ft)	
5	Spring washer	1			
6	Bolt M 12 x 80	1			
7	Washer	1			
8	Shock absorber	1		check for operation, replace if necessary	
9	Nut M 12	3		tighten to 11.5 mkg (83 lb ft)	
10	Spring washer	3			
11	Washer	6			
12	Nut M 12 x 35	3			
13	Special bolt	1		tighten to 12.5 mkg (90 lb ft) and secure	
14	Spacer	2	note installation position	install correctly, adjust diagonal arm if necessary	
15	Diagonal arm, assembly	1		inspect for damage	
16	Rubber stop	1			
17	Bolt M 10 x 22	3		tighten 3.5 mkg (25 lb ft)	
18	Spring washer	3			
19	Cover, spring plate hub	1			
20	Outer rubber bushing	1		install with talcum powder	
21	Spring plate	1	pry off	use VW 655/3	
22	Inner rubber bushing	1		install with talcum powder	
23	Torsion bar 24 mm (0.945 in.) diameter	1		left and right side different, note marking: L = left R = right, adjust	
24	Frame	1			

Removing

1 - Loosen slotted nuts.

Warning

Do not loosen or tighten the slotted nuts of the axle shafts with the vehicle on a hoist. Loosen and tighten nuts with the vehicle standing on its wheels only.

2 - Detach drive shaft at wheel end and protect joint with plastic cap.

3 - Remove lower shock absorber bolt.

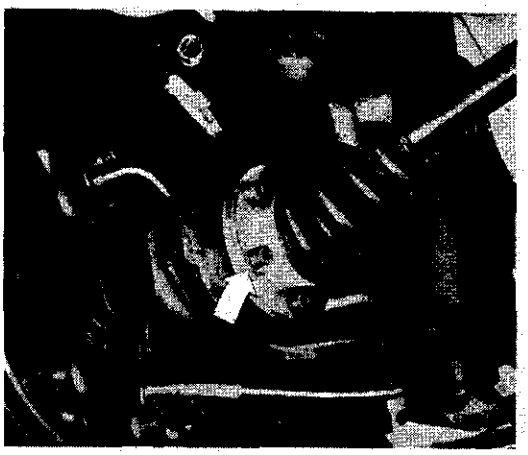
4 - Remove slotted nut and pull brake drum off. Detach brake line and parking brake cable from backing plate.

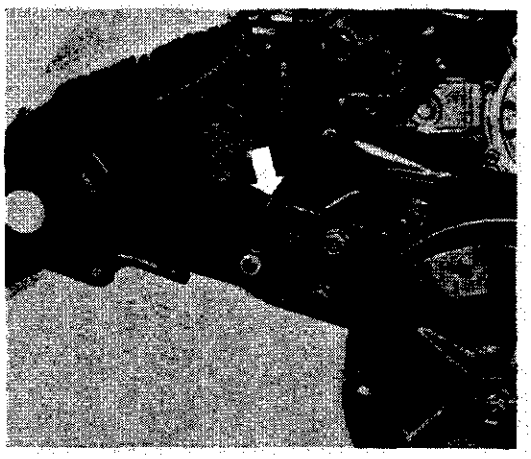
Note

If only the wheel bearings are to be disassembled, remove the brake drum and backing plate but do not disconnect the brake line and parking brake cable. Hang backing plate on vehicle with a piece of wire (see H 7.2/4).

5 - Mark location of spring plate and diagonal arm with a chisel (arrow).

6 - Remove nuts and bolts holding the diagonal arm on the spring plate.

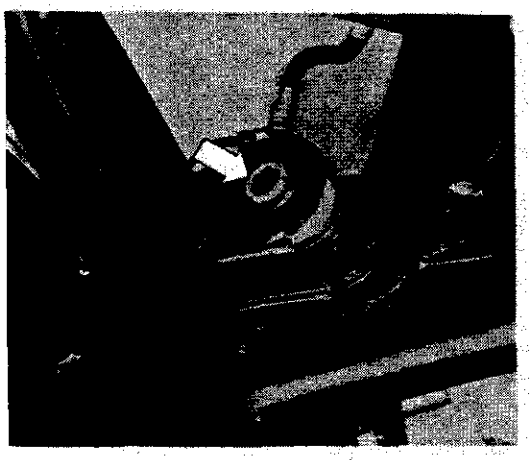




7 - Remove special bolt attaching arm to bracket (arrow) and take arm off.

Note

Note location of spacers. They must be put back in the same place.

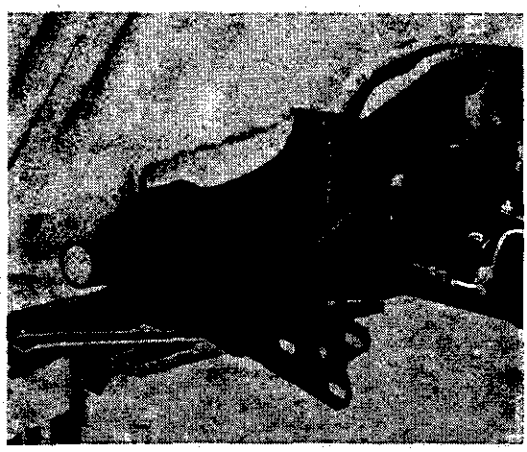


Removing diagonal arm with spring plate Type 1 / Model 181 3-3

8 - Remove bolts of cover on spring plate hub and take cover off.

Note

The spring plate can also be removed with the diagonal arm installed.



9 - Lift spring plate off lower stop with a lever.

10 - Take spring plate off and pull torsion bar out.

Note

Pieces of broken torsion bars can be pulled out with a tube which has been opened up at one end or by removing the opposite torsion bar and knocking out with a long drift.

Installing

Check torsion bar, rubber bushings and spring plates for wear and damage and replace parts if necessary.

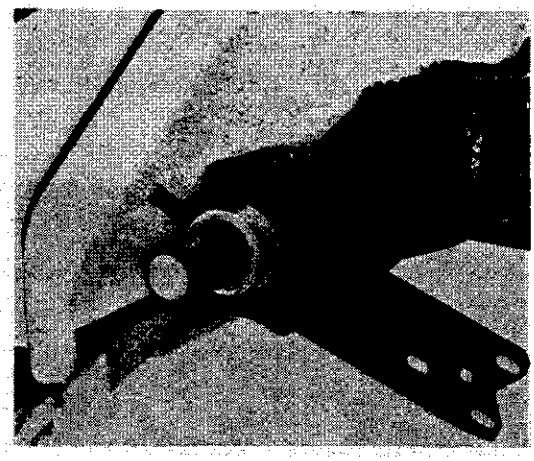
Caution

a - Damaged places in the protective paint on the bars must be touched up with paint in order to avoid fatigue fractures due to corrosion.

b - The torsion bars are prestressed in the working direction and must not be interchanged. The left bar has an "L" on the end face and the right bar has an "R".

1 - Grease torsion bar splines before inserting.

2 - Coat inner rubber bushing with talcum powder before installing.



Note

a - When installing the rubber bushings, note that the marking "oben" is at the top. Inner and outer bushings are different.

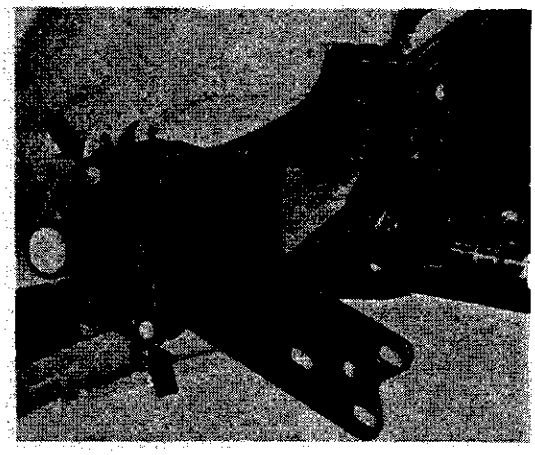
b - Coat bushings **with talcum** and not with graphite. All rubber bushings are intended to remain stationary on inner and outer surfaces and twist internally. If coated with graphite powder, the spring plate turns in the bushings and wears them out prematurely.

3 - Install spring plate and outer bushing and adjust torsion bar. See H 7.2/3.

Caution

When a spring plate is replaced, the position of the rear wheels must be checked on an axle alignment stand and set correctly.

4 - Mount spring plate hub cover with two bolts (arrows), using longer bolts if necessary.



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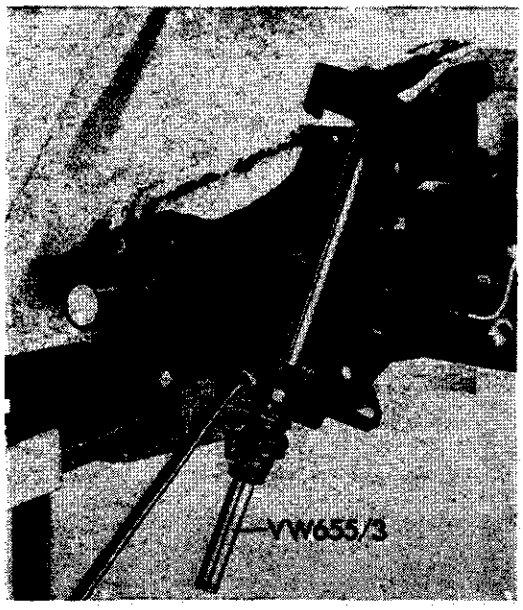


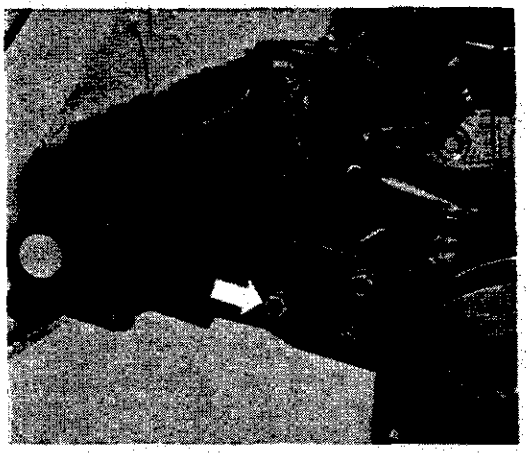
5 - Lift spring plate to lower stop with tensioner VW 655/3 and tighten the bolts in hub cover.

Caution

Use only the tensioner VW 655/3. Place it at the end of the spring plate. The upper bracket must be hooked between the body and support.

6 - Install remaining bolts in the cover and replace the two long bolts (if used) with the standard bolts. Tighten all bolts to correct torque.

7 - Attach diagonal arm to frame and insert special bolt. Do not tighten. Note location of spacers.



8 - Attach arm to spring plate. Watch the alignment marks. Tighten the nuts and bolt to **correct torque.** When adjusting the wheel toe with vehicle standing on its wheels the arm will slip to this position on its own.

Note

When a diagonal arm is replaced, the position of the rear wheel of that side must be checked on an axle alignment stand and rectified as required.

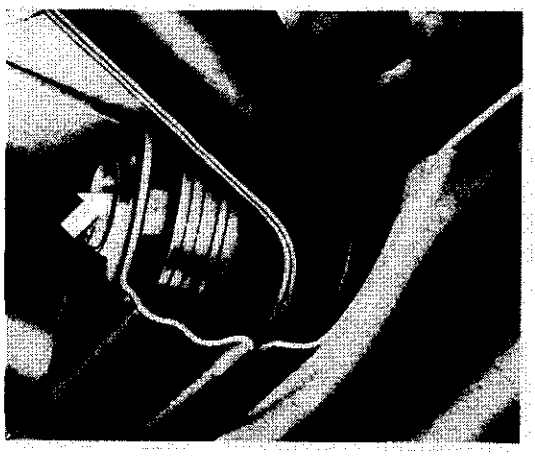
9 - Lift spring plate with VW 655/3 so that there is an angle of 4°35' between horizontal line and spring plate.

Note

In this position tighten special bolt to correct torque. Then lock bolt.

Note

To prevent tension in the bonded rubber bushings slightly tighten the special bolt in this position. Tighten afterwards to final torque. Lock bolt by peening the metal shoulder on bracket (arrow). If a diagonal arm was replaced, check the adjustment of drive shaft and correct if necessary (See H 7.2/3).



10 - Attach backing plate and bearing cover for rear wheel shaft to diagonal arm and tighten bolts to **correct torque.**

11 - Grease joint lightly and install shaft. Tighten socket head screws to **correct torque.** Use new lock washers and install them with the convex side towards the screw head.

Note

The contact surfaces of shaft flange and joint must be free of grease.

12 - Install brake drum, tighten slotted nut to **correct torque** and secure with cotter pin.

Warning

Do not loosen or tighten the slotted nuts with the vehicle on a hoist.
Loosen or tighten the nuts with the wheels of the vehicle on the ground.

13 - Bleed and adjust brakes.

Adjusting

The setting angle for the torsion bar is given in degrees with bar free of load and in relation to the longitudinal vehicle axis. If the protractor VW 261 is used (the spirit level works from the horizontal), the deviation between the vehicle longitudinal axis and true horizontal must be found first and taken into account in the setting angle.

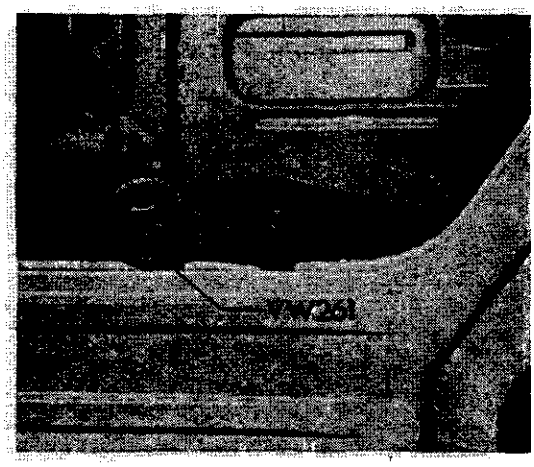
The torsion bars have different numbers of splines on the ends,

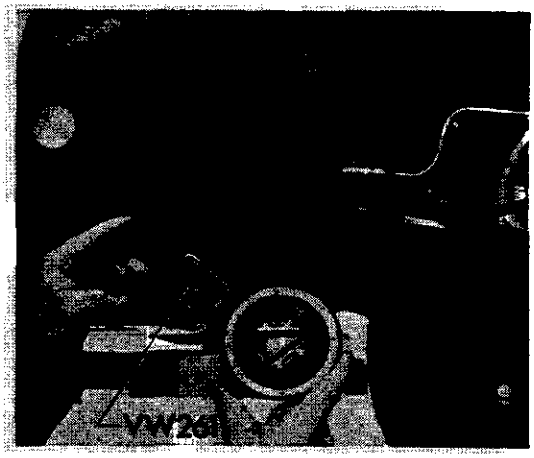
inner end 40 splines,
outer end 44 splines,

so that turning the torsion bar inner end one spline alters the angle 9°, and turning the spring plate back one spline alters the angle 8° 10'. This means that the smallest possible alteration is 50'.

Note

On vehicles with high mileage, always adjust both torsion bars because the bars tend to settle in use.





1 - Determine deviation of vehicle axis from the horizontal and note the reading.

CORRECT SETTING
20° ± 30'
TWENTY DEGREES
PLUS OR MINUS
30 MINUTES
60 MINUTES = 1 DEGREE

2 - Place spring plate on torsion bar, position protactor VW 261 on plate and measure angle. Lift the plate while measuring the angle in order to eliminate the play in the splines.

3 - If the angle deviates **more than 50'**, the angle must be corrected.

4 - According to the deviation, turn torsion bar one spline forward or back and spring plate one spline in the opposite direction.

Adjusting rear axle

The power unit consisting of the engine, transmission and final drive is attached to the frame cross tube at the front with a bonded rubber mounting. At the rear it is supported by a carrier which is bolted to the engine and secured to each side of the body with rubber bushings.

The independently suspended wheels are located by semi-trailing arms and trailing links. The trailing link which is usually referred to as the spring plate is bolted to the wheel bearing housing and splined on to the transverse torsion bars. The semi-trailing arm is a fabricated sheet metal construction (diagonal arm) which is mounted on a bracket welded to the cross tube. This suspension arrangement is designed to give a slight variation in camber angle which ensures optimal road holding under all load conditions.

Torque is transmitted from the flanges on the final drive to the wheel shafts via short drive shafts with two constant velocity joints per shaft. The sliding travel in the constant velocity joints compensates for all changes which occur in the distance between the flanges on the final drive and those on the wheel shafts. In order to prevent the sliding movement from being restricted due to varying manufacturing tolerances, the space between the wheel shaft flanges must be set correctly with the suspension at the bottom of its movement. The engine/transmission unit must also be centralized between the wheel shaft flanges.

Type 1 / Model 181 vehicles with double-joint axles must be adjusted as follows.

In order to make it possible to adjust the suspension when a diagonal arm has been replaced or accident damage repaired, the following checks and adjustments are provided on the rear axle:

a - The space between the wheel shaft flanges and the centralization of the engine/transmission unit is checked with suspension at the bottom of movement by using a ruler. This check also provides an direct check on the sliding travel of the constant velocity joints.

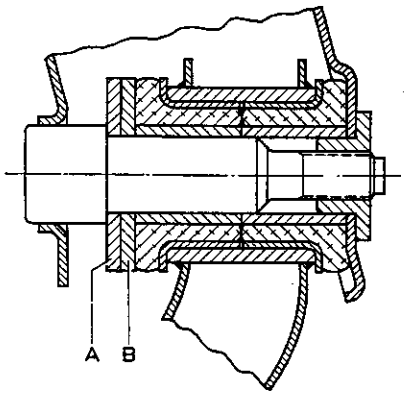
b - The diagonal arm can be moved laterally by moving two adjusting washers A and B. This adjusts the distance between the wheel shaft flanges.

c - The spring plate, which is made up of two plates is bolted to the diagonal arm with four bolts. The holes in the double spring plate are elongated so that the wheel track angle can be adjusted by moving the diagonal arm. As the wheel toe angle and the distance between the flanges are directly dependent on one another, the toe angle and diagonal arm setting must always be checked together when adjusting the rear axle.

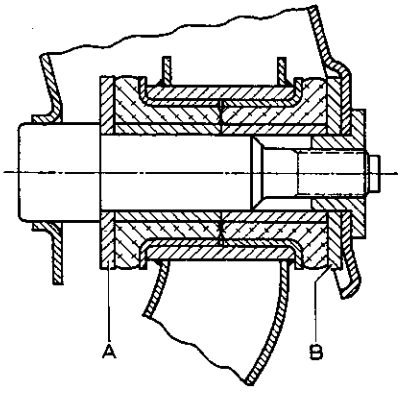
d - The rear engine mountings can also be moved sideways on the body so that the engine/transmission unit can be centralized.

There are two possibilities:

Version 1: both washers (A and B) outside



Version 2: one washer (A) outside, one inside (B)



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Adjusting rear axle

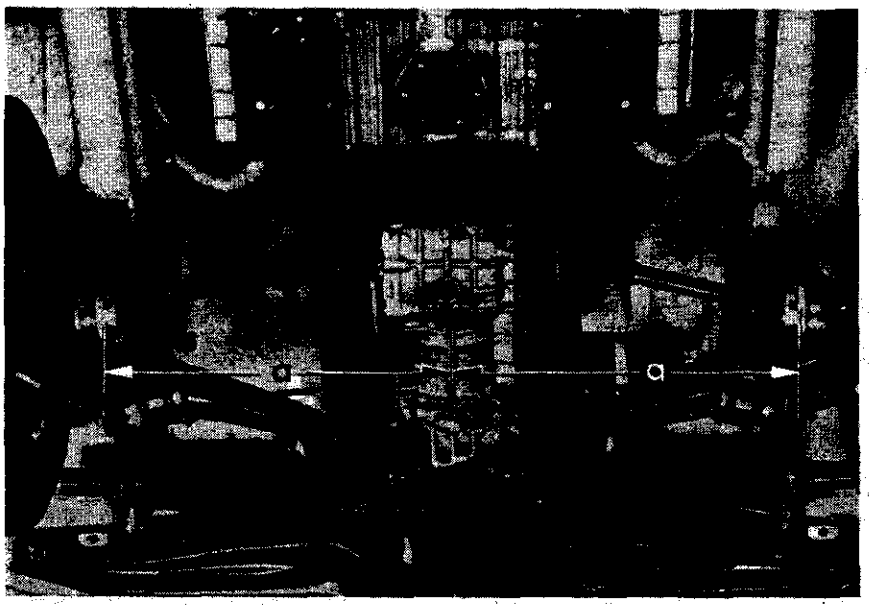
Checking

Before adjusting the rear axle in the vehicle check first dimension "a" (from center transmission case to flanges of driveshaft joints).

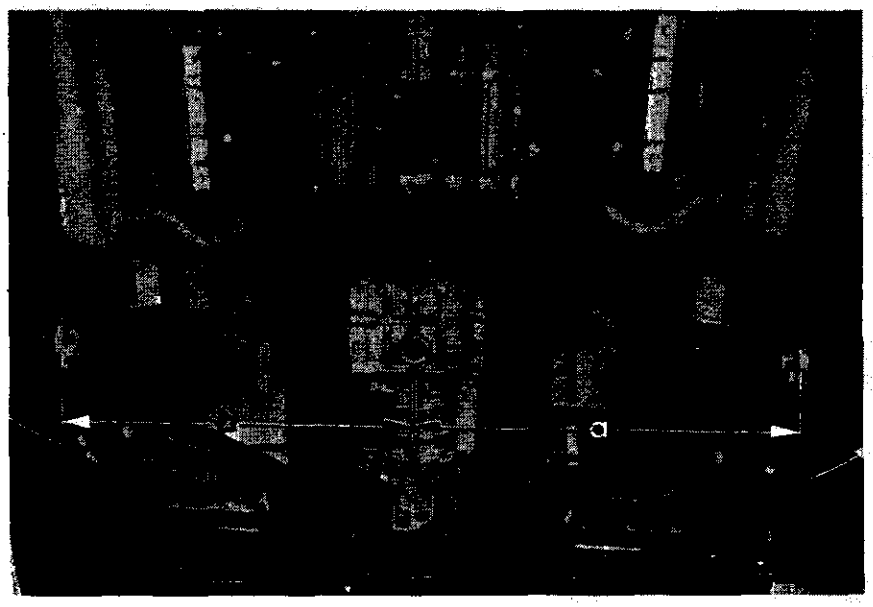
A = vehicle on a hoist (rear wheels **off** ground)

B = vehicle with rear wheels **on** ground

Check dimension with a ruler.



A - Vehicle on hoist, a = 487.5 ± 1.5 mm (19$^{3}/_{16}$ ± $^{1}/_{16}$ in.)



B - Vehicle on ground, a = 492.5 ± 1.5 mm (19$^{3}/_{8}$ ± $^{1}/_{16}$ in.)

Adjusting

When adjusting the rear axle, start with the diagonal arm which is the largest amount out of line with the transmission center.

1 - Remove nuts holding spring plate but do not take bolts out.

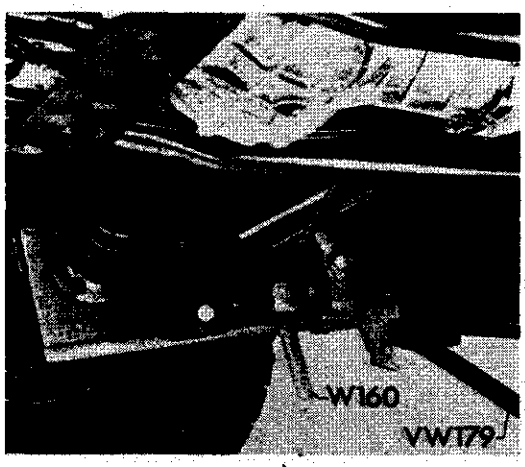
2 - Remove fitted bolt in diagonal arm with a 17 mm socket wrench.

3 - Press diagonal arm to one side with a lever until adjusting washer can be moved.

4 - Install the fitted bolt in diagonal arm.

5 - Install nuts in spring plate bolts and tighten slightly.

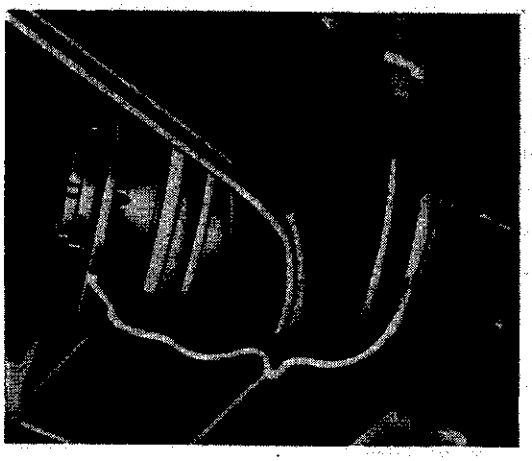
6 - Align vehicle properly on optical measuring stand and set wheel toe angle **on both sides** with VW 160 and VW 179. When tightening the spring plate bolts watch the angle between arm/plate. (H 7.2/3).



7 - Centralize the engine/transmission assembly by moving the engine mountings in the elongated holes in the body side members.

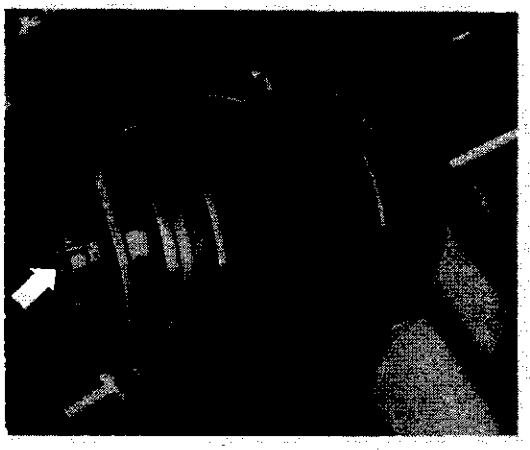
Note

There are two adjusting washers on each diagonal arm. It is necessary to install at least one of the washers on the outside. This means that there are only two alternative adjustments for each arm:



One adjusting washer outside and one inside.

8 - Install fitted bolt, tighten and secure by peening.



Both adjusting washers outside.

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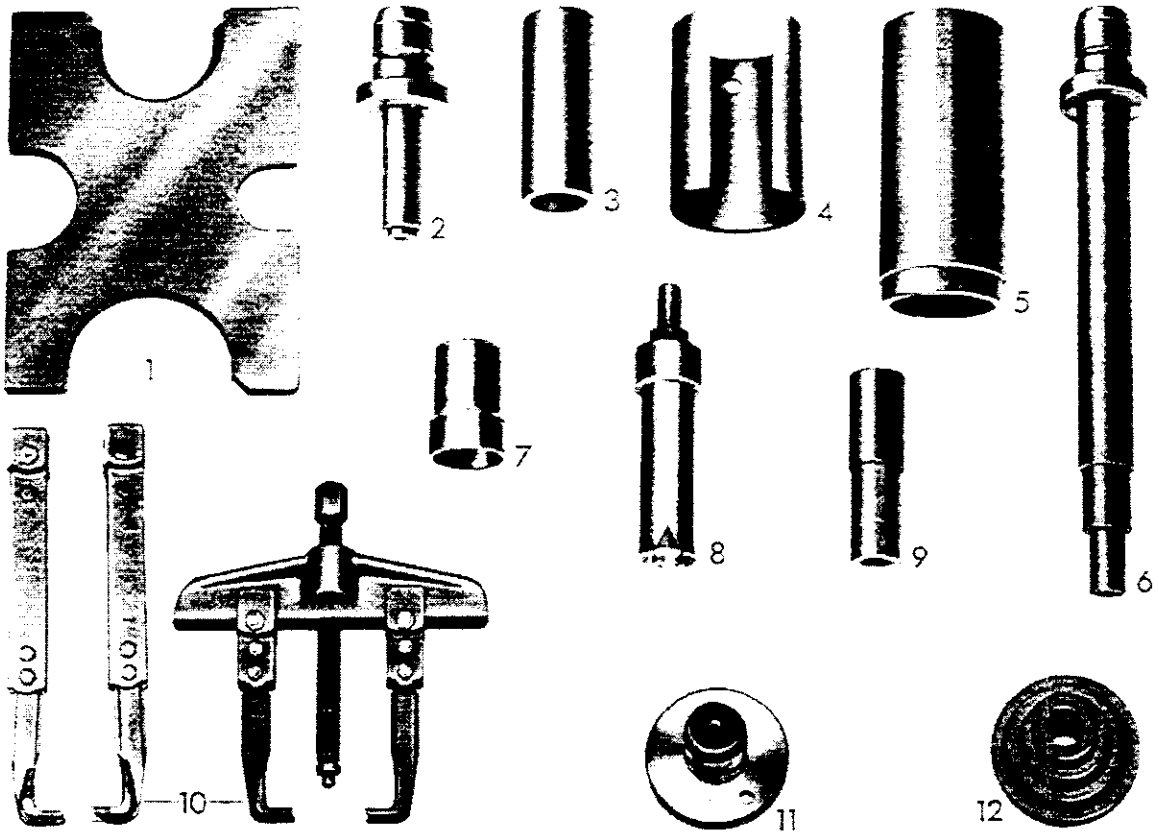

No.	Description	Special Tool	Remarks
1	Plate	VW 402	
2	Press tool	VW 409	
3	Thrust tube	VW 416 b	
4	Removing tool	VW 463/3	
5	Thrust tube	VW 415 a	
6	Press tool	VW 408 a	
7	Thrust sleeve	VW 454	
8	Extractor	—	local purchase item
9	Thrust tube	VW 421	
10	Puller	US 1078/79	
11	Press tool	VW 412	
12	Press tool	VW 474	

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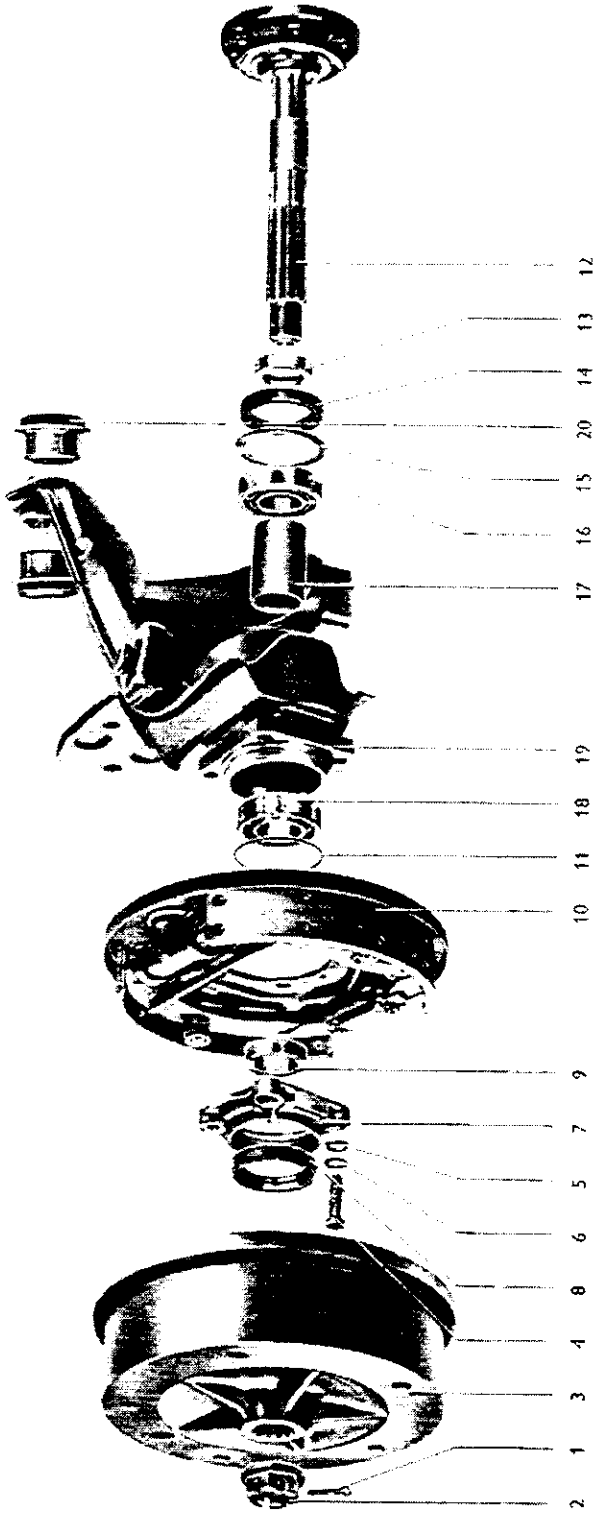
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No.	Description	Qty.	Note when disassembling	assembling	Special instructions see
1	Cotter pin 5 x 45	1		replace	
2	Slotted nut M 24 x 1.5	1		tighten to 35 mkg (253 lb ft)	
3	Brake drum	1		clean, check for wear or damage and thread for wheel bolts	
4	Bolt	4		tighten to 6 mkg (43 lb ft) use only bolts of tensile class 10 K	
5	Washer	4			
6	Spring washer	4			
7	Bearing cover	1			
8	Oil seal, outer	1	pry out with lever	replace, press in with VW 474	
9	Spacer, outer	1		check for wear, replace if necessary	
10	Backing plate, assembly	1			
11	O-ring	1			
12	Rear wheel shaft	1	drive out with punch or pull out with puller	drive in with rubber hammer	
13	Spacer, inner	1		check for wear, replace if necessary	
14	Oil seal, inner	1	pry out with lever	drive in with VW 415 a, or press in with VW 402, VW 412 and VW 415 a	
15	Circlip 62 x 2	1		check for proper seating	
16	Ball bearing	1	drive out with VW 295	check for wear, drive in with VW 415 a, or press in with VW 402, VW 412 and VW 415 a	
17	Spacer sleeve	1			
18	Roller bearing	1	drive out with punch	drive in with VW 415 a	
19	Diagonal arm	1		fill with multipurpose grease	
20	Bonded rubber bushing	2		check for wear, replace if necessary, note installation position, notches of bushings must be horizontal	

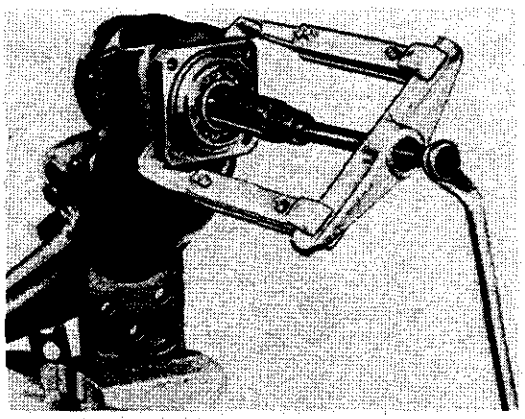
Disassembling

1 - Clamp diagonal arm flange in the vise.

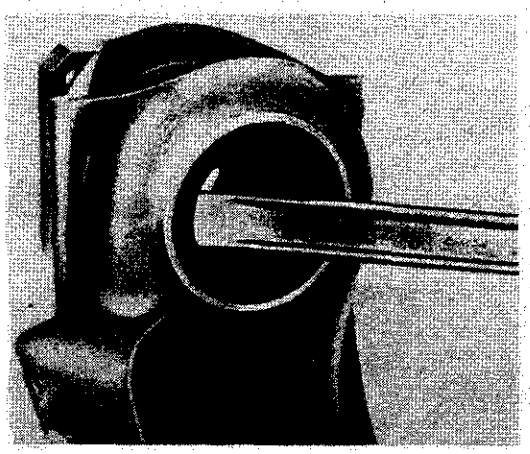
2 - Remove slotted nut and brake drum.

3 - Remove bolts holding bearing cover, take off cover with O-ring, outer spacer and backing plate.

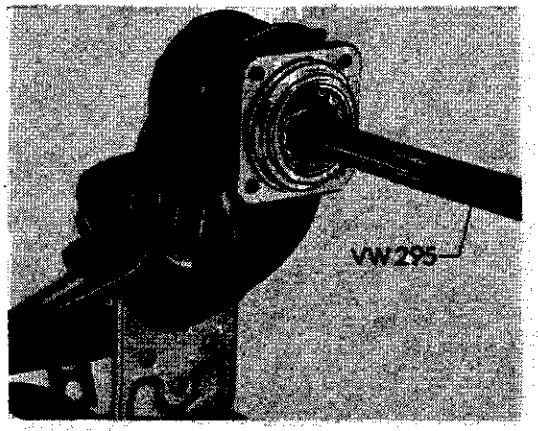
4 - Knock shaft out with a soft drift or press it out with a puller and 250 mm (10 in.) jaws. Take inner spacer out.



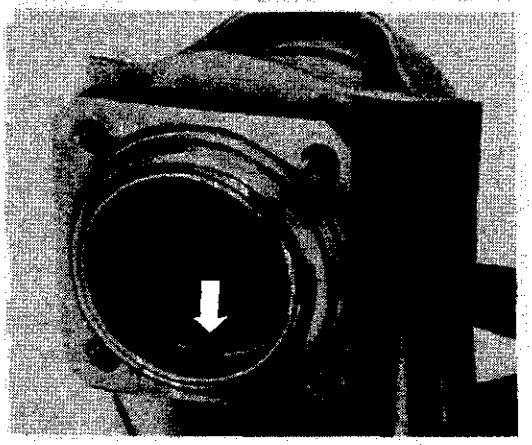
5 - Pry inner oil seal out.



6 - Take circlip off and knock ball bearing out with a drift (such as VW 295).



7 - Take out spacer sleeve, inner race of roller bearing and drive the outer race (arrow) out with a drift.



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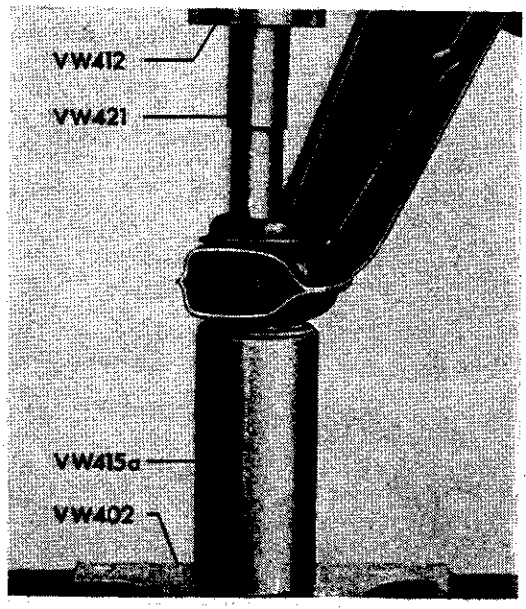
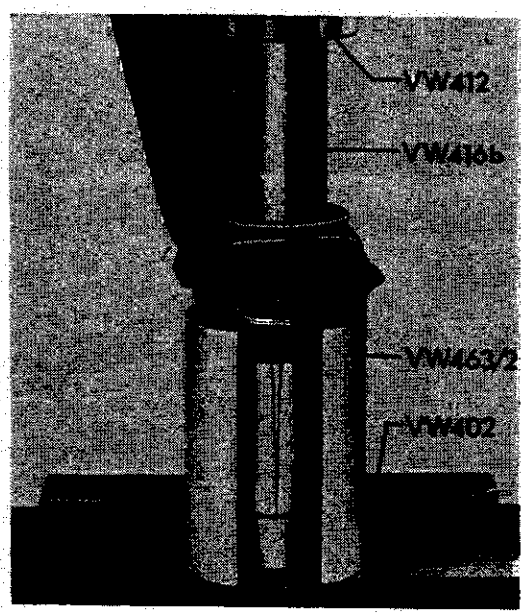


8 - Press inner sleeve of bonded rubber bushing out with VW 402, VW 412, VW 415a and VW 421.

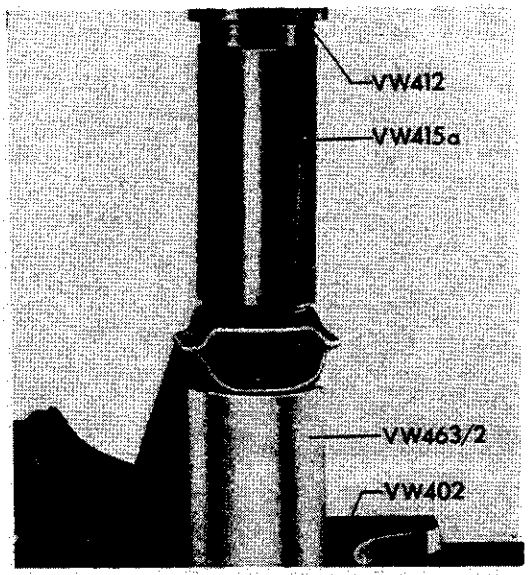


9 - Press outer sleeve of bonded rubber bushing out with VW 402, VW 412, VW 416b, 463/2 and internal extractor.

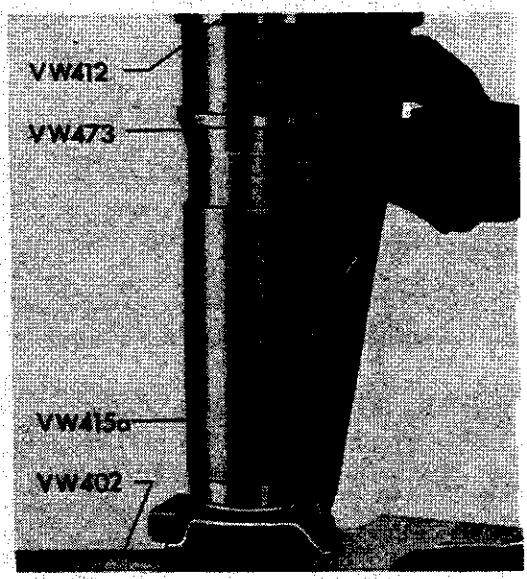
Assembling

1 - Check bonded rubber bushing, oil seals, wheel shafts and spacer rings for wear and damage or scoring. Replace damaged parts.

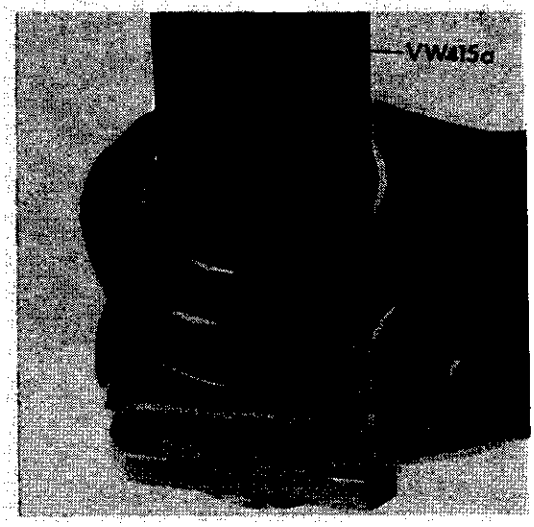
2 - Press one bonded rubber bushing in with VW 402, VW 412, VW 415a and VW 463/2.



3 - Press second bonded rubber bushing in with VW 402, VW 412, VW 415a and VW 473.



4 - Drive ball bearing in with VW 415a or press it in with VW 402, VW 412 and VW 415a.



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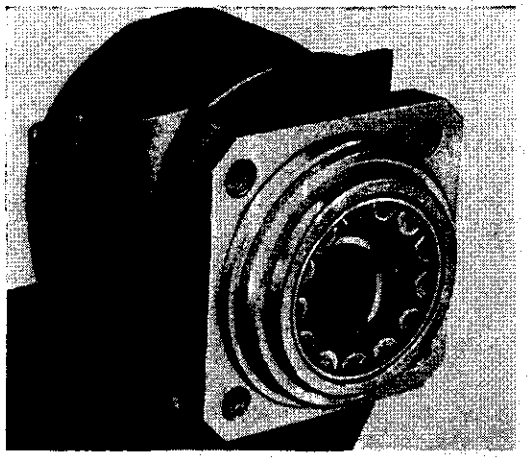
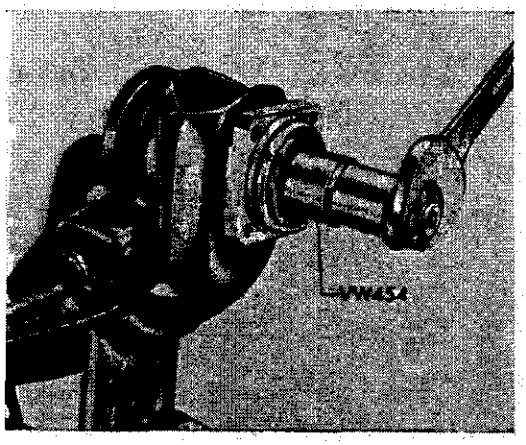


5 - Install circlip and drive oil seal in with VW 415a or press it in with VW 402, VW 412, VW 415a and VW 441.

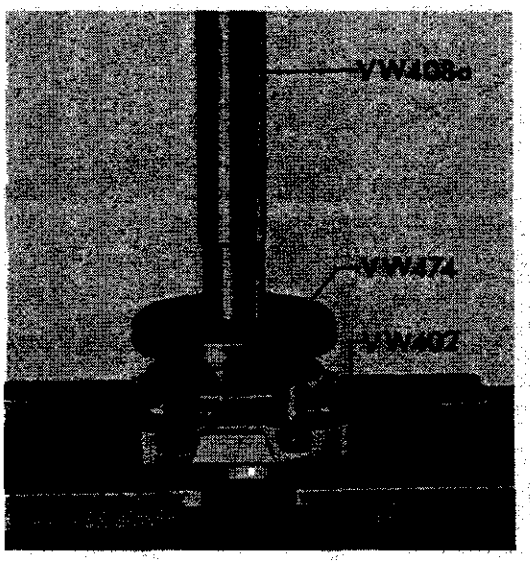
6 - Fill multi-purpose grease into hub of diagonal arm and grease ball bearing and oil seal lip. Drive shaft in or press it in lightly against bearing inner race with VW 402, VW 412 and VW 463/2.

7 - Install spacer sleeve. Grease outer race of roller bearing and drive it in with VW 415a.

8 - Drive in rear wheel shaft with rubber hammer.



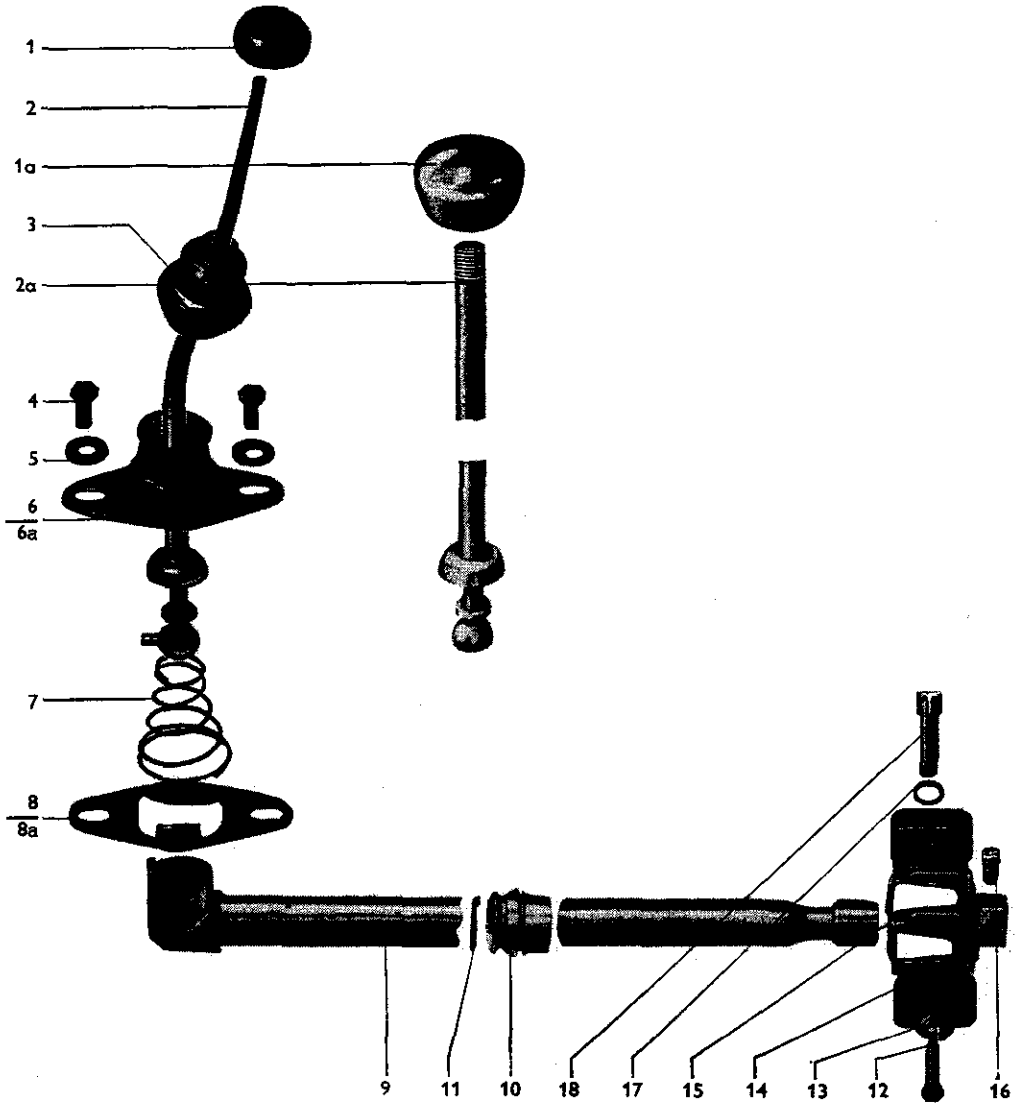
9 - Press bearing inner race in with outer spacer and VW 454 by tightening slotted nut.



10 - Press oil seal into bearing cover with VW 402, VW 408a and VW 474. Fill double lip of seal with grease.

11 - Install backing plate and bearing cover, spacer and new O-ring. Tighten bolts to correct torque.

12 - Install brake drum and slotted nut.



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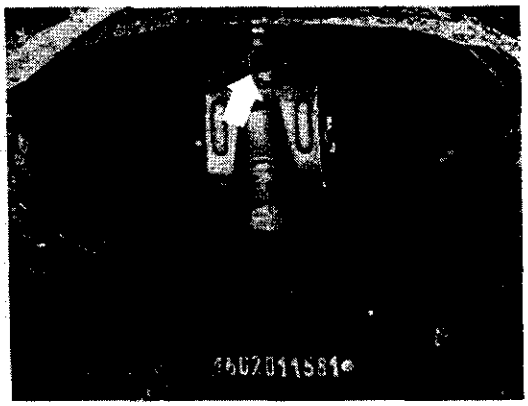
No.	Description	Qty.	Note when removing	Note when installing	Special instructions see
1	Knob	1		M 7 x 1 thread	
1a	Knob	1		M 12 x 1.5 thread	from Chass. No. 118 000 001
2	Gearshift lever	1		with pin in ball	
2a	Gearshift lever	1			straight from Chass. No. 118 000 001
3	Bellows	1			
4	Bolt M 8 x 20	2		2 mkg (14 lb ft)	
5	Spring washer 8.1 x 22	2			
6	Bracket	1		adjust	
6a	Bracket	1		adjust	from Chass. No. 112 2 000 001
7	Spring	1			
8	Stop plate	1		adjust	
8a	Stop plate	1		adjust	from Chass. No. 112 2 000 001
9	Gearshift rod	1		with slot in ball socket	
9a	Gearshift rod	1		without slot in ball socket	from Chass. No. 118 000 001
10	Sleeve	1		coat with Molykote	
11	Ring	1			
12	Hex. head sheet metal screw	1			
13	Locking cap	1			
14	Insert	2			
15	Housing	1			
16	Square head screw	1			
17	Washer	1			
18	Spring pin	1		coat with multi-purpose grease	

Removing

1 - Remove bolts holding gearshift lever bracket and take out lever, bracket, spring and stop plate.

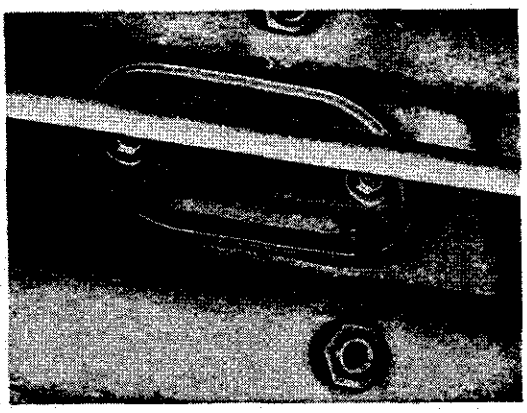
2 - Remove plate over access hole in frame fork, remove securing wire (arrow) and take out square headed screw with wrench VW 114.

3 - Remove sheet metal screw from spring pin in shift rod coupling and take coupling off.



4 - Remove plate in front apron. Loosen bolts (arrows) and take cover plate and gasket off frame head.

Sedan 111

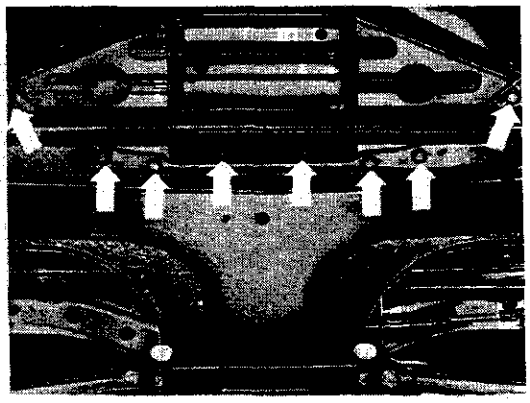


Sedan 113

5 - Slide shift rod forward with a pair of pliers. Pull it out through opening in frame head.

Note

On vehicles with the deformation element in front of the frame head first remove all bolts (arrows) in order to remove the element and then the cover plate.



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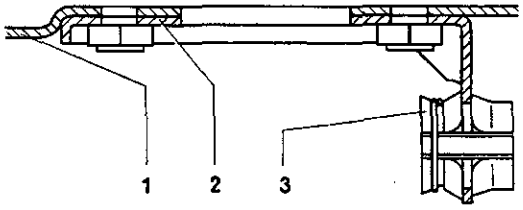


1 - Frame tunnel
2 - Reinforcement bracket
3 - Sleeve

Installing

1 - Check shift rod, coupling, gearshift lever, spring, bracket and guide sleeve for wear and replace parts as necessary.

Note

If the gearshift lever is angled, a shift rod with a slot in the ball socket must be used. Be sure that the correct lever and rod are installed.

2 - **Grease entire length of shift rod** and slide it into frame tunnel.

3 - Slide guide sleeve into the front guide bracket and install retaining ring. Grease sleeve.

Note

The sleeve is correctly installed when the slot is at the side.

4 - Push the shift rod through the front guide to the rear until the ball socket is in the center of the hole in the frame tunnel. Install frame head plate and gasket and front apron plate.

5 - Install shift rod coupling, insert the spring pin and tighten sheet metal screw.

6 - Install coupling on inner shift lever, tighten square headed screw with VW 114 and secure it with wire. Install cover plate on frame fork.

7 - Assemble gearshift lever. Install bracket, push bellows on and screw knob on.

Note

Coat bracket, ball and socket in shift rod with multi-purpose grease.

8 - Install spring and stop plate. The longer raised edge must be on the right. Install gearshift lever and tighten bolts or bracket.

Note

If the shift rod or gearshift lever rattles, check the guide sleeve and the retaining ring. If the gearshift lever rattles in the ball socket of the shift rod, it can be remedied by filling the ball socket of the rod with thick grease or by installing a gearshift lever with a ball which is at the upper tolerance.

Adjusting shift linkage

1 - Shift into second gear and loosen bolts in bracket.

Note

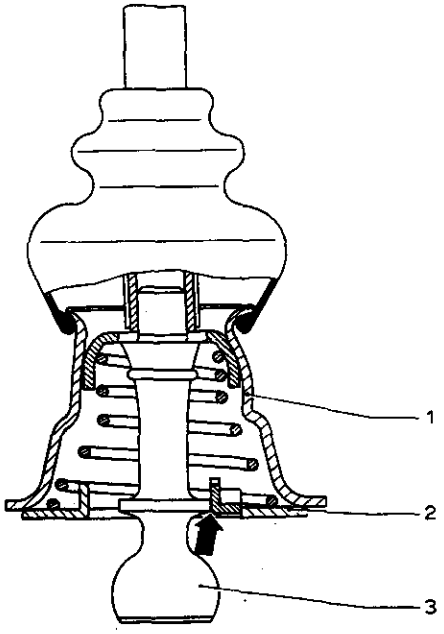
During the following operation the clutch pedal should be depressed.

2 - Align gearshift lever carefully in the second gear position. It must be exactly vertical in the transverse direction and inclined to the rear about 11° in the longitudinal direction.

3 - With a screwdriver, push the stop plate under the bracket to the left until it touches the shoulder on the lever (arrow). The gear lever must be moved by the plate.

4 - Tighten the bolts holding the bracket in this position. It should now be possible to move the lever sideways about 15 to 20 mm (5/8 to 3/4 in.) — measured at knob — with second gear engaged.

5 - Shift into all gears a few times, moving gearshift lever carefully in the H pattern. Do not try to move lever diagonally. The gears should engage easily and without jamming. Check that the reverse gear safety catch is effective.



1 - Bracket
2 - Stop plate
3 - Gearshift lever

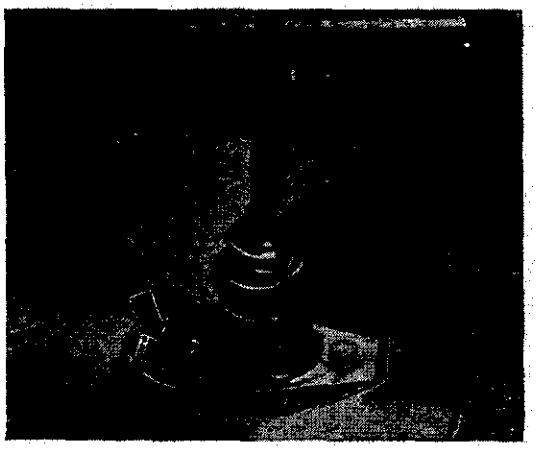
Modification

From Chassis No. 112 2 000 001 / August 1971

The shift lever bracket and the stop plate were modified.

When installing the new parts, make sure that the slotted hole with the pointed end, is pointing to the front (arrow).

Otherwise shifting difficulties will occur when shifting in reverse.



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Section K

Fuel and E.G.R. System

The function of the carburetor is to prepare a mixture of fuel and air in the right proportion for good engine performance under all conditions of temperature, speed and load. By using the vacuum created by the suction of the pistons in the engine cylinders, various systems within the carburetor become operative and allow fuel and air to flow in different amounts and proportions to suit engine operation.

The automatic choke provides a rich mixture for starting the cold engine. As the engine warms up, the choke valve gradually opens to admit more air and weaken the mixture.

Fuel is supplied to the carburetor by the fuel pump. When the fuel in the float chamber has reached a predetermined level the rising float lifts the float needle until it closes the valve, cutting off the fuel being supplied.

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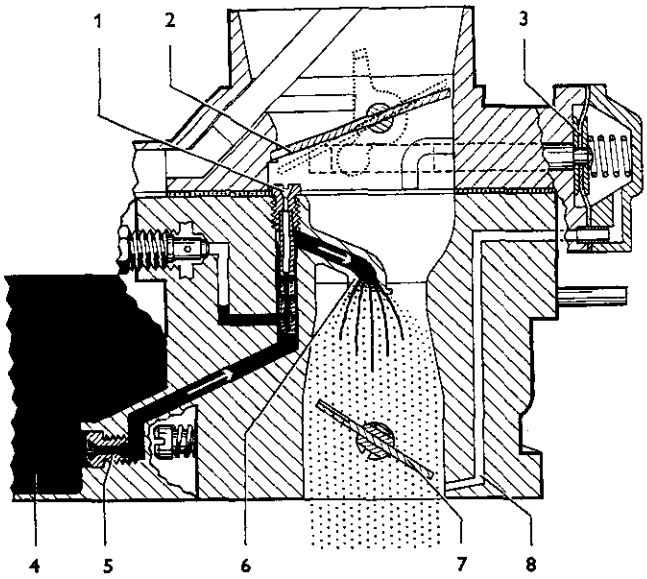


Automatic choke

Before starting when cold, the throttle valve (7) must be opened by depressing the accelerator pedal briefly once so that the tensioned bimetal spring can close the choke valve (2) via the operating lever. The idle adjusting screw then rests on one of the steps of the fast idle cam and opens the throttle valve a little. When the starter is operated, a vacuum is created which draws fuel from the float chamber (4), through the main jet (5), emulsion tube with air correction jet (1) and the discharge arm (6) into the venturi. The choke valve (2) is opened slightly against the tension of the bimetal spring by the vacuum diaphragm (3).

The vacuum diaphragm (3) is connected by a drilling (8) to the vacuum which is present below the throttle valve and can open the choke valve via the diaphragm rod.

As the bimetal spring heats up, the choke valve opens slowly until after about 2 to 3 minutes it is fully open. When the choke is fully open the throttle stop screw rests on the lowest step of the fast idle cam when the engine is idling.

Idle operation

When the engine is idling the speed of the air entering the carburetor, and therefore the vacuum in the venturi as well, is not great enough to draw the fuel out of the discharge arm. A high vacuum however is present directly below the closed throttle valve in the carburetor with the bypass air drilling, and the almost closed throttle valve in the standard type carburetor.

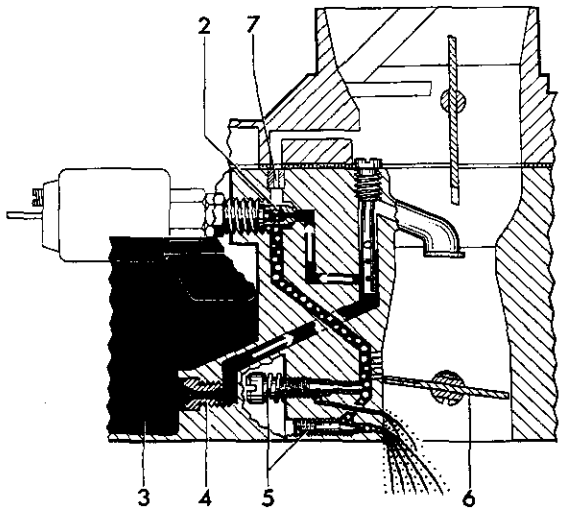
30 PICT-2

(Carburetor without bypass air drilling)

When idling, the engine receives combustion air through the gap at the more or less closed throttle valve (6). Due to the high vacuum below the throttle valve fuel is drawn through the main jet (4) to the pilot jet (2). Air is metered via a drilling through the pilot air jet drilling (7) into the pilot drilling where it forms an emulsion with the fuel.

The quantity of this emulsion can be adjusted by turning the volume control screw (5) in or out. The idle mixture is formed below the throttle valve from emulsion air being drawn in.

The bypass ports near the throttle valve gap smooth out the transition from the idle to the main jet systems.



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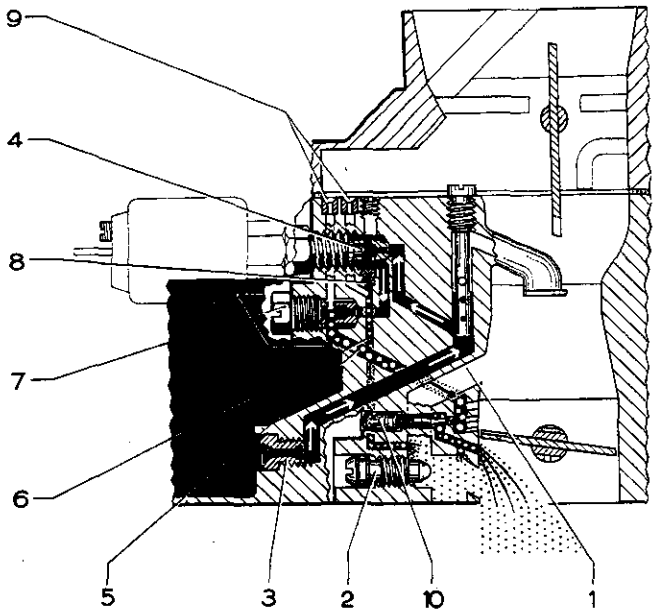


Carburetor with bypass drilling

The air, which is drawn in by the engine during idling, passes through a special drilling on the 30/34 PICT-3 carburetors and bypasses the throttle valve. The bore of this so-called bypass drilling (1) can be altered in size, according to the air requirements of the engine, with the aid of a screw (2). The fuel for idling passes via the main jet (3) to the pilot jet cutoff valve (4). When the ignition is switched on, the path to the two idle drillings (5 and 6) is open. The fuel is metered through the pilot jet (7) in the No. 5 drilling and through the auxiliary fuel jet (8) in the No. 6 drilling. This metered fuel which is mixed with air from the two air drillings (9) passes in part as an emulsion through the drilling (6) directly into the bypass drilling.

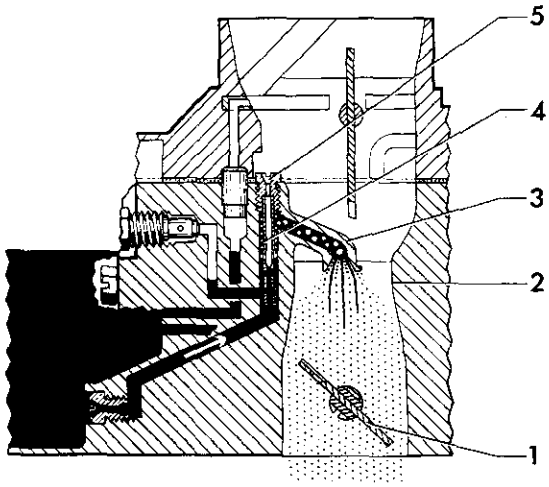
The main portion of the fuel however flows via the drilling (5) where it is metered by the volume control screw (10), to the discharge opening below the throttle valve. The volume control screw (10) is set to a final adjustment by the factory and should not be touched.

The idle adjustment should only be done by turning the bypass screw (2). The emulsion which flows from the drilling (6) into the bypass drilling ensures that the composition of the fuel mixture and thereby the composition of the exhaust gas remains constant even after the bypass screw has been turned.

Part throttle operation

The throttle valve (1) is now open. The air which is being sucked in by the cylinders flows from top to bottom through the carburetor. The discharge arm (3) is situated in the narrowest cross section of the venturi (2). At this point, due to the high air speed which is dependent upon the engine speed, there is a more or less high vacuum which draws the premixed fuel/air emulsion from the mixing tube (4) into the intake port.

Air which enters by way of the auxiliary air jet (5) prevents the mixture from becoming too rich during full load operation. It controls the increase of fuel progressively with the increase in engine speed.



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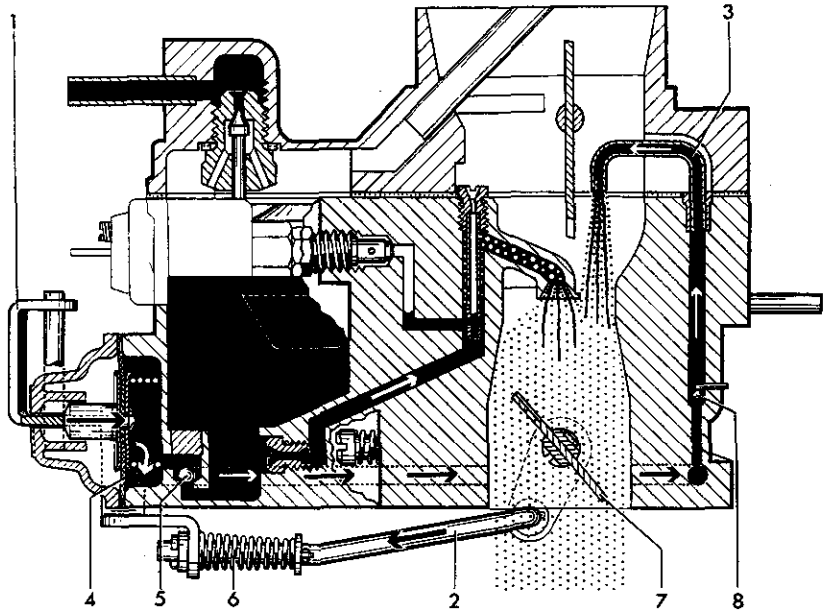
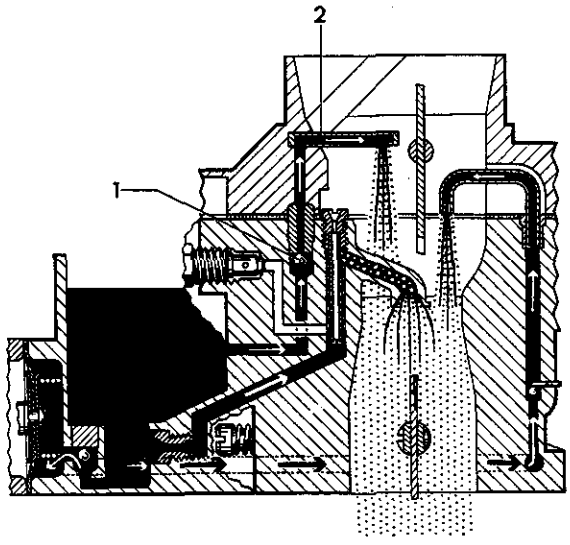


Accelerator pump

When accelerating from idle speed, the vacuum in the venturi is not high enough to draw the fuel out of the discharge arm due to the drop in vacuum caused by the throttle valve being opened suddenly at low engine speed. To overcome this "flat spot" condition, the accelerator pump injects additional fuel into the mixing chamber. The pump diaphragm (4) is operated by the throttle valve (7) via the pump lever (1) spring (6) and connecting rod (2). The diaphragm draws fuel from the float chamber through the ball valve (5), and forces it past the check valve (8) through the injection tube (3) into the carburetor mixing chamber. When the throttle valve closes, the accelerator pump is re-filled with fuel.

At the upper end of the engine speed range the vacuum around the injection tube increases to such an extent that additional fuel is drawn out of the float chamber through the accelerator pump.



Power fuel system

At full throttle and high engine speed, the fuel/air mixture is made even richer to make it possible for the engine to reach its maximum output. The vacuum near the power fuel tube (2) is then so great that additional fuel is drawn from the float chamber via a drilling (1). At lower and intermediate engine speeds, the vacuum is not sufficient to draw fuel through the power fuel tube.

Note

Solex 30 PICT-2 carburetors for engines in Automatic Stick Shift vehicles have a single vacuum takeoff near the throttle valve for the distributor.

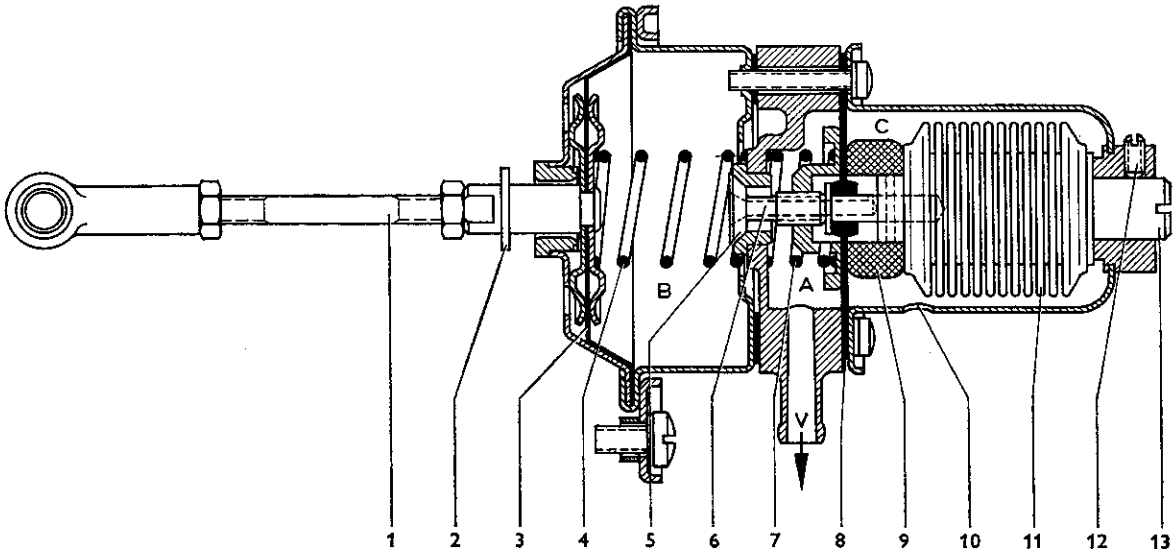
From Eng. No. 5 000 001

The exhaust gas from gasoline engines contains poisonous **carbon monoxide** gas and **hydrocarbons.** The actual amounts of carbon monoxide and hydrocarbons present in the exhaust gas depend to a large extent on the air to fuel ratio of the mixture. The ignition timing, temperature and engine condition are also of some importance. The mixture varies according to the engine operating conditions and this means that the composition of the exhaust gas also varies.

The carburetor and distributor are set so that the proportions of carbon monoxide and hydrocarbon in the exhaust are kept to a minimum.

A throttle valve positioner which opens the throttle valve in accordance with the intake manifold vacuum prevents the proportion of hydrocarbons in the exhaust from increasing when the vehicle is overrunning the engine. Engines of Automatic Stick Shift vehicles have no throttle positioner.

Throttle valve positioner



The purpose of the throttle valve positioner is to open the throttle slightly when the vehicle is overrunning the engine, thus preventing the intake manifold vacuum from rising as high as it would with a closed throttle. This ensures that, even on deceleration, the engine receives an adequate charge of combustible air-fuel mixture and stops the fuel from passing into the exhaust in an unburnt state. This also prevents backfiring in the muffler.

The vacuum (V) created below the throttle valve on deceleration becomes effective in chamber (A) and pulls diaphragm (8) to the left against the pressure of the spring (7). The valve (5) which is fixed to the diaphragm (8) opens and the vacuum present in chamber (A) becomes effective in chamber (B) and pulls the diaphragm (3) to the right against the pressure of spring (4). This movement is transmitted to the pull rod (1) which opens the throttle valve via the damper lever.

The pull rod stroke is limited by the stop washer (2). When the intake manifold vacuum decreases, the spring (7) presses the diaphragm (8) to the right, which closes valve (5). The spring (4) can now move the diaphragm (3) to the left because the vacuum in chamber (B) is eliminated via a connection to the atmosphere. The outside air passes through hole (10) into the housing (C) of the altitude corrector, through the plastic foam filter (9) and into chamber (B) via the drilling (6) in valve (5). The altitude corrector (11) is installed with a slight preload and presses on valve (5). The preload varies according to the existing atmospheric pressure.

When the atmospheric pressure is low, and the intake manifold vacuum and thus the opening force exerted by the diaphragm (8) on valve (5) reduced, the preload of the altitude corrector (11) on the valve (5) increases by the same amount so that the operation of the throttle valve positioner is never affected by the actual atmospheric pressure.

The throttle valve positioner can be set with the adjusting screw (13) which is locked with a set screw (12).

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Two-part throttle valve positioner

For California: from Eng. No. B 6 000 002
For all others: from Eng. No. B 6 000 001
up to Eng. No. AE 0 627 299 only

The operating part and the control part of the throttle valve positioner are arranged separately. The operating part is located as previously on a bracket on the carburetor flange, while the control part is located at the rear on the left of the engine compartment. The two parts are connected by a hose. In addition the modified throttle valve positioner acts as a closing damper. This prevents the throttle valve from closing immediately on deceleration.

Dashpot

For California: from Eng. No. AE 0 058 481
For all others: from Eng. No. AE 0 058 480
up to Eng. No. AE 0 627 299 only

Vehicles with manual transmission are equipped with a dashpot.

This ensures that the throttle valve does not immediately close when the accelerator pedal is released, i. e. the engine continues running at a fast idling speed until a sufficiently high vacuum is built up and the throttle valve positioner operates.

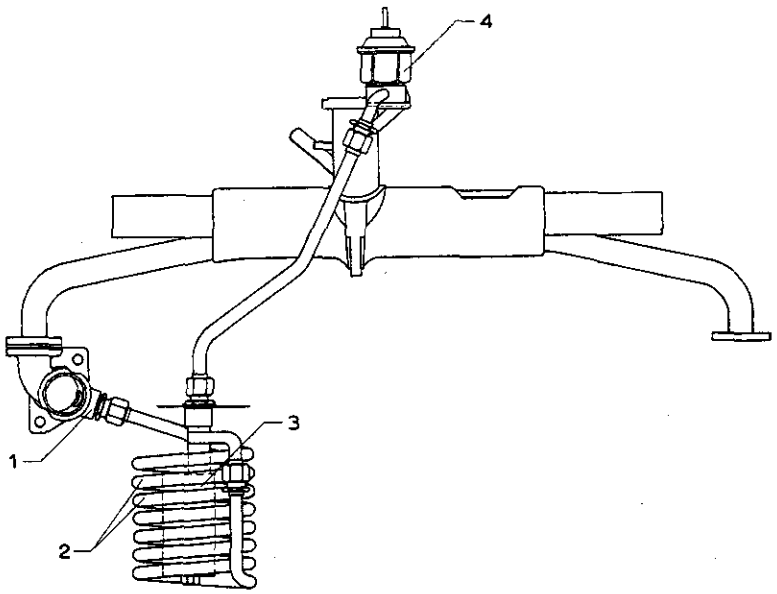
The dashpot is operated through a carrier plate welded to the throttle valve lever.

Recirculation of Exhaust Gases

For California only from Eng. No. AH 0 000 001

To reduce the oxide of nitrogen emission (NOx), exhaust gas which has been cleaned and cooled is recirculated into the intake system during partial load operation.

Exhaust gas is taken from the left rear exhaust flange (1) and cooled in the cooling coil (2). The coarse impurities are filtered out by a cyclone filter (3). The exhaust gas which has been so prepared passes into the intake manifold by way of the vacuum controlled exhaust recirculating valve (4). This exhaust gas recirculating valve (4) controls the exhaust gas flow dependent on the throttle valve position, so that mixing is only possible during **partial load operations.**



Note

From Eng. No. AH 0 005 900

on the Type 1 / Automatic Stick Shift the cooling coil and cyclone filter have been replaced by an element type filter.

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Vehicle Type:		Type 1/Model 181
Engine:	Code letter	AM
	Date introduced	1 August 1973
	Engine No.	AM...
Carburetor:	SOLEX	34 PICT-3
	Production	181 129 027 K
	Mod. state	VW 404-1
	Spare part No.	181 129 027 K
Jets:	Venturi dia. mm	26
	Main jet	× 127.5
	Air correction jet	75 Z
	Pilot jet	55
	Pilot jet air bleed	147.5
	Auxiliary fuel jet	47.5
	Auxiliary air jet	90
	Enrichment, without ball	2 x 100
	Injection quantity cm^3/stroke	1.3—1.6
	Float needle valve (mm)	1.5
	Washer under float needle valve (mm)	0.5
	Float weight (grams)	8.5
Octane requirement:	RON (new rating)	91 (86)
Idling:	Speed rpm	800—900
	CO value vol. %	1—3

Note

When replacing the carburetor see the note in the spare parts list.

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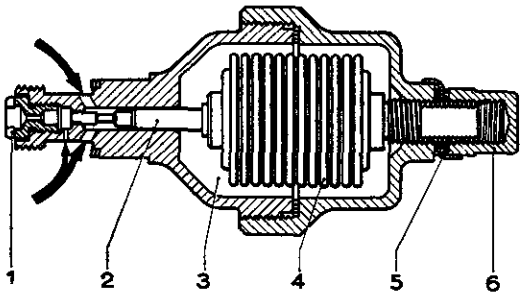
To ensure satisfactory mixture formation in the carburetor at high altitudes, the main jet carrier can be replaced by an altitude corrector with a suitable main jet.

Note

The jet carrier for altitude correctors of carburetors with main jets on the inside is longer than the altitude corrector shown here.

The main jet carrier is replaced by the altitude corrector which is installed in the same way as the main jet carrier.

At one end of the altitude corrector is the main jet (1) through which the fuel coming from the float chamber via an annular chamber has to flow.



The fuel flows to the main jet through four angled drillings and a small drilling which lies between the main jet and the four angled passages. The fuel also flows into the pressure unit chamber (3).

At the end opposite the main jet, the pressure unit is screwed into the housing of the corrector to locate it axially.

The other end of the pressure unit carries the needle (2) which moves freely in the passage leading to the main jet. When the pressure unit (4) expands due to the change in atmospheric pressure at high altitudes, the needle throttles the fuel flow to the main jet to suit the changing conditions.

When the vehicle is operating at sea level, the needle in the corrector moves into a position where it has no influence on fuel consumption.

Caution

When the altitude corrector is assembled, the pressure unit is set with the regulating nut (6) which is secured by a lock plate (5). This setting must not be altered on any account.

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The exhaust gas from gasoline engines contains poisonous **carbon monoxide** gas and **hydrocarbons.** The actual amounts of carbon monoxide and hydrocarbons present in the exhaust gas depend to a large extent on the air to fuel ratio of the mixture. The ignition timing, temperature and engine condition are also of some importance.

The mixture varies according to the engine operating conditions and this means that the composition of the exhaust gas also varies.

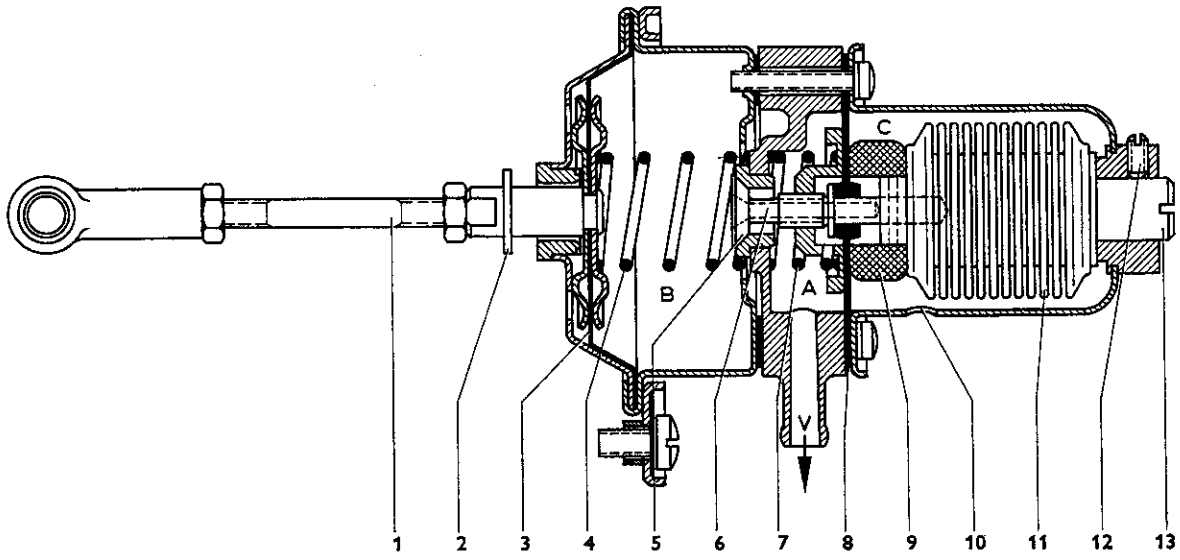
The carburetor and distributor are set so that the proportions of carbon monoxide and hydrocarbon in the exhaust are kept to a minimum.

A throttle valve positioner which opens the throttle valve in accordance with the intake manifold vacuum prevents the proportion of hydrocarbons in the exhaust from increasing when the vehicle is overrunning the engine. Engines of VW Automatic vehicles have no throttle positioner.

Throttle valve positioner

The purpose of the throttle valve positioner is to open the throttle slightly when the vehicle is overrunning the engine, thus preventing the intake manifold vacuum from rising as high as it would with a closed throttle. This ensures that, even on deceleration, the engine receives an adequate charge of combustible air-fuel mixture and stops the fuel from passing into the exhaust in an unburnt state. This also prevents backfiring in the muffler.

The vacuum (V) created below the throttle blade on deceleration becomes effective in chamber (A) and pulls diaphragm (8) to the left against the pressure of the spring (7). The valve (5) which is fixed to the diaphragm (8) opens and the vacuum present in chamber (A) becomes effective in chamber (B) and pulls the diaphragm (3) to the right against the pressure of spring (4). This movement is transmitted to the pull rod (1) which opens the throttle blade via the damper lever.



The pull rod stroke is limited by the stop washer (2). When the intake manifold vacuum decreases, the spring (7) presses the diaphragm (8) to the right, which closes valve (5). The spring (4) can now move the diaphragm (3) to the left because the vacuum in chamber (B) is eliminated via a connection to the atmosphere. The outside air passes through hole (10) into the housing (C) of the altitude corrector, through the plastic foam filter (9) and into chamber (B) via the drilling (6) in valve (5). The altitude corrector (11) is installed with a slight preload and presses on valve (5). The preload varies according to the existing atmospheric pressure.

When the atmospheric pressure is low, and the intake manifold vacuum and thus the opening force exerted by the diaphragm (8) on valve (5) reduced, the preload of the altitude corrector (11) on the valve (5) increases by the same amount so that the operation of the throttle valve positioner is never affected by the actual atmospheric pressure.

The throttle valve positioner can be set with the adjusting screw (13) which is locked with a set screw (12).

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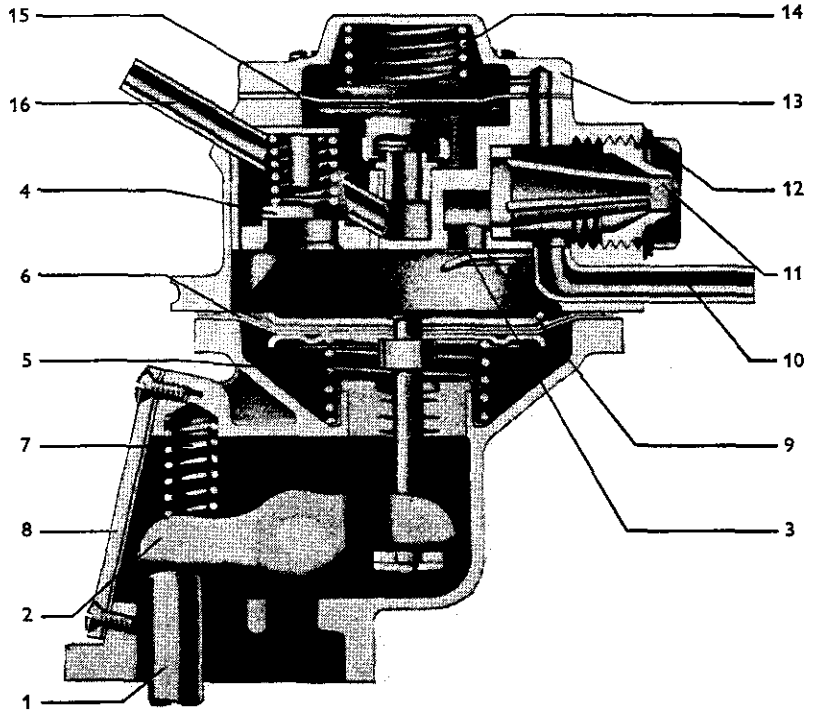
Fuel pump — Types 1 and 3

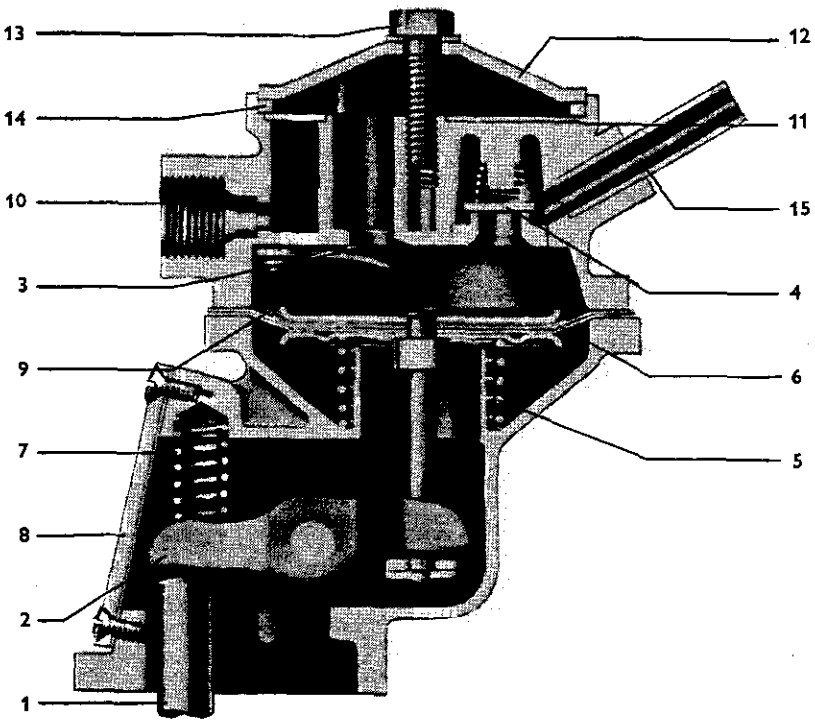
1 - Push rod
2 - Operating lever
3 - Suction valve
4 - Pressure valve
5 - Diaphragm spring
6 - Diaphragm
7 - Spring for lever
8 - Inspection cover
9 - Suction valve retainer
10 - Fuel inlet
11 - Filter
12 - Threaded plug
13 - Cover for upper part
14 - Spring
15 - Cut-off diaphragm
16 - Fuel outlet



The push rod (1) is operated by the cam on the ignition distributor drive shaft and pulls the diaphragm (6) down by means of the operating lever (2) and the pull rod. This movement creates a vacuum above the diaphragm which draws in fuel through the suction valve (3). When the push rod goes back, the spring (5) pushes the diaphragm up and forces fuel past the pressure valve (4) to the carburetor. There is a cut-off diaphragm (15) installed in the upper part of the fuel pump of Type 1 and Type 3 vehicles that stops the flow of fuel when the engine is stationary.

Fuel pump — Type 2

1 - Push rod
2 - Operating lever
3 - Suction valve
4 - Pressure valve
5 - Diaphragm spring
6 - Diaphragm
7 - Spring for lever
8 - Inspection cover
9 - Suction valve retainer
10 - Fuel inlet
11 - Filter
12 - Cover
13 - Hexagon head screw
14 - Sealing ring for cap
15 - Fuel outlet



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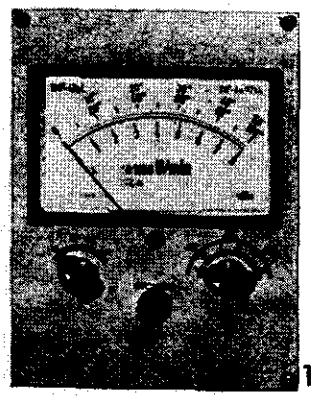
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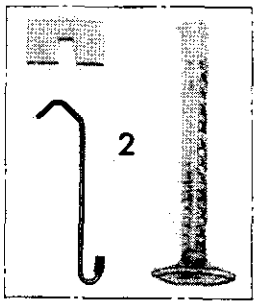

No.	Description	Special tool	Remarks
1	Dwell angle — tachometer tester		
2	Measuring gauge (Injection quantity)	VW 119	
3	CO-tester		not shown, local purchase item

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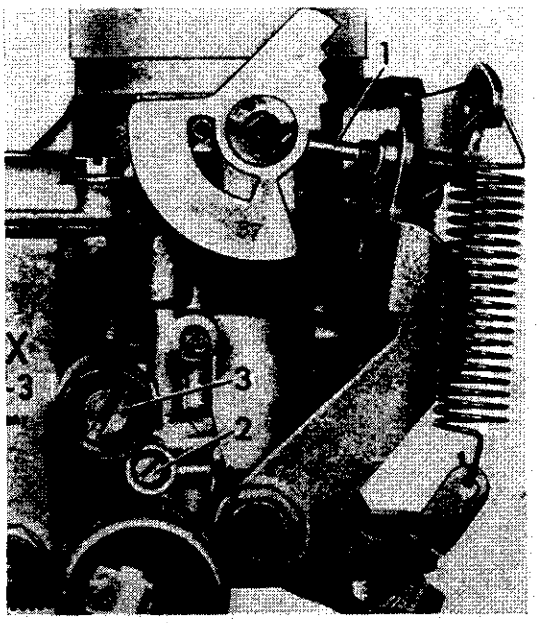
Idle speed adjustment

(Carburetor with bypass air drilling)



1 - Turn idle screw (1) out until there is clearance between screw and fast idle cam.

2 - Then turn screw in until it just touches the fast idle cam.

3 - From this position turn screw in further ¼ of a turn.

4 - Turn volume control screw (2) in slowly until it comes to a stop, and then turn it back 2,5 to 3 complete turns.

5 - Attach tachometer and insert thermometer for measuring oil temperature into engine in place of the oil dipstick. Check if the automatic choke is fully open.

6 - Start engine and set idle speed (900 rpm) by turning the bypass screw (3).

7 - By turning volume control screw adjust to the highest idle speed, then turn back until the engine speed drops by 20—30 rpm.

8 - Reset the correct idle speed by turning the bypass screw.

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Measuring and adjusting CO concentration in exhaust gases with a CO tester

Note

To be able to attain satisfactory exhaust gas composition the engine must be in good condition, the valves and ignition timing be correctly adjusted and there must be no leaks in the muffler.

Depending on CO tester being used, make the necessary engine connections and operate tester according to manufacturer's instructions. Use tachometer for idle adjustment before reading final CO value.

Manual transmission 800— 900 rpm
Automatic Stick Shift 900—1000 rpm

Read CO value and, if necessary turn volume control screw to attain

3 ± 1 % CO

Check engine speed again and if necessary adjust.

To eliminate "flat spots" on acceleration, it may be necessary to measure the amount of fuel injected by the accelerator pump and to correct it. With the appliance VW 119 it is possible to measure the injection quantity **on the carburetors on and off the vehicle.**

1 - Start engine briefly to ensure that there is sufficient fuel in the carburetor.

2 - Remove air cleaner.

3 - For carburetors without bypass air drilling only: Turn the idle adjusting screw back until the throttle valve is completely closed.

4 - Push the extension pipe over the injection tube in the carburetor.

5 - Open the choke valve and lock it in position with the plastic piece.

6 - Operate the throttle valve until fuel is ejected from the pipe.

7 - Hold glass vial under the pipe and operate the throttle valve rapidly 5 or 10 times.

8 - Divide the amount caught by 5 or 10 and compare the figure with the specified figure.

9 - If amount differs considerably carry out the following adjustments:

a - Install thicker or thinner washers between pump lever and cotter pin.

If injection quantity is too large — install thinner washers

if injection quantity is too small — install thicker washers.

Use washers with thickness 0.2 mm (0.007 in.) — Spare part No. 111 905 231.

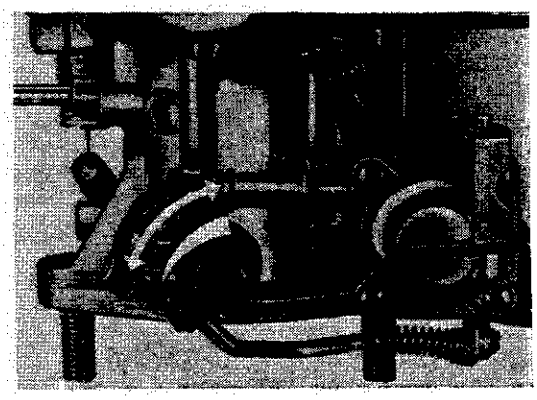
b - Move cotter pin in connecting link; if injection quantity is too large — move cotter pin to outer side

if injection quantity is too small — move pin to inner side.

c - Adjust bell crank lever if injection quantity is too large — adjust in direction (2),

if injection quantity is too small — adjust in direction (1).

10 - Check direction of fuel jet, must be on collar of discharge arm.



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Should it be necessary to check the fuel level in the float chamber, proceed as follows:

Checking

1 - Position vehicle on a level surface.

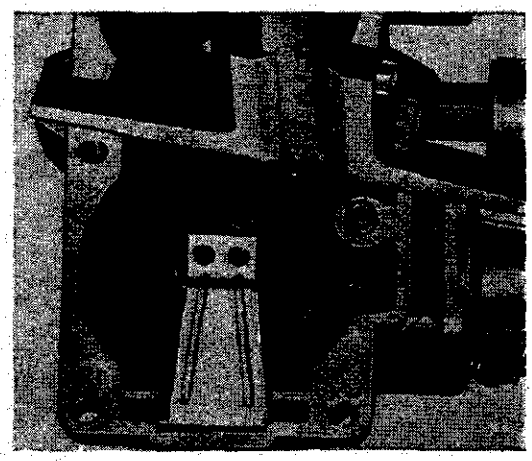
2 - Run engine briefly.

3 - Pull fuel hose off upper part of carburetor.

4 - Take upper part off complete with gasket. Hold feed pipe closed to prevent more fuel flowing into chamber as upper part is lifted.

5 - Measure fuel level from body joint with a depth gauge. The depth gauge must be held vertically. Do not measure too near the walls of the body.

The reading is taken when the tip of the gauge just touches the surface of the fuel and should be 12—14 mm (0.47—0.55 in.).

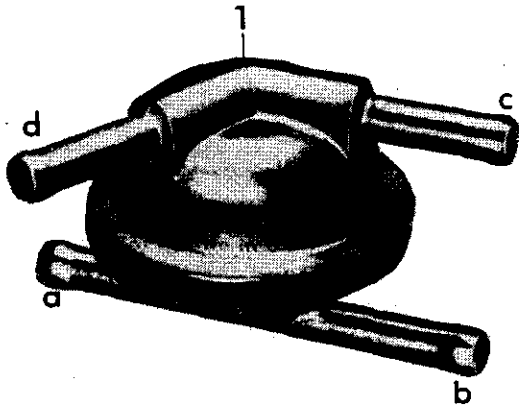


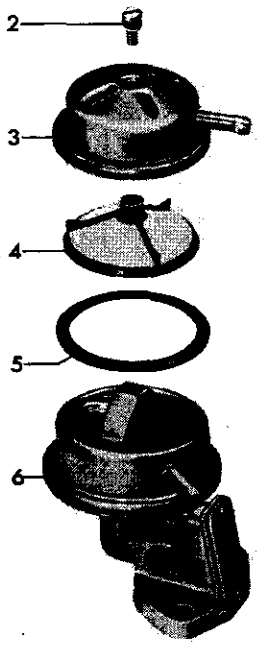
6 - If the level is too high, increase thickness of washer under needle valve, if too low, decrease washer thickness.

Washers of the following thicknesses are available:

Part No.	Thickness mm (in.)
111 129 213 A	0.5 (0.019)
111 129 213 B	0.8 (0.031)
111 129 213 C	1.0 (0.039)
111 129 213 D	1.5 (0.059)

From Engine No. AE 0 058 480
up to Engine No. AE 0 793 574
or AH 0 004 173





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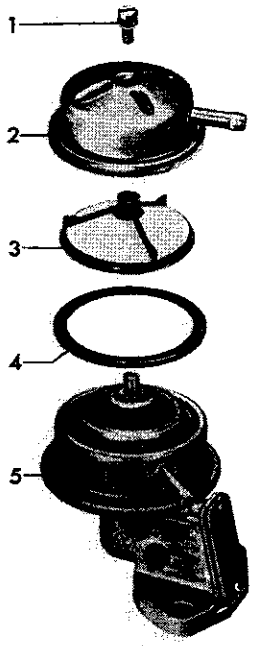
No.	Description	Qty.	Note when disassembling	assembling/installing	Special instructions see
1	Cutoff valve	1		Secure hose connections with clamps. a - from fuel tank b - to the fuel pump (suction pipe) c - from the fuel pump (pressure pipe) d - to the carburetor	
2	Screw	1			
3	Pump upper part	1			
4	Fuel strainer	1	Clean and blow out	When using repair set part No. 111 198 555 B, insert spacer bushing between the filter and the cover	
5	Gasket	1	Color: black	replace	
6	Fuel pump	1	Marked with VW 15	Secure hose connections with clamps	

From Engine No. AE 0 793 575
or AH 0 004 174



No.	Description	Qty.	Note when disassembling	assembling	Special instructions see
1	Screw	1			
2	Pump upper part	1			
3	Fuel strainer	1	Clean and blow out	When using repair set part No. 111 198 555 B, **do not** insert the spacer bushing	
4	Gasket	1	Color: grey	replace	
5	Fuel pump with cutoff valve	1	Marked with PE 20 000	Secure hose connections with clamps	

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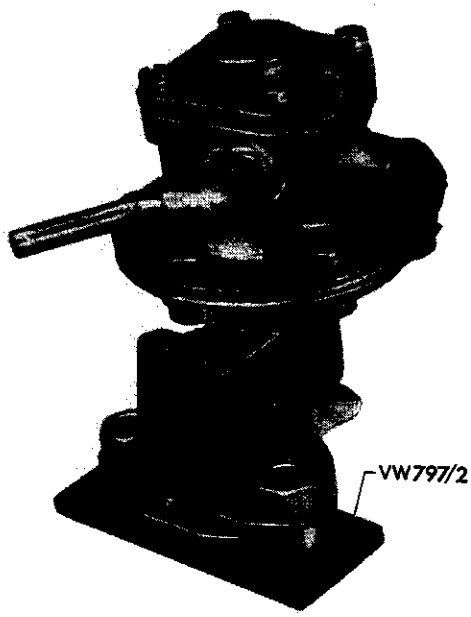
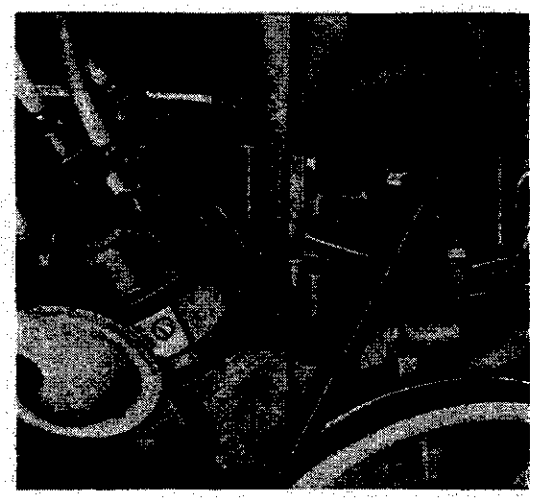


Installing diaphragm

Tighten VW 797/2 with two nuts. The operating lever is pressed in 13 mm (0.5 in.) (from pump flange) to move the diaphragm into the correct position. Tighten screws holding upper part.



Installing fuel pump

Check pump push rod stroke: At the highest point, the push rod should project 13 mm (0.5 in.). If necessary, this dimension should be altered by fitting suitable gaskets.

Caution

Secure hose connections with clamps.

No.	Description	Qty.	Note when disassembling	assembling	Special instructions see
28	Screw	2		move pump lever to "pressure stroke", then tighten	
29	Pump cover	1			
30	Pilot jet	1			
31	Cutoff valve for bypass mixture	1		note voltage	
32	Vacuum diaphragm	1			
33	Screw	3			
34	Vacuum diaphragm cover	1	note installation position		
35	Vacuum diaphragm spring	1			
36	Cap (plastic)	1		cap lug must engage in housing notch	
37	Cover with spring and heater element	1	from August 1971 marking: 60	middle mark must be in position with housing mark	
38	Retaining ring	1			
39	Spacer for cover	3			
40	Screw for retaining ring	3			

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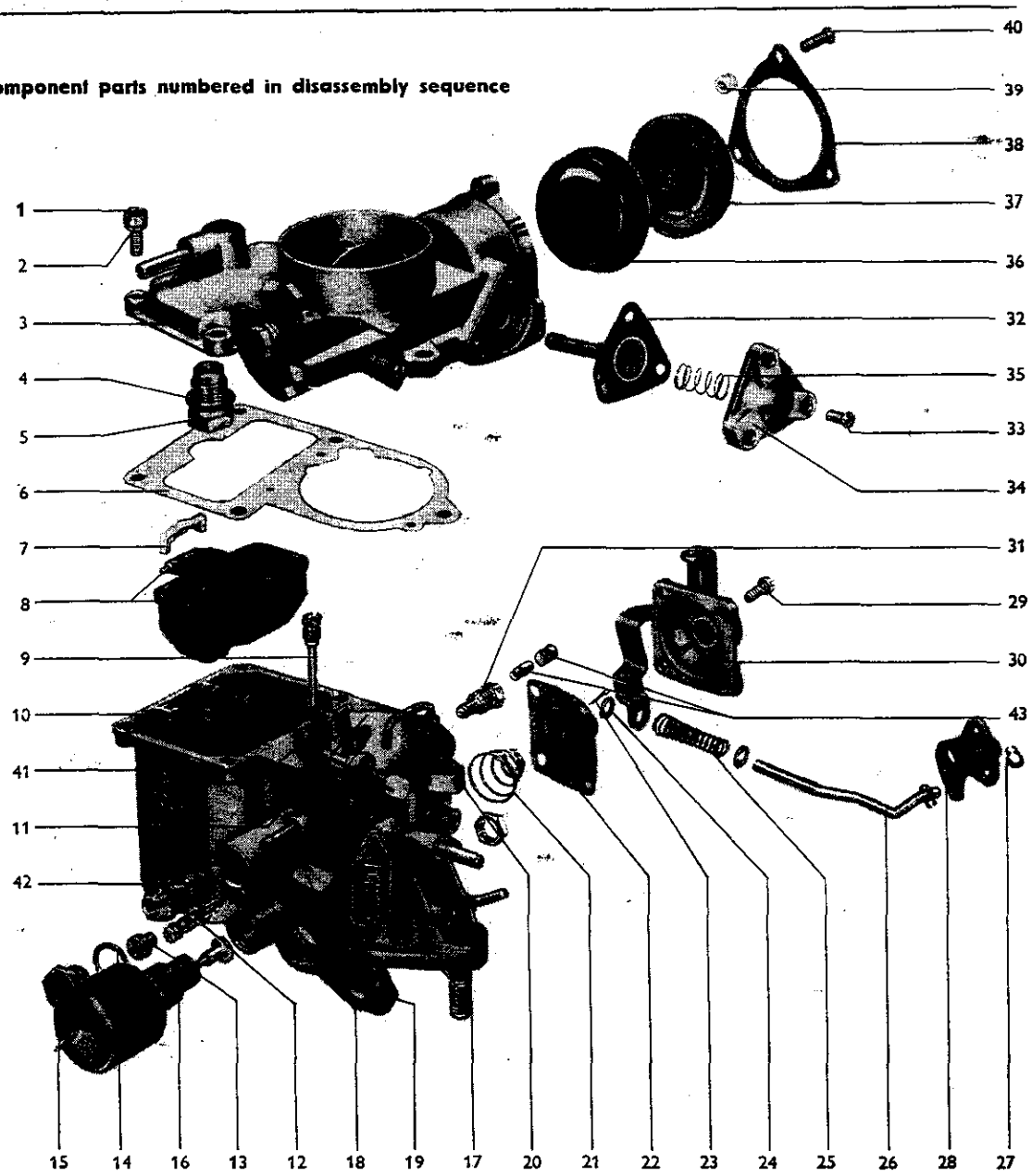
Component parts numbered in disassembly sequence



No.	Description	Qty.	Note when disassembling	Note when assembling	Special instructions see
1	Screw for upper carburetor part	5		tighten evenly, but do not overtighten	
2	Spring washer	5			
3	Carburetor upper part	1		power fuel systems differ, secure hose connection with clamp	
4	Washer for float needle valve	1		note washer thickness	
5	Float needle valve	1		check	
6	Gasket	1		replace	
7	Retainer for float pin	1			
8	Float and pin	1		check weight	

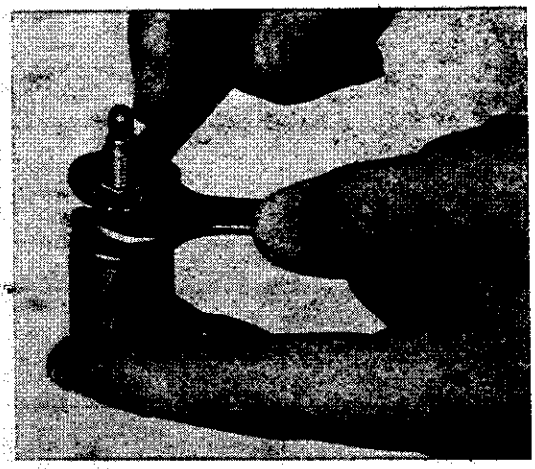
4 - Check float needle valve for leakage. It should not be possible to blow air through the valve when the needle is pressed lightly onto its seat. Check that needle moves freely and note thickness of washer under valve.

5 - Place float in hot water and check for leaks. If bubbles appear, replace the float.

6 - Checking and disassembling the electromagnetic pilot jet cutoff valve:

a - For cleaning purposes, the pilot jet can be screwed off the cutoff valve with two wrenches and blown out.

b - The valve can be checked by switching current off and on and listening for the ticking noise which indicates that valve is moving in and out.



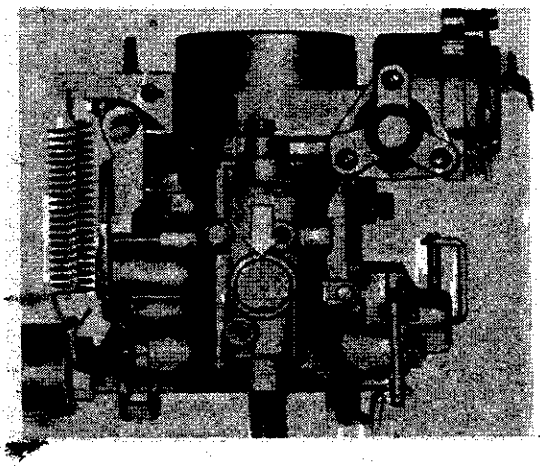
Note

If solenoid is defective, the valve can be opened and held in position by means of the small set screw.

7 - Carburetor bodies with worn choke valve and throttle valve bearings should be replaced.

8 - Oil all bearing points on carburetor lightly. The bearings and ball joints of the linkage should be lubricated with a molybdenum disulfide based paste.

9 - Replace plugs which are loose. Spare part No. 113 129 119 A.



Repair instructions

a - Remove all burrs from the drilling.

b - Lightly coat the sealing face of the plug with D 3 compound.

c - Install the plug so that the groove is at the bottom (arrow).

d - Expand the plug by peening.

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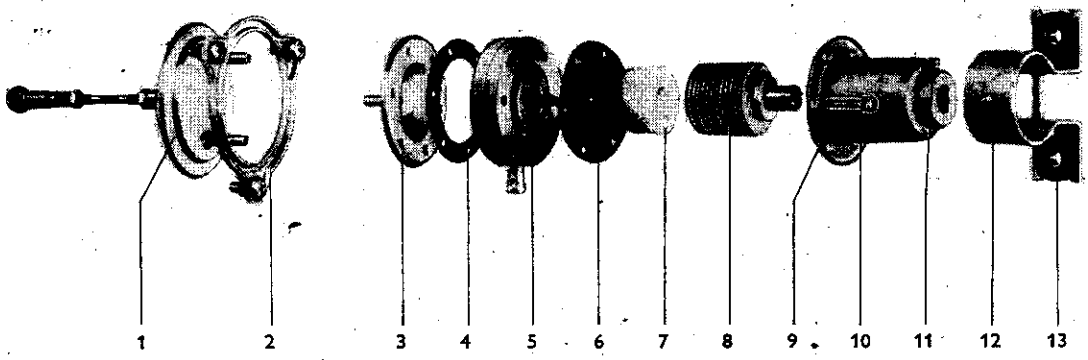
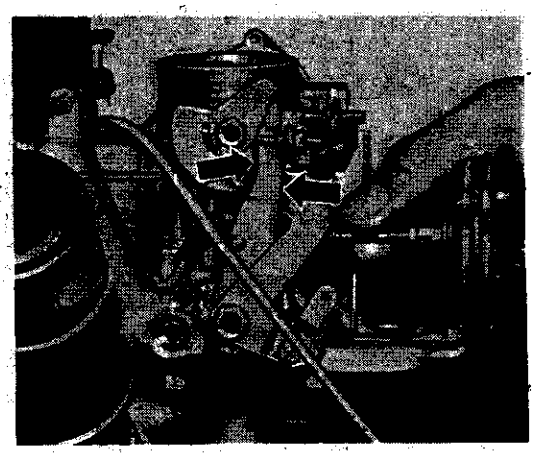


No.	Description	Qty.	Note when disassembling	Note when assembling	Special instructions see
1	Operating part	1			
2	Retaining ring	1			
3	Control part cover	1		connection to operating part	
4	Gasket	1		replace	
5	Control part	1		connection to vacuum drilling	
6	Control diaphragm	1			
7	Plastic foam filter	1			
8	Altitude corrector	1			
9	Altitude corrector housing	1			
10	Phillips screw	6			
11	Set screw	1			
12	Clamp	1			
13	Rubber mounting	1			



Note

When installing a new throttle valve positioner, the pull rod must be adjusted. The special lever must not touch the carburetor body or the throttle valve lever when the throttle valve is closed (see arrows).

See page 2.1/4-1
Adjusting throttle valve positioner.

No.	Description	Qty.	Note when disassembling	Note when assembling	Special instructions see
9	Air correction jet with emulsion tube	1		note size	
10	Carburetor lower part	1		if damaged replace with new carburetor	
11	Auxiliary air drilling	1		note adjustment instructions	
12	Volume control screw	1			
13	Main jet	1		note size	
14	Washer for plug	1			
15	Plug	1			
16	Bypass air cutoff valve	1		with current applied to the grounded valve, the valve core pulls in after slight finger pressure is applied to the core **Note** Finger pressure is necessary, since this pressure also exists on an installed valve.	
17	Return spring	1			
18	Fast idling lever	1			
19	Throttle valve lever with stop screw	1			
20	Injection tube for accelerator pump	1		jet direction on collar of discharge arm	
21	Spring for diaphragm	1			
22	Accelerator pump diaphragm	1			
23	Cotter pin 1.5 x 15	1			
24	Washer 4.2	2		thickness: 1 mm (0.04 in.)	
25	Spring for connecting rod	1			
26	Connecting rod	1			
27	Circlip	2		the connecting rod must have 0.3—0.5 mm (0.012—0.02 in.) axial play at the throttle lever	
28	Bell crank lever (adjustable)	1			
29	Screw	4		set pump lever to "pressure stroke" and then tighten screw	
30	Pump cover	1			
31	Pilot jet	1			
32	Vacuum diaphragm	1			
33	Screw	3			
34	Cover for vacuum diaphragm	1	note position		
35	Spring for vacuum diaphragm	1			
36	Plastic cap	1		cap lug must engage in the housing notch	
37	Cover with spring and heater element	1		middle mark must be in position with housing mark	
38	Retaining ring	1			
39	Spacer for retaining ring	3			
40	Screw for retaining ring	3			
41	Pilot jet air bleed	1			
42	Air bypass screw	1			
43	Auxiliary fuel jet and plug	1			

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Removing and installing

Caution

Before you start working disconnect the battery ground strap.

Secure accelerator cable as follows: With accelerator pedal in full throttle position, there must be a gap between throttle valve lever and its stop on carburetor body:

"a" = 1—1.5 mm (0.039—0.058 in.)

Caution

Always secure hose connections with clamps.

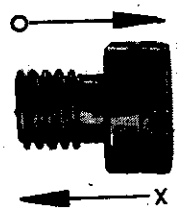
Repair instructions

The following instructions are valid for all carburetors.

1 - Wash all parts, with the exception of the automatic choke cover, in fuel. Sticky deposits in the automatic choke housing can be removed with acetone. Check that the vacuum piston for the automatic choke moves freely.

2 - Blow out jets, valves and drillings with compressed air. Never attempt to clean jets with pins or pieces of wire.

When replacing jets, floats or other parts, use only parts marked "SOLEX".

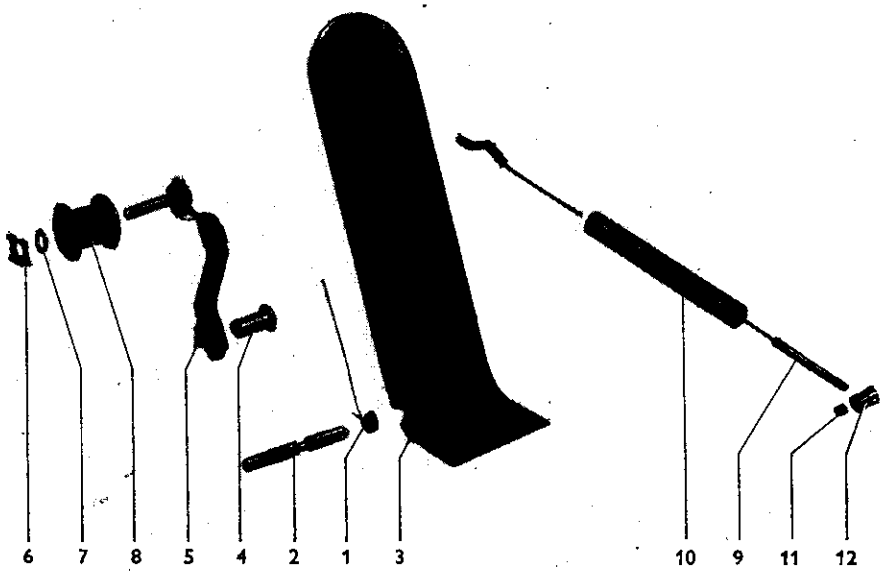


Note jet flow directions.

Jets marked **O** 120 (for example) have flow direction O

Jets marked **X** 120 (for example) have flow direction X

3 - Replace all gaskets and sealing washers.



No.	Description	Qty.	Note when disassembling	Note when assembling	Special instructions see
1	Accelerator pedal return spring	1			
2	Accelerator pedal mounting pin	1			
3	Accelerator pedal with rubber cover	1			
4	Pin 8 x 18	1			
5	Accelerator cable connecting lever	1			
6	Clip for roller	1			
7	Washer 6.4	1			
8	Roller for accelerator pedal	1			
9	Accelerator cable	1	pull out toward front	lubricate and note length, adjust	
10	Accelerator cable protective tube	1			
11	Set screw M 5 x 5	1			
12	Swivel pin	1			

Note

Lubricate all moving parts with multi-purpose grease.

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File

SERVICE

Workshop Bulletin

No. K
of 1 October 1973

Subject:	Type/Model:
Exhaust Gas Recirculation	1

see workshop manual

All Type 1 vehicles are now equipped with an exhaust gas recirculation system. The following table shows the various versions.

Type	Vacuum dependent exhaust recirculation	Exhaust recirculation according to throttle valve setting	Exhaust recirculation valve 1 stage	Exhaust recirculation valve 2 stage	Throttle in the valve feed line	Remarks
1	X		X		X	
1/Automatic Stick Shift	X		X			as before
1/Model 181	X		X			as before
1/California	X			X	X	
1/Autom.Stick Shift-California	X	X		X		
1/Model 181 - California	X			X	X	

Maintenance: every 24,000 miles replace filter element.

Checking exhaust gas recirculating valve

1 - Run engine at idling speed.

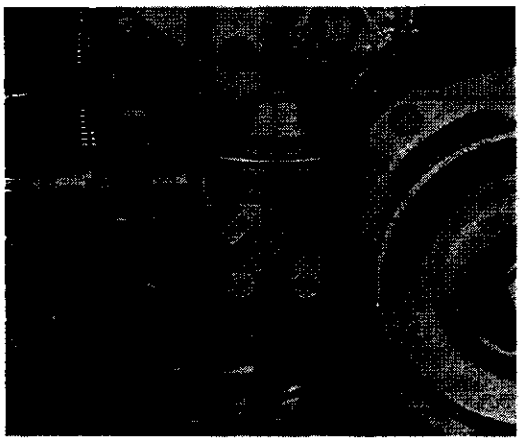
2 - Pull vacuum hose off exhaust gas recirculating valve. Install black hose from intake air preheating temperature regulator in its place.

A noticeable drop in engine speed, or stalling of the engine indicates that exhaust gases are being fed back.

If the engine speed does not change at all, either the valve or the hose is blocked.

Printed in Germany 3.48.572.098.21

see workshop manual



N o t e

The function of the exhaust re-circulating valve can be checked on engines with 2 stage valves without changing the hoses over. The pin (arrow) on these valves is visible and can be observed if it operates depending on engine speed.

Caution

The 2 stage valves may only be replaced together with the feed line.

Checking the switch on the throttle valve shaft and two-way valve

1 - Run engine at idling speed.

2 - Operate the switch by hand.
Engine speed must drop noticeably or stall. If there is no change in engine speed, there is a fault at the switch, two-way valve or in the electrical system.

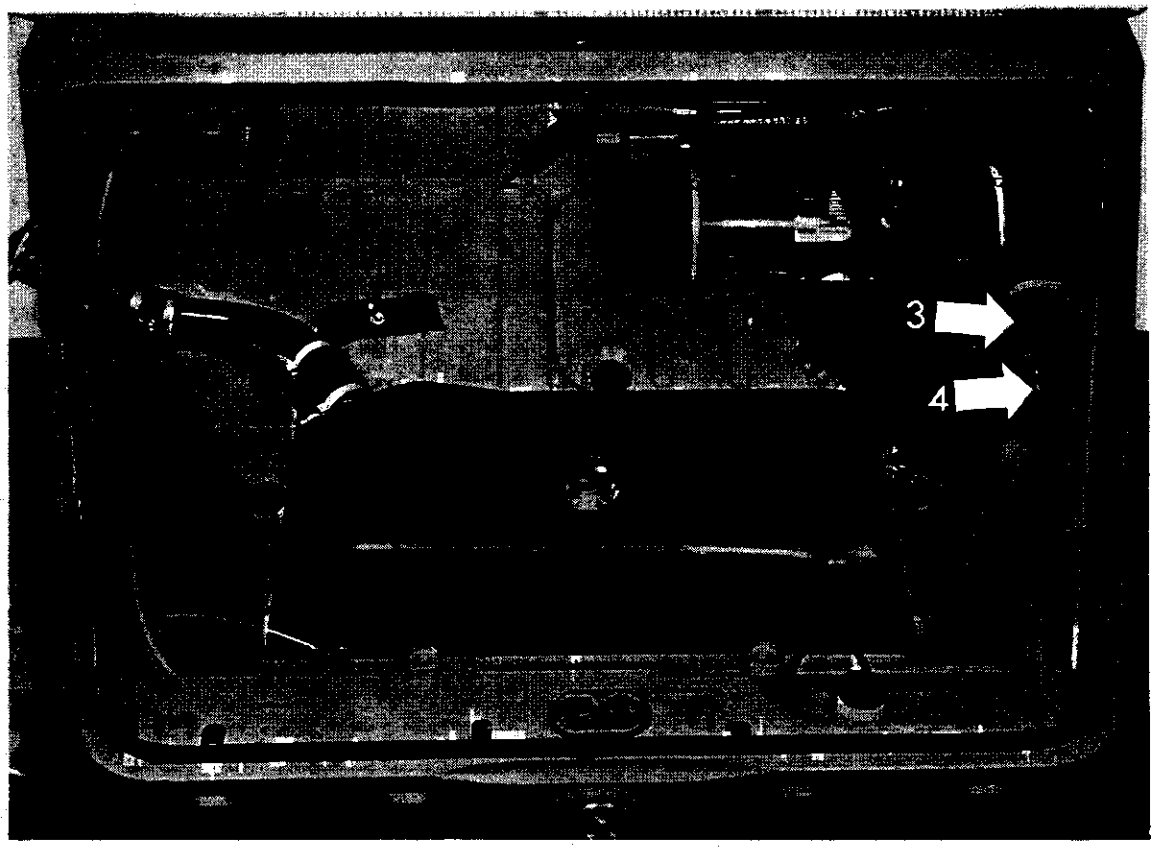
Adjusting the switch on the throttle valve shaft

The switch is to be adjusted with the special protractor (see W.B.- M). Starting with a closed throttle valve at 0° it switches at 12° and 72° with an audible click.

see workshop manual

4 - Activated charcoal filter system

The expansion chamber is mounted on the left side in the luggage compartment, while the activated charcoal filter container is attached to the frame above the rear axle.



1 - Breather and return hose
2 - Hose to expansion chamber
3 - Expansion chamber
4 - Hose to activated charcoal filter

SERVICE

Workshop Bulletin

No. K

of 2 April 1973

Subject:	Type/Model:
Fuel system	1/Model 181

see workshop manual

The fuel system is basically the same as on the Type 1 / Sedans. Note the following differences:

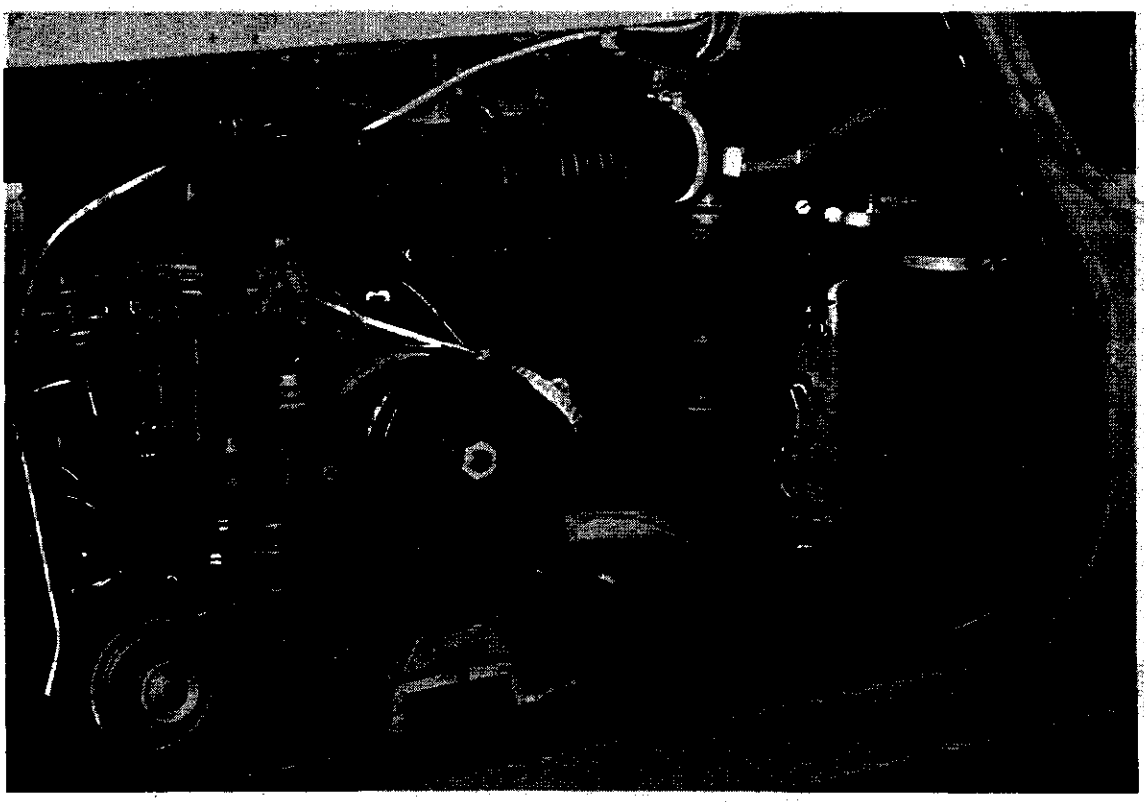
1 - Carburetor SOLEX 34 PICT-3 with jet sizes to suit Model 181 and a dash pot, but without a throttle valve positioner.

2 - Exhaust recirculation system.

3 - Oilbath air cleaner mounted on the right side in the engine compartment.

4 - Position of activated charcoal filter.

Note
For description of the engine see Workshop Bulletin M of 2 April 1973.



Printed in Germany 3.48.572.079.21

see workshop manual

1 - Carburetor, jet sizes and octane rating

Model			Type 1 / Model 181
Engine	Code letter		AM
	Introduced		April 1973
	Engine No.		AM . ...
Carburetor	SOLEX		34 PICT-3
	Standard		181 129 027 K
	Modification state		VW 404-1
	Spare part No.		181 129 027 K
Jet sizes	Venturi	mm diameter	26
	Main jet		127.5
	Air correction jet		75 Z
	Idling jet		55
	Idling air jet		147.5
	Auxiliary fuel jet		47.5
	Auxiliary air jet		90
	Enrichment, without ball		2 x 100
	Accelerator pump capacity cm^3 per stroke		1.3 - 1.6
	Direction of injection squirt		on collar of discharge arm
	Float needle valve mm diameter		1.5
	Float needle valve washer thickness	mm	0.5
	Float weight	gramm	8.5
Octane rating	ROZ		91
Idling speed		rpm	800 - 900
	CO value Vo. %		1 - 3
Dash pot adjustment:	With dash pot in fully closed position the gap between the plunger and throttle lever must be 1.0 mm (0.04 in.)		

3 - Exhaust gas recirculation system

Under partical throttle position the system operates basically as on Type 1 / Automatic Stick Shift. The exhaust gas is drawn from the left side muffler only and passes a filter before entering the intake manifold. Depending on the vacuum in the carburetor it is controlled by a valve. Maintenance see W.B. K of 7 September 1972.

4 - Oilbath air filter

Capacity:	0.6 liter (1.25 US pt) (1.0 Imp. pt)
Oil change:	every 18 000 miles (in dusty areas it may be necessary to change the oil more frequently)

file

SERVICE

Workshop Bulletin

No. K

of 13 April 1973

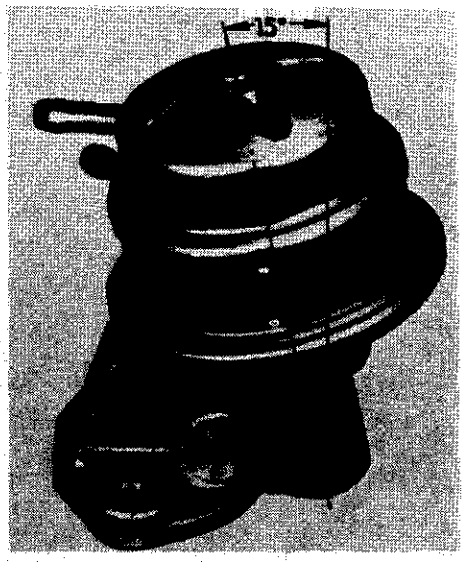
Subject:	Type/Model:
Modifications to fuel system	1

see workshop manual

1 - Modifications to fuel system with alternator

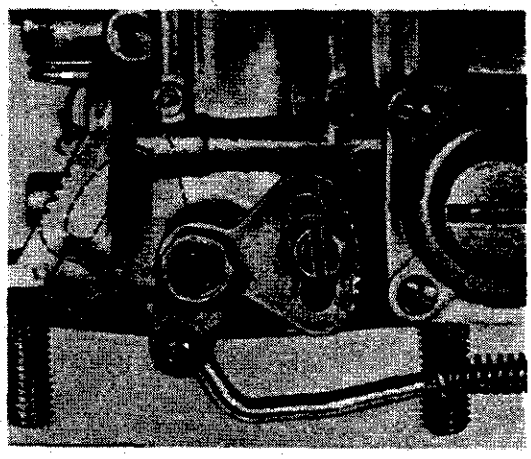
With the installation of an alternator, the fuel system has had to be modified as follows:

a - Pump inclined 15° to the left.



b - Pump push rod length:
100 mm (3.937 in.)
previously:
108 mm (4.252 in.)

c - Carburetor with modified accelerator pump linkage (the adjusting segment is towards the accelerator pump).



2 - Throttle valve positioner — California only

The throttle valve positioner has been discontinued on Type 1 vehicles with manual transmission for California. The dashpot remains.

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Section K/S
Technical Information

The demands placed upon lubricants parallel the developments of the automobile industry. Although the basic functions of the lubricants have not changed, the changes in the automobile over the past fifteen years have made some of the tasks more difficult. The oil companies have, however, met the challenge. The quality lubricants of today are able to carry out their required functions better than ever before.

K 2nd Supplement (USA) Printed in Germany 11. 72

Engine Oil

Engine oils are now classed both by viscosity and by their performance under various service requirements.

Viscosity

The use of the proper viscosity engine oil is essential to satisfactory engine performance. The lubricant must be thick enough at high temperatures to provide a protective oil film between moving parts, yet must also be sufficiently thin at lower temperatures to allow quick starting and adequate lubrication during the warmup period. Because of the importance of viscosity, this property is one of the primary means of classifying motor oils.

Viscosity is a measure of the resistance of a liquid to flow. This resistance is due to the internal friction of the liquid molecules moving past each other. The most important variable affecting viscosity is temperature.

While there are many ways of measuring viscosity, the system presently used to classify motor oils (for example SAE 30, SAE 10W) was developed by the Society of Automotive Engineers (SAE). The SAE grade numbers which are not followed by the letter W are obtained from determined viscosity measurements at 210° F. Numbers containing a W (for "winter") are developed on the basis of a viscosity at 0° F. These grade numbers serve as an important guide in the selection of the proper viscosity oil for various temperature and service conditions.

Service Classification Requirements

These requirements range from the mildest (SA, SB, SC), requiring minimum protection against deposits, wear or rust to the severe requirements (SD, SE) imposed on automotive gasoline engines by:

Short-trip, start-and-stop service

High temperature trailer towing

Sustained high-speed, high-temperature driving.

For Volkswagen vehicles, the new designation SD (S for Service; D for the class of Service) replaces the former designation MS (Motor Severe) which in turn replaced the original designation HD (Heavy Duty).

The designation SD is a rating of the new alphabetically graded system, with the letters (SA) being the lowest and, at present, (SE) being the highest service classification level.

A combination of designations (SB/SD) indicate that the oil meets more than one service classification requirement.

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Transmission oil

There are two groups of transmission oils which may be used in vehicles:

High pressure transmission oil (HP)

Hypoid transmission oil (EP extreme pressure).

Oils of the first group are used in manual transmission and final drives with spiral gears. The hypoid transmission oils are used in hypoid gear final drives.

Construction features which combine the final drive and manual transmission in the same housing require an oil which fulfills the demands of both hypoid and manual transmissions.

Hypoid oils of the specification MIL-L 2105 B (additive base: sulphur/phosphorus) are oils which will stand great stress and whose wear capabilities are influenced by additives such as sulphur/phosphorus. Under pressure, these additives react upon the tooth surface and build up a protective coating, thereby preventing metal to metal contact and consequent wear.

This specification, which was originally developed for U.S. military vehicles, has also been adopted for use on Volkswagen vehicles.

Automatic transmission fluid (ATF) DEXRON ®

The fluid used in automatic transmissions fulfills several functions. It lubricates the bearings and gears, minimizes wear of the clutch linings and brake bands, serves as a hydraulic fluid, works as a power transfer medium in the torque converter and acts as a means to transfer heat.

(Dexron is the registered trademark of the General Motors Corporation for automatic transmission fluid formulated to their specifications).

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High pressure grease (calcium universal grease)

The term high pressure grease indicates its suitability in high pressure applications. Greases which have saponified calcium as a thickening agent are used on vehicles at points of secondary importance. They are greases which, due to their resistance to water, are used at locations that remain cold during operation and where the sealing quality of the grease is also of importance.

Multipurpose grease (lithium grease)

Lithium saponified greases have a wider temperature range of operation than calcium saponified greases. Bearing pressure and anti-corrosion capabilities are greatly improved by the addition of chemical additives. Such a grease can be used in plain (sleeve) and roller bearings.

Molybdenum grease (lithium grease with microfine molybdenum disulphide additive)

Lithium grease with molybdenum disulphide additive provides a low friction level for minimal drag and prevents metal to metal contact. It is used in the constant velocity joints.

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General

The fuel most commonly used in automobile and internal combustion engines is gasoline. Fuels such as diesel, liquid petroleum gas (LPG) and others are usually for specialized applications.

The two most important characteristics of gasoline as used for fuel in automotive engines are volatility and antiknock qualities.

Volatility

The volatility of any liquid is its vaporizing ability. This characteristic is of vital importance when starting a cold engine.

Anti-knock qualities

The ability of a fuel to burn without causing detonation or knocking is aided by the addition of such compounds as tetraethyl lead and in the case of some gasolines, by additional refining processes.

Knocking

In most cases knocking or pinging is an audible indication that normal combustion is not taking place in an engine. During normal combustion, the burning is progressive. However, under certain conditions, the extreme heating of the unburned part of the mixture may cause it to ignite spontaneously and explode. It is this rapid uncontrolled burning that causes knocking with consequent loss of power, overheating and possible damage to the engine.

Octane rating

The ability of a fuel to resist detonation is measured by its octane rating. This rating is determined by matching a fuel against mixtures of normal heptane and iso-octane in a test engine under specified test conditions, until a mixture of the pure hydrocarbons is found which gives the same degree of knocking in the engine as the gasoline being tested. The octane number of the fuel is then the percent of the iso-octane in the matching iso-octane normal heptane mixture. For example, a gasoline rating of 90 octane is equivalent in its knocking characteristics to a mixture of 90 percent iso-octane and 10 percent normal heptane.

However the tendency of a fuel to detonate varies in different engines, and also in the same engine under different operating conditions. It is important to emphasize that the octane number of a fuel has nothing to do with its starting qualities, power, volatility or other major characteristics. If an engine operates satisfactorily with a fuel of a certain octane rating, its performance will not be improved by using fuel of a still higher octane rating.

Of the two methods of determining octane ratings (Research or Motor) the Research method is the one most commonly quoted by fuel suppliers and automobile manufacturers.

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Section M

Engine, Ignition System

VW engines are air-cooled, four-cylinder, four-stroke carburetor or fuel injection engines with two pairs of horizontally opposed cylinders and overhead valves. They are attached to the transmission case with four bolts. The engine/transmission unit is fitted at the rear of the vehicle.

Ignition system

The ignition system has a coil and a distributor with automatic spark advance. The low tension current from the battery is converted to high tension current by the ignition system and fed to each of the four plugs in the correct sequence and exactly at the proper time by the distributor. The distributor is driven from the crankshaft by a gear and a short shaft.

Cooling

The engine is cooled by a radial fan. The fan draws air in through an opening in the fan housing and forces it past the heavily finned cylinders and cylinder heads. The air flow is directed by deflector plates fitted round the cylinders and cylinder heads. Part of the fresh cooling air is used for the heating system and is warmed by the exhaust pipes in the heat exchangers.

A thermostat controls the quantity of cooling air by means of two flaps fitted in front of the intakes to the cylinder ducts so that the engine warms up quickly and the temperature remains fairly uniform under all operating conditions. The quantity of air for the heating system is not affected by the flaps.

Lubrication system

The engine is lubricated by a pressure feed system with an oil cooler in the circuit.

The gear type oil pump is driven by the camshaft and is situated in the crankcase at the gear end of the camshaft. The oil is drawn from the lowest point in the crankcase and forced through the cooler into oil passages. Part of the oil goes through the crankshaft main bearings into drillings in the crankshaft and lubricates the connecting rod bearings. A second part lubricates the camshaft bearings and a third part passes through the hollow push rods to the rocker arms to lubricate these bearings and the valve stems. Cylinder walls, pistons and piston pins are splash lubricated.

Impurities in the oil are retained by a strainer fitted at the lowest part of the crankcase.

The oil temperature is reduced in the oil cooler by means of air supplied by the fan. The cooler is fitted in the oil circuit so that the oil from the pump must pass through the cooler before reaching the various bearings. The oil is then cooled so that it retains its full lubricating properties even at high outside temperatures and high engine speeds.

When the oil is cold and thick, an oil pressure relief valve opens and permits part of the oil to flow directly into the engine without passing through the cooler.

In the pressure circuit between oil pump and cooler there is a switch for the oil pressure warning lamp. This switch opens at a pressure of between 2.1 and 6.3 psi (0.15—0.45 kg/cm²) and breaks the circuit to the oil pressure warning lamp.

The lamp lights when the ignition is switched on and when the oil pressure is too low.

Cylinder heads

Each pair of cylinders has a detachable, finned cylinder head of cast light alloy with shrunk-in valve seat inserts and valve guides.

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Valve gear

The camshaft runs in three bearings with split steel, white-metal coated shells and is driven from the crankshaft by helically toothed gears. No. 3 bearing takes the camshaft thrust. The camshaft gear is of light metal alloy and is riveted to the camshaft. The valves are operated via cam followers, push rods and rocker arms. Each cam operates the valves of two opposed cylinders in turn.

Cylinders

The four cylinders are all identical and can be replaced separately complete with pistons. The cylinders have fins to improve transfer of heat to the cooling air.

Pistons

The light alloy pistons with steel inserts are fitted with two compression rings and one oil scraper ring. The piston pins are fully floating in the piston bores und are secured laterally by circlips.

Crankcase

The split crankcase is a pressure die casting of light alloy. Both halves are machined together and must, therefore, only be replaced as a pair.

Crankshaft

The crankshaft is forged in one plane and all bearing journals are induction hardened. The crankshaft runs in four bearings in the crankcase. Bearings 1, 3 and 4 are aluminium bushes with lead-coated surfaces. No. 2 bearing — seen from the clutch end — is a split shell three-layer type. No. 1 bearing takes up the crankshaft end thrust. The flywheel is provided with a toothed ring for the starter drive and is held to the crankshaft by four dowels and a gland nut.

Connecting rods

The four I-section connecting rods are forged in steel. At the crankshaft end they have three-layer bearing shells and at the piston pin end they are fitted with steel bushes with a lead-bronze coating.

Clutch

Between engine and manual transmission is a dry, single-plate clutch which is fitted in the flywheel. The driven plate with linings on both sides is free to slide axially on the splined transmission drive shaft. The clutch cover, the pressure plate and the springs are bolted concentrically to the flywheel face. When engaged, the driven plate is pressed against the clutch surface on the flywheel by the pressure of the springs. Power can then be transmitted from engine to transmission.

Type	1/1600	1/1600	1/1600 [1])	1/Model 181
Engine code letter	B	AE	AE, AK, AH [2])	AM
Bore mm (in.)	85.5 (3.96)	85.5 (3.96)	85.5 (3.96)	85.5 (3.36)
Stroke mm (in.)	69.0 (2.72)	69.0 (2.72)	69.0 (2.72)	69.0 (2.72)
Capacity cm^3 (cu. ins.)	1584 (96.6)	1584 (96.6)	1584 (96.6)	1584 (96.6)
Compression ratio	7.5	7.5	7.3	7.3
Output DIN PS at rpm	47/4000	50/4000	48/4000	48/4000
SAE bhp at rpm	57/4400	60/4400	46/4000 [3])	46/4000 [3])
Torque DIN mkg at rpm	10.6/2200	10.8/2800	10.2/2000	10.2/2000
SAE ft lb at rpm	81.7/3000	81.7/3000	72.0/2000 [3])	72.0/2000 [3])
Piston speed				
meter per sec. at rpm	9.2/4000	9.2/4000	9.2/4000	9.2/4000
feet per min. at rpm	1811/4000	1811/4000	1811/4000	1811/4000
Octane requirement RON	90	91	91	91
Dry weight kg (lbs.)	115 (253)	120 (265)	120 (265)	
Ignition	Battery			
Coil	12 volt			
Distributor	see M 3.2/1-1			
Ignition timing	see M 3.2/1-1			
Firing order	1—4—3—2			
Dwell angle	44—50°			
Spark plugs	see M 3.2/1-1			
Spark plug thread	M 14×1.25×12.7			
Spark plug gap mm (in.)	0.6 (0.024)			
Cooling	Air cooling by radial fan on generator shaft			
Air quantity liter (cu. ft.)/sec.	575 (21)	620 (24)		
at rpm	/4000	/4000		
Lubrication	Pressure feed by gear type pump			
Engine oil cooling	Oil cooler in fan air stream			
Engine oil filter	—			
Engine oil pressure indicator	By warning lamp			
Engine oil, changing quantity	2.5 liter (5.3 US pints)			
Engine oil, initial filling	2.0 liter (4.25 US pints)			
Oil consumption liter/1000 km	0.5—1.0			
US pints/1000 miles	1.7—3.4			

[1]) from engine No.: AE 558 001
[2]) M 27 (engines with exhaust recirculation system / Automatic Stick Shift for California only)
[3]) SAE net ratings

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Type	1/1600 1/Model 181
Engine code letter	B, AE, AH, AK, AM
Cylinder heads	One for each pair of cylinders with cooling ribs
Valve seat inserts	Shrunk-in, sintered steel
Valve guides	Shrunk-in, special brass
Spark plug threads	Cut in cylinder head
Valve mechanism	Camshaft below crankshaft, cam followers in crankcase, push rods and rocker arms
Valve timing with 1 mm (0.04 in.) valve clearance	
Intake opens before TDC	7° 30′
Intake closes after BDC	37°
Exhaust opens before BDC	44° 30′
Exhaust closes after TDC	4°
Valves	1 intake, 1 exhaust per cylinder
Valve head exhaust	32.0 mm (1.260 in.) diameter
Valve head intake	35.5 mm (1.397 in.) diameter
Clearance: intake	0.15 mm (0.006 in.)
exhaust	0.15 mm (0.006 in.)
Valve springs	1 spring per valve
Cylinders	Separate cylinders of special gray cast iron with cooling ribs
Distance between centers	112 mm (4.41 in.)
Pistons	Light alloy with steel inserts
Piston pins	Floating, secured by circlips
Piston rings	2 compression 1 oil scraper
Crankcase	Two-part magnesium alloy, divided vertically through crankshaft and camshaft bearings
Camshaft	Gray cast iron, three bearings
Camshaft bearings	Thin-wall steel shells with white metal layer
Camshaft drive	Helical gears
Crankshaft	Forged high quality steel, four main bearing journals
Main bearings, 1, 3 and 4	Aluminum, lead coated
Main bearing, 2 (center bearing)	Split shells, three-layer
Main bearing journal 1—3	55.0 mm (2.165 in.) diameter
Main bearing journal 4	40.0 mm (1.575 in.) diameter
Connecting rod journals	55.0 mm (2.165 in.) diameter
Flywheel	Forged, with integral starter ring
Connecting rods	Forged, with I-section shaft
Connecting rod bearings	Three-layer, thin-wall shells
Piston pin bearings	Pressed-in steel bushings with lead-bronze layer
Clutch	
Type	Single disc, dry
Total lining area	363 cm² (56 sq. in.) [1]
Pressure	357.5—392.5 kg (786—863 lb.) [1]

[1] from August 1972 diaphragm spring clutch total lining area: 339 cm² (53 sq. in.)
pressure: 380—440 kg (838—970 lb.)

Type	1/1600 1/Model 181	
	New part	Wear limit *)
Cooling		
Thermostat ..... opening temperature	65–70° C (149–158° F)	–
Fan pulley / crankshaft pulley out of balance	–	–
Fan ..... out of balance	max. 5 cmg	–
Belt pulley ..... radial runout	–	–
Engine lubrication system		
1 - Oil pressure (only for SAE 30 oil) at an oil temperature of 70° C (158° F) and 2500 rpm ... pressure	3 kg/cm² (42 psi)	2 kg/cm² (28 psi)
2 - Oil pressure relief valve spring (up to July 1969)		
Length loaded	43.2 mm (1.700 in.)	–
Load	2.5–4.2 kg (5–9 lbs.)	–
3 - Oil pressure relief valve spring (from August 1969)		
Length loaded	44.1 mm (1.736 in.)	–
Load	5.6–7.3 kg (12–16 lbs.)	–
4 - Oil pressure regulating valve spring		
Length loaded	20.2 mm (0.795 in.)	–
Load	2.9–3.6 kg (6–8 lbs.)	–
5 - Oil pump: Gears/housing without gasket ..... end play	–	0.1 mm (0.004 in.)
Gears ..... backlash	0.0–0.2 mm (0.0–0.008 in.)	–
6 - Oil pressure switch opens at ..... pressure	0.15–0.45 kg/cm² (2–6 psi)	–
Cylinder head and valves		
1 - Cylinder seating depth in cylinder head	13.45–13.55 mm 0.5295–0.5334 in.)	–
2 - Combustion chamber capacity	48–50 cm³ [1]) (2.9–3.0 cu. in.) [1])	–
3 - Rocker arm ..... inside diameter	18.00–18.02 mm (0.7086–0.7094 in.)	18.04 mm (0.7102 in.)
4 - Rocker shaft ..... diameter	17.97–17.98 mm (0.7074–0.7078 in.)	17.95 mm (0.7066 in.)
5 - Rocker shaft/arm ..... radial play	0.02–0.05 mm (0.0008–0.002 in.)	–

*) The term "Wear limit" means that parts which are near, or have reached the dimensions given should not be reinstalled during repairs.

[1]) from August 1970: 50–52 cm³ (3.0–3.2 cu. in.).

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Type		1/1600 1/Model 181	
		New part	Wear limit
6 - Valve seat:			
Intake	width	1.4–2.5 mm (0.055–0.098 in.)	–
Exhaust	width	1.4–2.5 mm (0.055–0.098 in.)	–
Intake	seat angle	45°	–
Exhaust	seat angle	45°	–
Outer correction angle		15°	–
Inner correction angle		75°	–
7 - Valve guides:			
Intake	inside diameter	8.00–8.02 mm (0.315–0.316 in.)	8.06 mm (0.317 in.)
Exhaust	inside diameter	8.00–8.02 mm (0.315–0.316 in.)	8.06 mm (0.317 in.)
8 - Valve stems:			
Intake	diameter	7.94–7.95 mm (0.3126–0.3129 in.)	7.90 mm (0.3110 in.)
Exhaust	diameter	7.91–7.92 mm [1] (0.3114–0.3118 in.) [1]	7.87 mm (0.3098 in.)
	out of round	max. 0.01 mm (0.0004 in.)	–
9 - Valve guide/valve stem:			
Intake	rock	0.21–0.23 mm (0.008–0.009 in.)	0.8 mm (0.032 in.)
Exhaust	rock	0.23–0.27 mm (0.009–0.010 in.)	0.8 mm (0.032 in.)
10 - Valve spring:			
Length loaded		31.0 mm (1.22 in.)	–
Load		53.2–61.2 kg (117–135 lbs.)	–
11 - Compression (with engine warm, throttle open, all plugs out, gauge in plug seat and engine turned by starter)			
with code letter	B, AE [2]	8–10 kg/cm² (114–142 psi)	7 kg/cm² (100 psi)
with code letter	AE, AH, AK, AM	7.5–9.5 kg/cm² (107–135 psi)	6 kg/cm² (85 psi)
Difference between cylinders		–	max. 2 kg/cm² (28 psi)
Cylinders and Pistons			
1 - Cylinder	out of round	max. 0.01 mm (0.0004 in.)	–
2 - Cylinder/piston	clearance	0.04–0.06 mm (0.0016–0.0024 in.)	0.20 mm (0.008 in.)

[1]) from August 1970: 7.92–7.94 mm (0.3118–0.3126 in.)
[2]) up to engine No. AE 558 000

Type	1/1600 1/Model 181	
	New part	Wear limit
3 - Piston weight		
−Weight (brown)		
engine code letter B, AE, AM	402–412 g	
(engine code letter AE from Aug. 1970 up to July 1971)	398–410 g	
+Weight (grey)		
engine code letter B, AE, AM	410–420 g	
(engine code letter AE from Aug. 1970 up to July 1971)	406–418 g	
4 - Weight difference between pistons in one engine	max. 5 g	–
during repair	max. 10 g	–
5 - Compression ring upper ..... side clearance	0.07–0.10 mm (0.0028–0.004 in.)	0.12 mm (0.0047 in.)
lower ..... side clearance	0.05–0.07 mm (0.002–0.0028 in.)	0.10 mm (0.004 in.)
6 - Oil scraper ring ..... side clearance	0.03–0.05 mm (0.0011–0.0019 in.)	0.10 mm (0.004 in.)
7 - Compression ring upper ..... gap	0.30–0.45 mm (0.012–0.018 in.)	0.90 mm (0.035 in.)
lower ..... gap	0.30–0.45 mm (0.012–0.018 in.)	0.90 mm (0.035 in.)
8 - Oil scraper ring ..... gap	0.25–0.40 mm (0.010–0.016 in.)	0.95 mm (0.037 in.)
Connecting rods		
1 - Connecting rod weight, in production	500–610 g	–
supplied as spare part		–
−weight (brown or white)	580–588 g	–
+weight (gray or black) ..	592–600 g	–
2 - Weight difference between connecting rods in one engine	max. 5 g	max. 10 g
3 - Connecting rod bushing . diameter	22.008–22.017 mm (0.8664–0.8667 in.)	–
4 - Piston pins ..... diameter	21.996–22.000 mm (0.8658–0.8661 in.)	–
5 - Piston pin/bushing ..... radial play	0.01–0.02 mm (0.0004–0.0008 in.)	0.04 mm (0.0016 in.)
Crankcase bores		
1 - Bores for crankshaft bearings	65.00–65.02 mm	65.3 mm
a) Bearing Nos. 1–3 .... diameter	(2.559–2.5598 in.)	(2.5708 in.)
b) Bearing No. 4 ..... diameter	50.00–50.03 mm (1.9685–1.9696 in.)	50.4 mm (1.984 in.)
2 - Bore for seal at flywheel end ..... diameter	90.00–90.05 mm (3.5433–3.5452 in.)	–
3 - Bore for camshaft bearings ..... diameter	27.50–27.52 mm (1.0826–1.0834 in.)	–
4 - Bore for oil pump housing diameter	70.00–70.03 mm (2.7559–2.7570 in.)	–
5 - Bore for cam followers . diameter	19.00–19.02 mm (0.7480–0.7488 in.)	19.05 mm (0.750 in.)

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Type		1/1600 1/Model 181	
		New part	Wear limit
Camshaft			
1 - Bearings	inside diameter	25.02–25.04 mm (0.9850–0.9858 in.)	–
2 - Camshaft journals	diameter	24.99–25.00 mm (0.9838–0.9842 in.)	–
3 - Camshaft/bearings	radial play	0.02–0.05 mm (0.0008–0.002 in.)	0.12 mm (0.0047 in.)
	end play	0.04–0.13 mm (0.0016–0.0051 in.)	0.16 mm (0.0063 in.)
4 - Runout at center bearing (Nos. 1+3 on V-blocks)		max. 0.02 mm (0.0008 in.)	0.04 mm (0.0016 in.)
5 - Camshaft gear	backlash	0.00–0.05 mm (0.0–0.002 in.)	–
6 - Cam follower	diameter	18.96–18.98 mm (0.7464–0.7472 in.)	18.93 mm (0.7452 in.)
7 - Bore/cam follower	radial play	0.02–0.06 mm (0.0008–0.0024 in.)	0.12 mm (0.0047 in.)
8 - Push rod	runout	max. 0.3 mm (0.012 in.)	–
Crankshaft			
1 - Crankshaft at No. 2 and 4 bearings (Nos. 1 and 3 on V-blocks)	runout	–	0.02 mm (0.0008 in.)
2 - Crankshaft	out of balance	max. 12 cmg	–
3 - Main journal	out of round	–	0.03 mm (0.0012 in.)
4 - Connecting rod journal	out of round	–	0.03 mm (0.0012 in.)
5 - Connecting rod bearing	inside diameter	55.02–55.05 mm (2.1661–2.1673 in.)	–
6 - Connecting rod journal	diameter	54.98–55.00 mm (2.1645–2.1653 in.)	–
7 - Connecting rod journal/ Connecting rod bearing	radial play	0.02–0.07 mm (0.0008–0.0028 in.)	0.15 mm (0.006 in.)
	end play	0.1–0.4 mm (0.004–0.016 in.)	0.7 mm (0.028 in.)
8 - Crankshaft bearings			–
Bearings Nos. 1 and 3	diameter	55.03–55.07 mm (2.1665–2.1681 in.)	–
Bearing No. 2	diameter	55.02–55.08 mm (2.1661–2.1685 in.)	–
Bearing No. 4	diameter	40.05–40.10 mm (1.5767–1.5787 in.)	
9 - Crankshaft bearing journals			
Bearings Nos. 1, 2, 3	diameter	54.97–54.99 mm (2.1641–2.1649 in.)	–
Bearing No. 4	diameter	39.98–40.00 mm (1.5740–1.5748 in.)	–

Type	1/1600 1/Model 181	
	New part	Wear limit
10 - Crankshaft bearing/ crankshaft		
Bearings 1 and 3 ..... radial play	0.04–0.10 mm (0.0016–0.004 in.)	0.18 mm (0.0071 in.)
Bearing 2 ..... radial play	0.03–0.09 mm (0.0012–0.0035 in.)	0.17 mm (0.0067 in.)
Bearing 4 ..... radial play	0.05–0.10 mm (0.002–0.004 in.)	0.19 mm (0.0075 in.)
end play	0.07–0.13 mm (0.0028–0.0051 in.)	0.15 mm (0.0059 in.)
11 - Flywheel ..... lateral runout (measured at center of friction surface)	max. 0.30 mm (0.0118 in.)	–
imbalance	max. 20 cmg	–
Shoulder for oil seal .... outside diameter	69.9–70.1 mm (2.7519–2.7598 in.)	69.4 mm (2.7322 in.)
Machining of tooth width	–	max. 2.0 mm (0.08 in.)
12 - Drive plate ..... imbalance	max. 5 cmg	–
Clutch		
1 - Complete clutch ..... out of balance	max. 15 cmg	–
2 - Pressure plate ..... runout	–	0.10 mm (0.004 in.)
3 - Release ring ..... runout	max. 0.3 mm (0.012 in.)	0.4 mm (0.016 in.)
4 - Flywheel/release ring .. distance	26.7–27.3 mm (1.051–1.075 in.)	–
5 - Clutch springs color	white red	
Length loaded	29.2 mm 29.2 mm (1.149 in.) (1.149 in.)	–
Load ..... new	44.5–49.5 kg 34–37 kg (99–100 lb) (75–81 lb)	–
Load ..... settled	39–44 kg 29.5–32.5 kg (86–97 lb) (66–72 lb)	–
6 - Clutch plate ..... runout [measured at 195 mm (7.677 in.) diameter]	max. 0.5 mm (0.02 in.)	–
7 - Free play at clutch pedal	10–20 mm ($^3/_8$–$^3/_4$ in.)	–

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Engines for vehicles with manual transmission

General

Engine testing should cover the following points:

1 - Preliminary inspection
2 - Warmup
3 - Fuel consumption test
4 - Output test
5 - Final inspection

Completely or partly reconditioned engines should also be tested in this way. A test stand with water brake is most suitable for these tests. On this type of stand the load on the engine can be adjusted to suit the performance and fuel consumption test conditions.

Preliminary check

a - Adjust valve clearance.
b - Adjust contact points and set ignition.
c - Check belt tension.
d - Fill the engine with oil (see M 1.1/1-1).

Warming up

Prior to starting, crank the engine several revolutions by hand. If the engine has not been in operation for a long period, it is advisable to inject a few drops of oil into the air intake opening of the carburetor while starting the engine.

After the engine has been started, the oil pressure warning light must go out immediately as the engine speed increases. Otherwise the oil pump has not picked up any oil to feed bearings and friction surfaces.

The generator warning lamp should also go out at a fast idle speed.

When the engine starts running check for leaks at fuel pump, fuel lines and carburetor. Check fuel pump pressure.

The warmup period on the test bench may generally be limited to 30 minutes. The engine should run:

10 minutes at 1500 rpm with minimum load.
20 minutes at 2500 rpm with increased load.

Fuel consumption test

Check the fuel consumption at the end of the 30 minute warmup period, using a suitable measuring glass and a stop watch. At a fixed speed and load the fuel consumption can be determined from the time taken to consume a given amount of fuel.

	Engine speed rpm	Brake load kg (lb.)	Seconds to consume 100 ccm
up to July 1970	2900	6.5 (14.3)	51—55
	4000 (full throttle)	at least 11.2 (24.5)	21.5—22.5
from Aug. 1970	2500	5.7 (12.3)	55—65
	4000 (full throttle)	at least 11.4 (24.7)	19.0—20.5

Output test

After the fuel consumption test, the engine output is tested and compared with the values given in the output graph. A variation of ±5% is permissible to compensate for manufacturing tolerances and differences in test conditions.

The correction factor "f" is found in the diagram by using the measured intake air temperature and the barometric pressure.

The engine output is dependent on the oil temperature. The output test should, therefore, be carried out at an oil temperature of at least 80° C (176° F) in the crankcase.

Final Inspection

1 - Set idling speed while engine is warm.
2 - Check for oil leaks.
After the full-load and fuel consumption test, the engine should be checked for oil leaks. Special attention should be paid to push rod tubes, oil pump, oil cooler, cylinder head covers and the crankcase joint.
3 - Check the compression.
The compression is checked with the throttle fully open and the engine warm. The spark plugs are removed and the engine turned over with the starting motor.
4 - Re-check.
Before installation in the vehicle, check valve clearance and belt tension. The air cleaner should be clean and filled with the required amount of oil.

Storage of engines

Engines which are to be stored for a long time must be specially treated to prevent corrosion. All remaining traces of fuel and combustion gases will become chemically active and attack the cylinder walls, valve guides, etc.

To prevent damage of this kind, it is recommended that anti-corrosion oil be injected through the carburetor air intake during the last engine revolutions.

The spark plugs can also be removed and anti-corrosion oil injected directly into each cylinder. The exterior of the engine should be sprayed with anti-corrosion oil.

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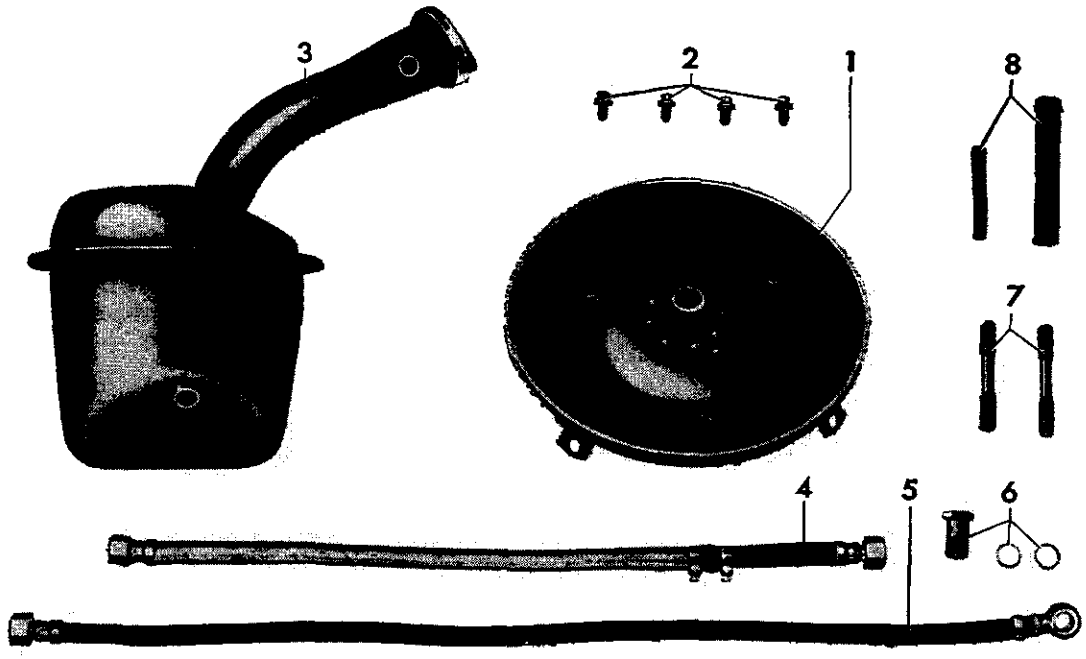
Special instructions for engines for vehicles with Automatic Stick Shift

When testing engines for vehicles with Automatic Stick Shift on a test stand, additional preparations are necessary. These engines have drive plates instead of the flywheel, additional vacuum connections on carburetor, manifold or balance pipe and a second oil pump for the converter ATF feed and bolts instead of the two engine mounting studs.

The following additional parts are required and should be available at every test stand:



1 - Drive flange
2 - 4 twelve points bolts
3 - ATF tank with dipstick (cap)
4 - ATF pressure hose with suction hose and approx. 2 quarts of ATF
5 - ATF return hose
6 - Union bolt with two washers
7 - 2 studs AM 10×82
8 - Plugged hose

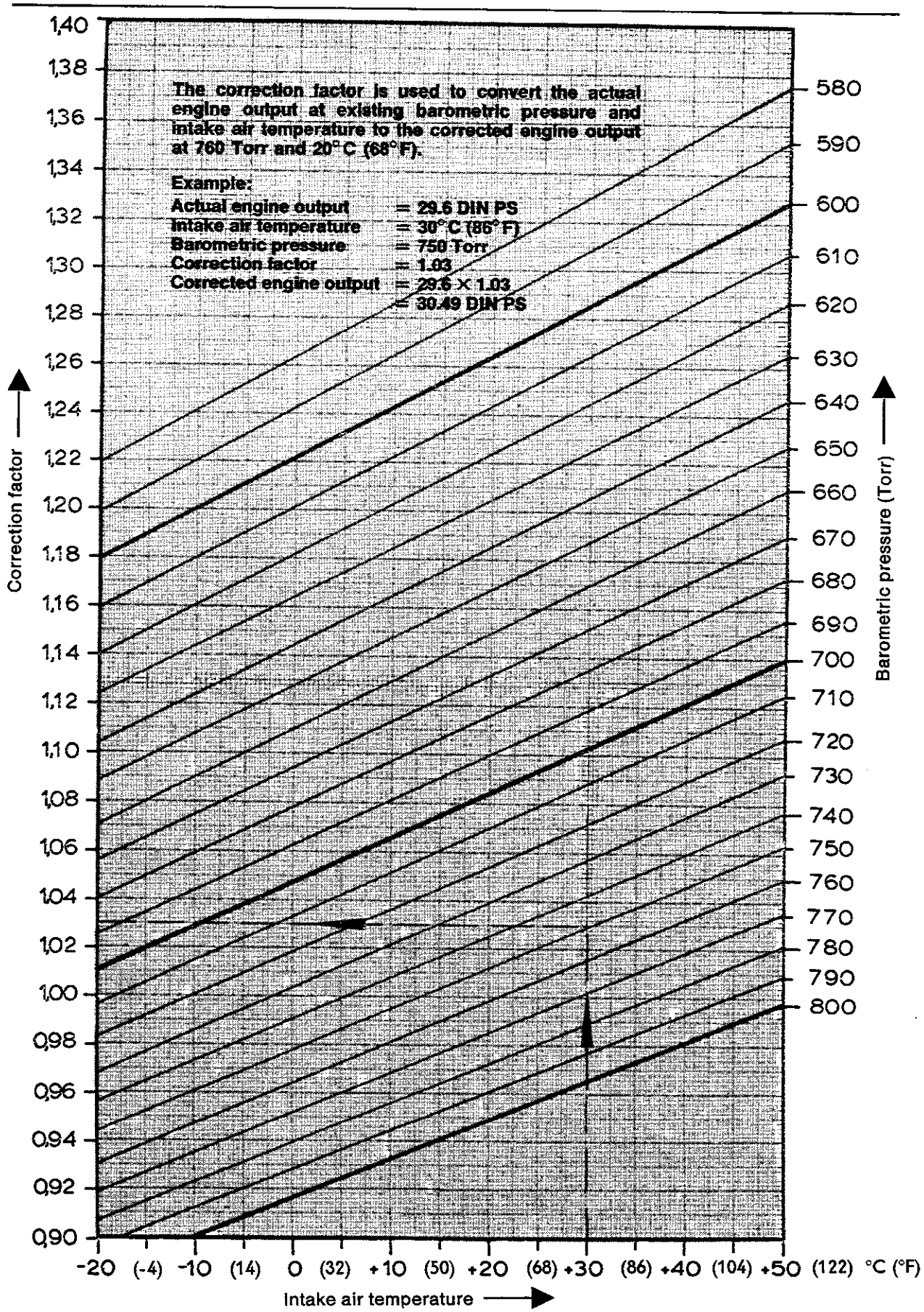
Installation instructions

1 - Attach drive flange to drive plate on engine with the four twelve point bolts.

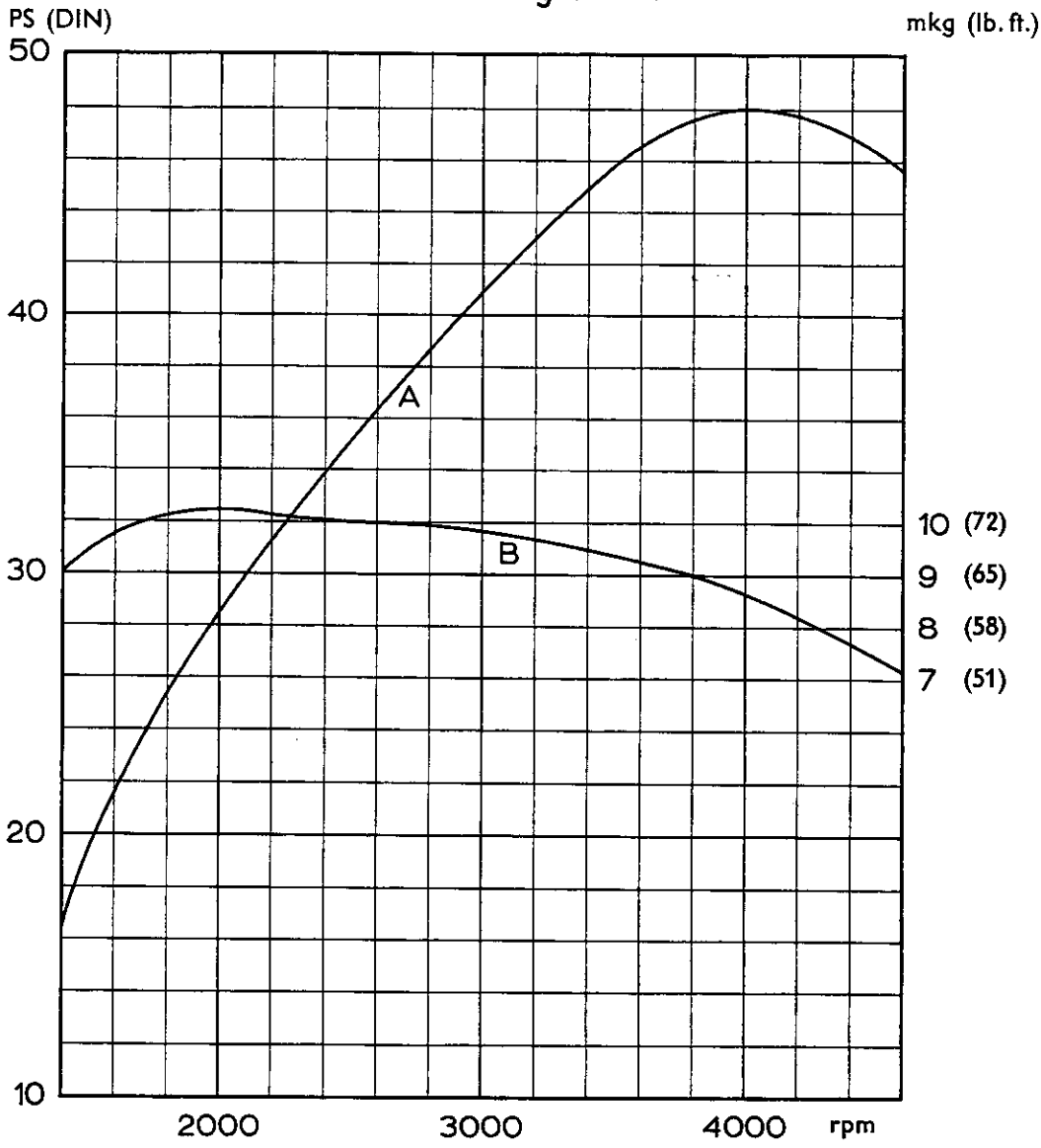
2 - Install the two lower engine mounting studs into the crankcase.

3 - Connect ATF tank to dual pump.

4 - Seal the vacuum connections on carburetor and intake manifold.


The correction factor is used to convert the actual engine output at existing barometric pressure and intake air temperature to the corrected engine output at 760 Torr and 20° C (68° F).
Example:
Actual engine output = 29.6 DIN PS
Intake air temperature = 30° C (86° F)
Barometric pressure = 750 Torr
Correction factor = 1.03
Corrected engine output = 29.6 × 1.03
= 30.49 DIN PS
Correction factor
1,40
1,38
1,36
1,34
1,32
1,30
1,28
1,26
1,24
1,22
1,20
1,18
1,16
1,14
1,12
1,10
1,08
1,06
1,04
1,02
1,00
0,98
0,96
0,94
0,92
0,90
Barometric pressure (Torr)
580
590
600
610
620
630
640
650
660
670
680
690
700
710
720
730
740
750
760
770
780
790
800
-20 (-4) -10 (14) 0 (32) +10 (50) +20 (68) +30 (86) +40 (104) +50 (122) °C (°F)
Intake air temperature

from August 1971



A = Output (PS)

B = Torque

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Testing and checking engines

General

Engine testing should cover the following points:

1 - Preliminary inspection

2 - Warming up

3 - Fuel consumption test

4 - Output test

5 - Final inspection

Fully and partly reconditioned engines should also be tested in this way. A test stand with water brake is most suitable for these tests. On this type of stand the load on the engine can be adjusted to suit the performance and fuel consumption test conditions.

Preliminary check

a - Adjust valve clearance.

b - Adjust contact points and set ignition.

c - Check belt tension.

d - Fill the engine with oil (see M 1.3/1-1 for quantity).

Warming up

Prior to starting, crank the engine several revolutions by hand. If the engine has not been in operation for a long period, it is advisable to inject a few drops of oil into the air intake opening of the carburetor while starting the engine.

After the engine has been started, the green oil pressure warning light must go out immediately as the engine picks up speed. Otherwise the oil pump has not picked up any oil to feed bearings and friction surfaces.

The red generator warning lamp should also go out at a fast idle speed.

After the engine has been started check for leaks on fuel pump, fuel lines and carburetor. Check fuel pump pressure.

The warm up period on the test bench may generally be limited to 30 minutes. The engine should run:

10 minutes at 1500 rpm with 3 kg (6.6 lb.) load.

20 minutes at 2500 rpm with 6 kg (13.2 lb.) load.

Fuel consumption test

Check the fuel consumption at the end of the 30 minute warm up period, using a suitable measuring glass and a stop watch. At a fixed speed and load the fuel consumption can be determined from the time taken to consume a given amount of fuel.

	Engine speed rpm	Brake load kg (lb.)	Seconds to consume 100 cc
1/1200	2200	5.0 (11)	84.5—91.5
	3600 (full throttle)	at least 9.1 (20)	30—33
1/1300	2500	5.7 (12.5)	66.5—71.5
	4000 (full throttle)	at least 9.6 (21)	25.5—27.5
1/1600	2900	6.5 (12.5)	51—55
	4000 (full throttle)	at least 10.2 (22.5)	21.5—22.5
2/1600	2400	5.6 (12.3)	65—70
	4000 (full throttle)	at least 11.0 (24)	20.5—23.0
3/1600	2500	5.7 (12.5)	65—70
	4000 (full throttle)	at least 12.8 (28.2)	18.5—20.5
3/1600 M 236	2900	6.5 (12.5)	51—55
	4000 (full throttle)	at least 10.5 (23)	18—20

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M1.6 Testing and Checking Engines, Output Graph

Output test

After the fuel consumption test, the engine output is tested and compared with the values given in the output graph. A variation of ± 5 % is permissible to compensate for manufacturing tolerances and differences in test conditions.

Note the following to obtain accurate test results:

1 - Connect generator or regulator to the electrical circuit on the test stand.

2 - Install damper pipe or tail pipes on the muffler.

3 - Open the flaps on the heat exchangers and connect flexible metal hoses.

3/1600:

4 - Close the fresh air pipes.

5 - Check engine oil temperature with the thermometer on the test stand.

6 - Measure intake air temperature.

7 - Find corrected engine output with the aid of the correction factor.

8 - Extract exhaust gas as well as heating and cooling air.

Additional notes to above points:

To point 5:

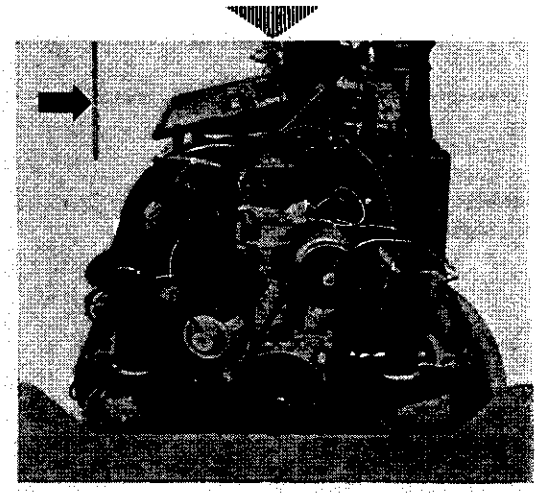
The engine output is dependent on the oil temperature. The output test should, therefore, be carried out at the following oil temperatures:

Type 1, 2 and Industrial Engine:	at least 80° C (176° F) in crankcase
Type 3:	at least 60° C (140° F) in oil filler neck

The temperatures are different because of the location of the temperature sensing unit. (Types 1—2 in the crankcase, type 3 in the oilfiller neck.)

To point 6:

To establish the correction factor, is it necessary to measure **the temperature of the intake air** about 10—15 cm (4—6 in.) away from the air cleaner during the test.



To point 7:

The engine output is influenced by barometric pressure and temperature. Therefore, it is necessary to adjust the actual output of an engine to certain standard operating conditions. According to DIN 70020, these standard conditions are 20° C (68° F) and 760 Torr (= 760 mm Hg or 29.92 in. Hg). The engine output based on these figures is called "Corrected output".

The various factors (and their units of measurement) that must be considered in the calculation of engine output and torque are:

Actual brake load	$= F_e$ (kg)
Corrected brake load	$= F_{red}$ (kg)
Engine speed	$= n$ (rpm)
Actual engine output	$= P_e$ (bhp)
Corrected engine output	$= P_{red}$ (bhp)
Intake air temperature	$= t$ (°C)
Barometric pressure	$= b$ (Torr)
Correction factor	$= f$
Torque	$= M_d$ (mkg)

The values needed to check the performance of the engine are computed on the basis of the following equations:

1 - Actual engine output: $P_e = \frac{F_e \cdot n}{1000}$ (bhp)

2 - Corrected engine output: $P_{red} = P_e \cdot f$ (bhp)

3 - Corrected engine output: $P_{red} = \frac{F_e \cdot n}{1000} \cdot f$ (bhp)

4 - Correction factor: $f = \frac{760}{b} \cdot \sqrt{\frac{273 + t}{293}}$

5 - Torque: $M_d = F_{red} \cdot 0.716$

These equations are represented graphically on pages M 1.6/1-4 to M 1.6/1-6. The diagrams are read in the following manner:

Correction Factor Diagram

The correction factor is found by using the measured intake air temperature and the barometric pressure.

Output Diagram

The actual engine output is found by reading the actual brake load at the given engine speed.

The corrected engine output can now be established by multiplying the actual engine output with the correction factor. This method should be used whenever the engine performance test is conducted under extreme weather conditions.

Consolidated Diagram

In this diagram the corrected engine output can be read directly. In the lower left hand part of the coordinate system, the correction factor is obtained from the intake air temperature and the barometric pressure. The field on the upper left yields the values for corrected brake load and torque on the basis of the actual brake load and the correction factor.

On the right hand side of the coordinate system, the corrected engine output can be determined by reading right from the vertical axis to the engine speed and down to the horizontal axis.

Note: Always read parallel to the coordinates. For further details see examples in each diagram.

To point 8:

Exhaust gases have to be emitted outdoors because they contain poisonous carbon monoxide. Assure good ventilation of the test room.

To avoid overheating the engine (output drop), it is advisable to extract cooling and heating air as well.

Final Inspection

a - Set idling speed while engine is warm.

b - Check for oil leaks.

After the full-load and fuel consumption test, the engine should be checked for oil leaks. Special attention should be paid to push rod tubes, oil pump, oil cooler, cylinder head covers and the crankcase joint.

c - Check the compression.

The compression is checked with the throttle fully open and the engine warm. The spark plugs are removed and the engine turned over with the starting motor.

d - Re-check.

Prior to installation in the vehicle, check valve clearance and belt tension. The air cleaner should be clean and filled with the required amount of oil.

e - Storage of engines.

Engines which are to be stored for a long time must be specially treated to prevent corrosion. All remaining traces of fuel and combustion gases will become chemically active and attack the cylinder walls, valve guides, etc. To prevent damage of this kind, it is recommended that anti-corrosion oil be injected through the carburetor air intake during the last engine revolutions. The spark plugs can also be removed and anti-corrosion oil injected directly into each cylinder. The exterior of the engine should be sprayed with anti-corrosion oil.

Checking on a vehicle test stand

The output and fuel consumption can be measured on a vehicle test stand when the engine is installed. Test conditions and values for this type of test are given in the respective specification charts.

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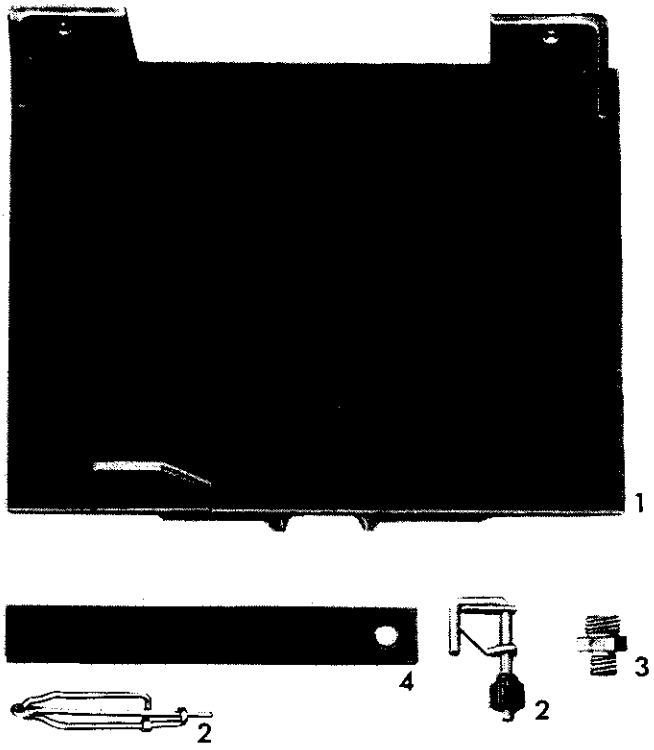

No.	Description	Special tool	Remarks
1	Support for engine jack	VW 612/2	
2	Clip for fuel line	VW 647	
3	Union M 16×1.5		soldered up
4	Retaining plate for converter	VW 802	

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Removing

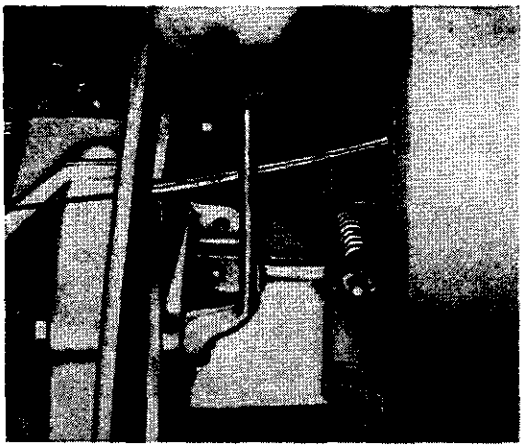
1 - Disconnect ground strap from battery.

2 - Remove air cleaner.

3 - Up to Engine No. H 5924000:

Remove throttle positioner.

4 - Remove nuts from two upper engine mounting bolts.



Note

From August 1970, a special nut is pressed into crankcase on upper left side. On these engines the bolt must be inserted from the transmission side.

5 - Disconnect wires from generator, ignition coil, oil pressure switch and carburetor.

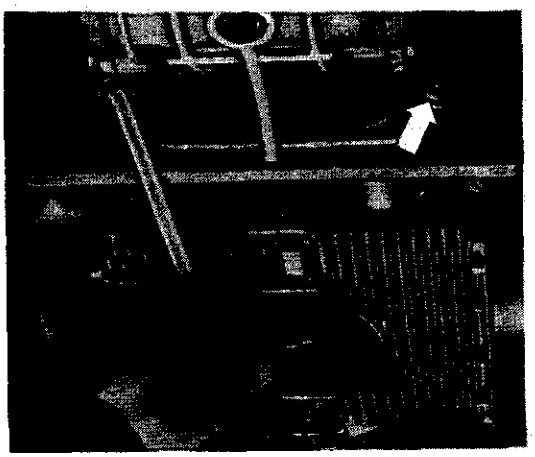
6 - Disconnect accelerator cable from carburetor.

7 - Pull fuel hose off and plug it.

8 - Disconnect both heater flap cables and detach heater pipes from engine.

9 - Pull accelerator cable out of guide tube.

10 - Remove two nuts from lower engine mounting bolts (arrow).



11 - Remove engine downward.

Caution

Take care not to damage the main drive shaft, clutch and clutch plate.

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Installing

1 - Check clutch release bearing for wear and replace if necessary.

Roughen up the plastic ring with coarse emery and lightly rub in molybdenum disulfide paste.

2 - Rub molybdenum disulfide powder lightly into splines of drive shaft with a clean cloth.

3 - Lubricate starter bushing lightly with multi-purpose grease.

4 - Clean transmission case and engine flange.

5 - If the damping material in the engine compartment is loose, secure it properly before installing engine.

6 - When inserting the engine and guiding it over the main drive shaft, take care not to damage the shaft, the clutch plate and the release bearing.

It is advisable to turn the engine back and forth with the belt pulley (engage a gear).

7 - When installing the engine, locate the lower studs in the transmission flange first then insert upper bolts. Tighten nuts uniformly.

8 - Adjust clutch pedal free play.

9 - Install engine seal properly.

10 - Adjust accelerator cable at full throttle.

11 - Adjust ignition.

The following sequence of operations is recommended when disassembling and assembling the engine:

Disassembling

1 - Drain engine oil.

2 - Remove front cover plate.

3 - Remove rear cover plate.

4 - Remove muffler.

5 - Remove heat exchangers (left and right).

6 - Remove fan housing complete with generator.

7 - Remove intake manifold complete with preheating pipe.

8 - Remove generator support.

9 - Remove cylinder cover plates (left and right).

10 - Remove crankshaft pulley.

11 - Remove distributor and fuel pump.

12 - Remove distributor drive shaft.

13 - Remove oil cooler.

14 - Remove rocker arm shafts.

15 - Remove cylinder heads.

16 - Remove cylinders.

17 - Remove pistons.

18 - Remove clutch.

19 - Remove flywheel.

20 - Remove oil pump and strainer.

21 - Split crankcase.

22 - Take out camshaft and crankshaft.

Assembling

Proceed in reverse order. Additional instructions are found on following pages.

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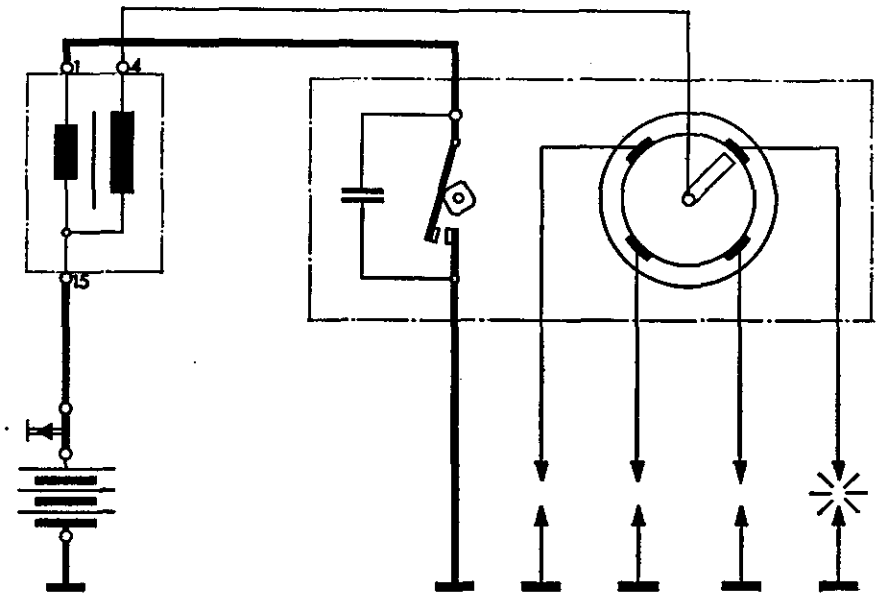
Ignition System

The ignition system is a battery type.

The battery voltage is stepped up in the coil to 15,000—20,000 volts as in a transformer. This takes place as follows:

As the distributor shaft rotates (driven by the crankshaft), the integral contact breaker cam opens the contact points.



This interrupts the flow of current in the primary windings of the coil. The magnetic field built up in the two windings by the flow of current collapses and induces a high voltage surge in the secondary winding.

This high voltage surge passes through an ignition cable to the rotor in the distributor. The tip of the rotor is just opposite the contact in the distributor cap to which the spark plug in the cylinder to be fired is connected.

A spark jumps across the plug electrodes and ignites the compressed fuel/ air mixture in the cylinder.

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Ignition coil

The coil consists of a laminated iron core around which is wrapped a few turns of thick wire to form the primary winding and a large number of turns of thin wire to form the secondary winding. The beginning of the secondary winding is attached to the iron core to which the high voltage cable is connected. The end of the secondary winding is connected to the beginning of the primary winding and both are connected to terminal 1 on the coil.

Distributor

The distributor provides a means of distributing the ignition current to each of the four spark plugs in the correct sequence and exactly at the firing point.

The distributors are fitted with a vacuum or combined centrifugal and vacuum spark control arrangement to ensure that the ignition timing is automatically varied to suit all engine speeds and load conditions.

Vacuum spark control

The vacuum advance mechanism controls the firing point according to engine load and speed. There are **two** vacuum drillings in the carburetor, one in the venturi and one near the throttle valve. The drilling in the venturi gives a speed-sensitive vacuum advance and the drilling near the throttle valves gives a load-sensitive advance.

The depression created in the carburetor is routed to the vacuum unit on the distributor. A diaphragm in the vacuum unit is moved by the vacuum and a pull rod transmits the movement of the diaphragm to the contact breaker plate and turns it against the direction of rotation of the cam on the distributor shaft. When the depression ceases, a return spring moves the breaker plate back to its original position.

Centrifugal and vacuum spark control

1 - Centrifugal control

Two weights on a carrier plate fly outward as the distributor speed increases. The contact breaker cam is connected to the weights by a small link so that cam is turned in the direction of rotation of the distributor shaft and the ignition timing is advanced. Return springs pull the weights back to the initial position as the speed drops.

2 - Single vacuum control

a - The vacuum taken from the carburetor via **one** drilling near the throttle valve acts mainly in the part load range in addition to the centrifugal advance and turns the breaker contact plate against the direction of rotation of the cam on the distributor shaft.

b - Double vacuum control

The vacuum is taken in front of and behind the throttle valve and led in separate lines to the two chambers in the vacuum unit. The diaphragms of these chambers are connected by a rod to the breaker contact plate which is moved either in the direction of distributor shaft rotation to retard the spark timing or against the direction of distributor shaft rotation to advance the spark timing.

To give the retarded timing required at idling speed the vacuum is taken from behind the fully closed throttle valve and acts on the breaker contact plate via the ring-shaped diaphragm.

When the throttle valve is opened, the vacuum in the drilling in front of the throttle valve increases and the breaker contact plate is moved in the direction of advanced timing.

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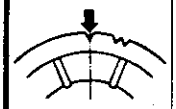
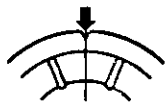
Model		1/Manual Transmission 1/Model 181				
Code letters		B	AE	AE, AH, AK	AK	AM
Used	from	11 Aug. 1969	1 Aug. 1970	1 Aug. 1971	1 April 1973	1 April 1973
Engine No.	from	B 6 000 001	AE 000 001	AE 558 001 AH, AK 000 001	AK 1 200 009	AM 000 001
Distributor Production		113 905 205 T	113 905 205 AJ	113 905 205 AN	043 905 205	113 905 205 AN 043 905 205 C
Distributor Replacement		111 905 205 AA	113 905 205 AJ	113 905 205 AN	043 905 205	043 905 205 C
Ignition timing		0°	5° after TDC		7.5° before TDC	5° after TDC
Timing marks						
Speed	rpm	800—900				
Vacuum hose or hoses		off	on		off	on
Dwell angle	set to	44—50°				
	wear limit	42—58°				
Centrifugal spark control Begin	rpm		1000—1250	1000—1250	1050—1250	1000—1250
	rpm Degrees		1500 6—12	1500 6—12	1500 6—12	1500 6—12
	rpm Degrees					
End	rpm Degrees		3800 22—25	3800 22—25	3800 22—25	3800 22—25
Vacuum spark control advance Begin	mmHg	3—7	110—160	110—160	60—100	110—160
	mmHg Degrees	30 17—19				
End	mmHg Degrees	70—76 32—35	210—240 9—12	180—200 5—8	200 8—12	180—200 5—8
Vacuum spark control retard Begin	mmHg		80—130	80—150		80—150
End	mmHg Degrees		160—230 11— 13	160—230 11—13		160—230 11—13
Spark plugs [1]	below +25° C (77° F)	W 145 T 1				
	above +25° C (77° F)	W 175 T 1				

[1]) Or plugs from other manufacturers with equivalent heat values and approved by VW factory.

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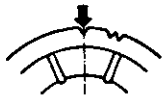
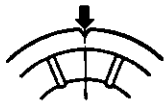
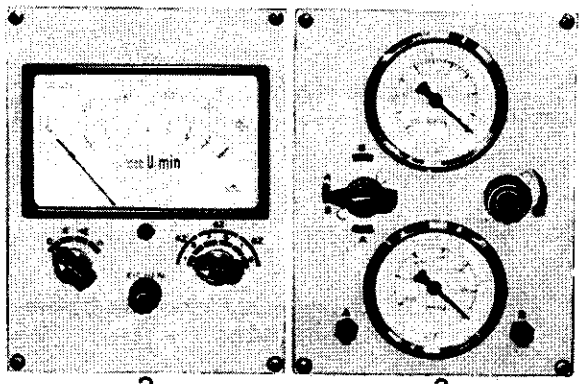
Model		1/Automatic Stick Shift			
Code letters		B	AE, AH	AH	AK
Used	from	11 Aug. 1969	1 Aug. 1970	1 April 1973	1 Aug. 1972
Engine No.	from	B 6 000 002	AE 000 002	AH 090 024	AK 000 001
Distributor Production		113 905 205 AD 113 905 205 AE	113 905 205 AH	043 905 205 A	113 905 205 AH
Distributor Replacement		113 905 205 AE	113 905 205 AH	043 905 205 A	113 905 205 AH
Ignition timing		0°	5° after TDC	7.5° before TDC	5° after TDC
Timing marks					
Speed	rpm	800—900			
Vacuum hose or hoses		on		off	on
Dwell angle	set to	44—50°			
	wear limit	42—58°			
Centrifugal spark control					
Begin	rpm	1050—1200	1000—1200	1000—1200	1000—1200
	rpm Degrees	1700 13—15	1600 12—15	1600 12—15	1600 12—15
	rpm Degrees	2200 13—16	2200 12—16	2200 12—16	2200 12—16
End	rpm Degrees	3900 25—28	3800 22—25	3800 22—25	3800 22—25
Vacuum spark control advance					
Begin	mmHg	70—120	110—160	60—100	110—160
	mmHg Degrees				
End	mmHg Degrees	240 8—12	150—170 2—5	200 8—12	150—170 2—5
Vacuum spark control retard					
Begin	mmHg	60—100	80—130		80—130
End	mmHg Degrees	170 6—8	160—230 11—13		160—230 11—13
Spark plugs [1]	below +25° C (77° F)	W 145 T 1			
	above +25° C (77° F)	W 175 T 1			

[1]) Or plugs from other manufacturers with equivalent heat values and approved by VW factory.



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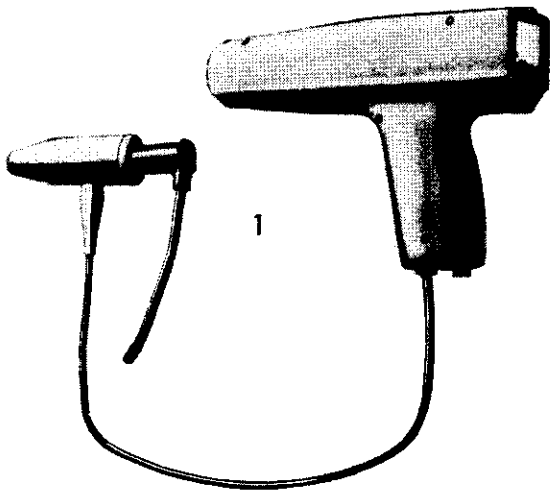

1

No.	Description	Special tool	Remarks
1	Stroboscopic timing light		
2	Dwell angle — tachometer tester		
3	Vacuum measuring gauge		range 0—100 and 0—600 mm Hg

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Coil

Keep coil cap clean and dry.

Distributor

1 - Check points for pitting and build-up, replace if necessary.

2 - Lubricate fiber block on breaker arm with a small amount of multi-purpose grease.

3 - Lubricate breaker arm bushing and felt wick in shaft with a drop of engine oil.

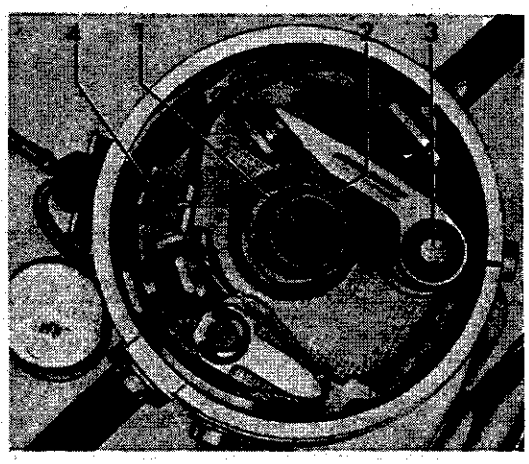
4 - Check that distributor cap is clean. Check for cracks and arcing marks. Clean or replace as necessary.

5 - Check and adjust dwell angle.

6 - Check timing and adjust if necessary.

Spark plugs

Clean, check gaps and adjust.



Special instructions (lubrication)

A - The felt wick in the distributor shaft (1) and the contact arm bushing (3) should be lubricated with a few drops of engine oil regularly.

B - The fiber block on the breaker arm must be lubricated with multi-purpose grease. To avoid the risk of grease getting on to the contact points, use only a very small quantity and press it into the corner between fiber block and breaker arm (2) and on the ball (4).

5 - Run engine at 1000 to 1200 rpm and note dwell meter reading.

Dwell angle: 42°—58°

6 - Run engine at 2000—2500 rpm and check reading again.

Note:

Small breaker gap = large dwell angle
Large breaker gap = small dwell angle

Evaluating meter readings:

The point gap must not be less than .012 in. (0—3 mm). If the dwell angle reading shows that a smaller gap is necessary (measured with feders) there is a **mechanical defect in the distributor.**

When the speed is increased, the dwell angle must not alter noticeably (max. ±1°). Large deviations indicate **defects in distributor,** such as worn bearings or a worn cam.

Unsteady, jerky movements of the needle are usually caused by burned and **unserviceable breaker points.**

Adjusting contact points with feeler gauge

The contact points should only be adjusted with a feeler gauge if a dwell meter is not available. Even when there is only a small build-up on the points, the points can no longer be set accurately by this method.

1 - Remove distributor cap and rotor.

2 - Turn the crankshaft until the breaker arm is fully lifted by the cam.

3 - Loosen the screw holding the fixed contact point.

4 - Insert screwdriver between the two small pins on the contact breaker plate and in the slot at the end of the fixed point. Turn the screwdriver until the clearance is .016 in. (0.4 mm).

5 - Tighten lock screw.

Important

When the contact points have been adjusted, the ignition timing must be reset as an alteration of .004 in. (0.1 mm) in the breaker gap alters the ignition timing about 3°.

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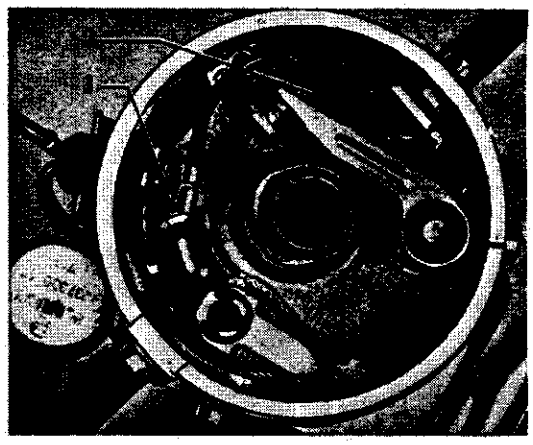
Normal wear of the rubbing block allows the contact point gap to close, causing the points to burn rapidly with subsequent engine misfiring.

Removing

1 - Disconnect wire (1).

2 - Remove screw (2).



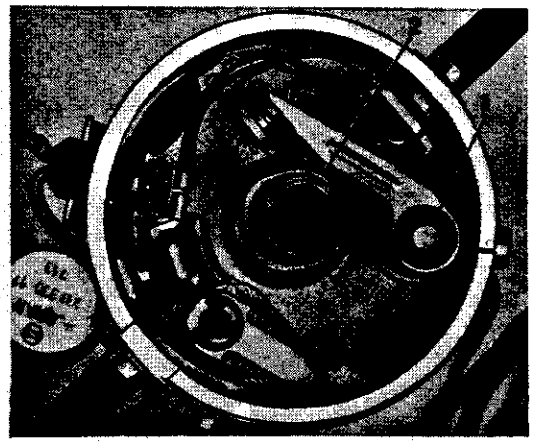
Installing

1 - Lubricate contact pivot (1) with one drop of engine oil.

2 - Lubricate cam and fiber block (2) with the enclosed grease capsule.

3 - Remove any oil or grease which may have gotten on the points accidentally.

4 - Adjust points.

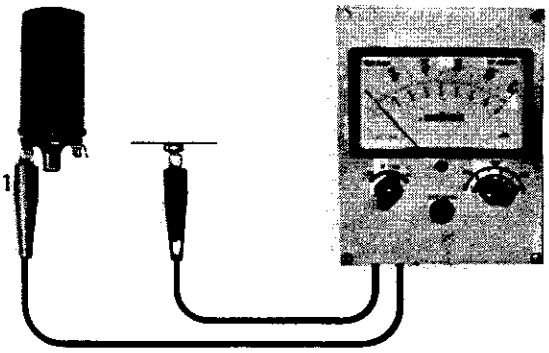


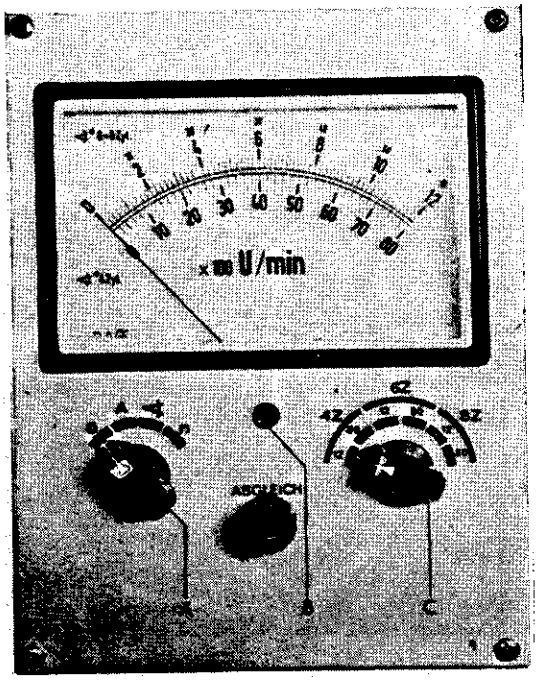
Adjusting dwell angle

If the dwell angle tester used is different from the one shown here, the appropriate instructions for use must be followed.

1 - Connect tester:

Connect green clip to terminal 1 on coil and black clip to a metal part.





A - Test selection switch

B - Zeroing screw

C - Measuring range selection switch

2 - Calibrate the tester:

Set test selection switch to "A". Turn knob of calibrating switch until the needle is exactly on the end mark (12 or 80) of the scale.

3 - Measure dwell angle.

Set test selection switch to "⏚" and measuring range selection switch to 4 Z (number of cylinders).

Start engine and run it at about 1000 rpm. Read off dwell angle on lower scale (1 graduation = 2°).

Then increase engine speed to about 2000 rpm. The needle must not deviate more than ±1° from the previous reading. If it does, it indicates that the distributor shaft or the breaker plate is worn. In such cases remove distributor and replace breaker plate.

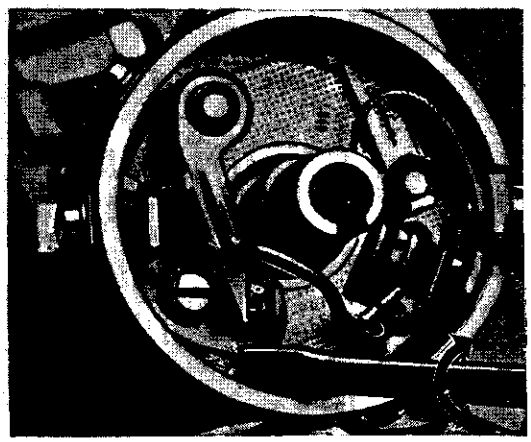
Compare readings with specified figures.

Specified dwell angle	44–50°
Wear limit	42–58°

This means that **new** contacts must be adjusted to the specified figure and that worn contacts should not be adjusted as long as the dwell angle is within the wear limit.

4 - Adjust dwell angle.

Take distributor cap and rotor arm off and loosen screw holding the contacts. With ignition switched on and starter turning the engine over, alter the contact gap until the correct angle can be read on the tester. Tighten contact securing screw and check again to see that the angle has not changed as the screw was being tightened.



5 - Install rotor arm and distributor cap and check dwell angle again.

Note

When the dwell angle has been adjusted, the ignition timing must also be readjusted.

If the instrument used is different from the one shown here, the appropriate instructions for use must be followed.

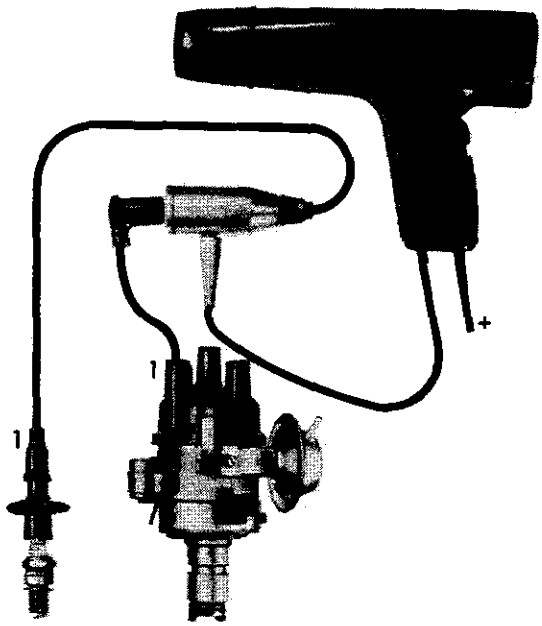
1 - Check dwell angle, if necessary adjust.

2 - Engine oil temperature 30–70° C (86 to 158° F).

3 - Connect the dwell angle tester and calibrate it. Set test selection switch to "n". Set measuring range selection switch to "4 Z" and to "12" in this group.

The speed is read off on the upper or lower scale.

4 - Connect stroboscopic timing light. The impulse unit is connected in the No. 1 cylinder plug cable as shown. The adjusting disc in the handle must be turned back to the zero stop.



5 - **Only if specified:**

Pull vacuum hose or hoses off the vacuum unit on the distributor (see table M 3.2/1).

6 - Run engine at the given speed 800–900 rpm.

Note

Set engine to specified speed with throttle valve closed by turning the bypass air screw.

7 - Check ignition timing:

The mark on the pulley must be in line with the crankcase joint.

8 - Adjust ignition timing:

Turn distributor until the setting mark aligns with the reference mark (see M 3.2/1).

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If the instruments used are different from those shown in the list of tools the appropriate instructions for use must be followed.

1 - Connect dwell angle tester and trim it. Set test selection switch to "n". Set measuring range selection switch to "4 Z" and to "80" in this group. The speed is read off on the lower scale.

2 - Connect stroboscopic timing light.

3 - Start engine, check basic ignition timing and rectify as necessary.

4 - **Pull hose or hoses off the vacuum unit on distributor.**

5 - Run engine at 900 rpm. and direct flashes onto the timing mark.

The setting may deviate from the basic setting due to the absence of the vacuum connections and this should be "brought back" with the aid of the adjusting disc on the control angle measuring instrument. Note the reading.

6 - Increase speed slowly. The start of the spark advance will be shown by the movement of the timing mark.

7 - Set the speed to the figure given in the table (see M 3.2). "Bring the mark back" with the aid of the disc on the control angle measuring instrument. Read off the advance in degrees on the instrument and subtract the reading at point 5 to obtain the centrifugal spark control.

8 - If the test results do not agree with the specified figures, the control mechanism in the distributor must be repaired (freed up, weak springs replaced) or a new distributor installed.

1 - Pull hose off vacuum unit on carburetor and connect hoses of **vacuum tester** to engine so that connection "A" is connected to the vacuum unit and connection "B" to the carburetor.

2 - Connect stroboscopic timing light (see page 3.3/2).

3 - Set change-over knob to "B" and close control valve. Start engine. If no vacuum is show, the vacuum connection in the carburetor is blocked.

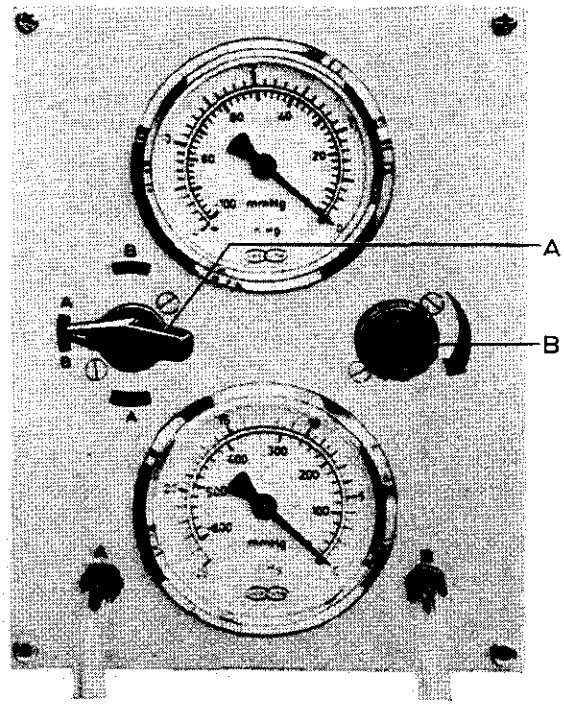
If vacuum is present, move change-over knob to "AB" and increase speed until a reading of at least 100 mmHg is recorded. Then move knob to "A" and switch engine off. The indicated vacuum must remain constant for at least 1 minute, otherwise the vacuum unit or the hose is leaking.

4 - Move knob to "AB" and open control valve. Start engine, check basic ignition timing and rectify if necessary.

5 - Close control valve and increase speed until the vacuum reading is higher than given in the table (see 3.2/1) for the end of advance check. Move knob to "A" and let engine run on at idling speed.

6 - Reduce the vacuum with the control valve to the test pressure given in the table.

Direct flashes from timing light onto the timing mark and "bring the mark back" with the adjusting disc. Read off the advance in degrees on the measuring instrument.



A - Change-over knob

B - Control valve

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Vacuum spark retard

1 - Connect tester between "retard unit" and vacuum line.

2 - Pull vacuum hose off "advance unit".

3 - Run engine at 900 rpm and direct flashes onto timing mark. (Vacuum control valve must be open.)

4 - Bring mark back with adjusting disc.

Read off the total spark retard on the measuring instrument (see specified figures page 3.2/1).

5 - Close vacuum control valve slowly. Read off vacuum figures for beginning and end of spark retard.

Vacuum spark advance

1 - Connect tester between "advance unit" and vacuum line.

2 - Pull vacuum hose off "retard unit".

3 - Run engine at 900 rpm and direct flashes onto timing mark. (Vacuum control valve must be open.)

4 - With the adjusting disc on the measuring instrument, bring back the deviation from the basic ignition timing caused by the absence of the "retard" vacuum connection. Note the reading.

5 - Increase speed until the vacuum reading is higher than given for the end of spark control check in table (see page 3.2/1).

6 - Maintain vacuum and reduce speed to 900 rpm.

7 - Bring mark back with adjusting disc and read off the advance. Subtract the reading noted at point 4 to obtain the vacuum spark advance.

8 - Open vacuum control valve slowly. Read off the vacuum figures for beginning and end of advance.

Checking coil

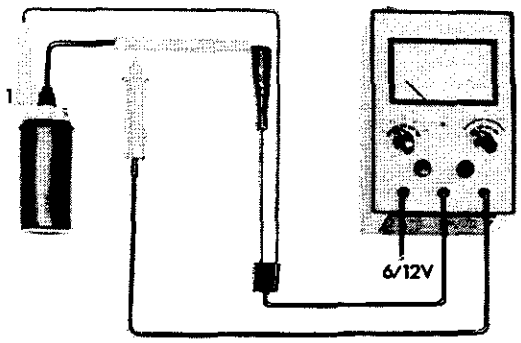
1 - Keep coil cap clean and dry to avoid shorting and tracking.

2 - Check that the flat terminals fit tightly to prevent voltage drop.

3 - Check coil output with coil tester.

The test appliance should be connected as shown in illustration and operated in accordance with manufacturer's instructions.

A resistance is connected to the high tension side of the coil (terminal 4) and a constant impulse flow fed into the coil from the test appliance. The ignition voltage given by the coil under this load is measured and should be in the order of 18,000 V (18 kV).



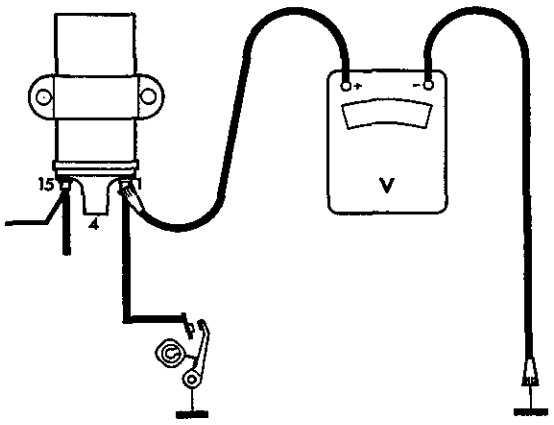
4 - If such a test appliance is not available, the coil can be tested as follows:

Pull the high tension cable out of the center of the distributor cap (terminal 4) and hold it about 10 mm away from a suitable ground. It is advisable to use a pair of insulated pliers for this purpose. Then turn the engine over with the starter and see if a spark jumps from cable end to ground. If there is no spark, check the voltage at terminal 15 on the coil with a voltmeter. There should be at least 9 volts at this point on a 12 volt system.

If the measured voltage is above this figure, check terminal 1 on coil (connection to distributor) with a voltmeter or test light. There should be no voltage reading at this terminal when the contacts are closed and a reading when they are open. Should there be no voltmeter reading even when contacts are open (distributor not being shorted) there is an open circuit in the coil and the coil must be replaced.

Checking contact points (electrical)

Connect voltmeter to terminal 1 on the coil and ground. Turn engine until points in distributor are closed. The meter needle should move. When points are open, meter needle should not move. If the meter needle does not move when points are closed, the points are either dirty or burned.



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Checking condenser

The condenser reduces arcing when the points first open and prevents them from being burned prematurely.

A defective condenser causes badly burned points, a poor spark with starting difficulty or complete loss of ignition spark.

The condenser can be tested for short circuit with a test light:

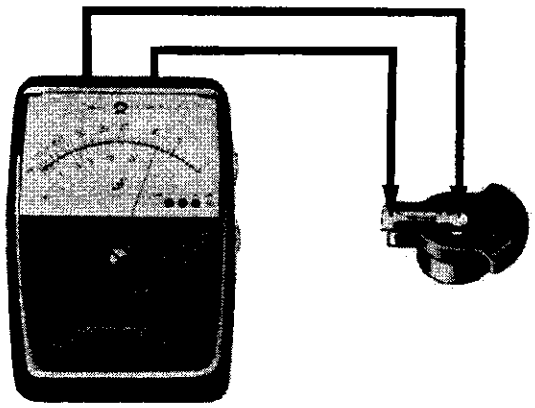
Pull off wiring to distributor at coil (terminal 1). Connect a test light between terminal 15 on the coil and the wiring (1) on the distributor. When the points are open and ignition switched on, the lamp should not light up. If it does light, there is a short in the condenser. There are condenser testers with which it is possible to test the insulation resistance, the capacity and the series resistance of a condenser. These testers should be used in accordance with the manufacturer's instructions.

Only condensers of the prescribed type should be used as replacements as condensers with different capacities will reduce the service life of the points (see Parts List.).

Checking suppression resistances

The resistance of the copper-cored cables is too low to conform to the radio interference suppression regulations in some countries. For this reason, suppression resistances are installed in the plug connectors and in the rotor. Further resistances in the cable connectors are often installed when a radio is being installed in the vehicle.

Failure of any of these resistances can cause misfiring.



1 - Check rotor with an ohmmeter.

The suppressed rotor has a moulded-in resistance which has a resistance value of up to 10 kΩ. If the resistance is higher, the rotor must be replaced.

2 - Check plug and distributor connectors with an ohmmeter.

The resistance of a plug connector or cable connector must not be more than 5—10 kΩ.

Trouble shooting

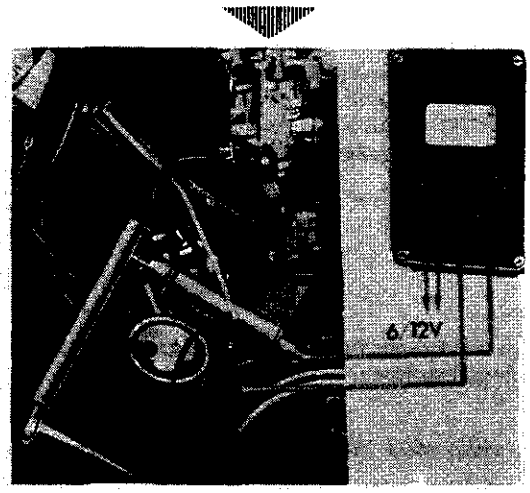
Checking coil

1 - Keep insulating cap clean and dry to avoid shorting and tracking.

2 - Check that the flat terminals fit tightly to prevent voltage drop.

3 - Check coil output with coil tester.

The test appliance should be connected as shown in illustration and operated in accordance with manufacturer's instructions.



Operation:

A resistance (1) is connected to the high tension side of the coil (terminal 4) and a constant impulse flow fed into the coil from the test appliance (2). The ignition voltage given by the coil under this load is measured and should within specifications.

4 - If such a test appliance is not available, the coil can be tested as follows:

Pull the high tension cable out of the center of the distributor cap (terminal 4) and hold it about .4 in. (10 mm) away from a suitable ground. It is advisable to use a pair of insulated pliers for this purpose. Then turn the engine over with the starter and see if a spark jumps from cable end to ground. If there is no spark, chech the voltage at terminal 15 on the coil with a voltmeter. There should be at least 9 volts at this point on a 12 volt system.

If the measured voltage is above this figure, check terminal 1 on coil (connection to distributor) with a voltmeter or test lamp. There should be no voltage reading at this terminal when the points are closed and a reading when they are open. Should there be no voltmeter reading even when points are open (distributor not being shorted) there is an open circuit in the coil and the coil must be replaced.

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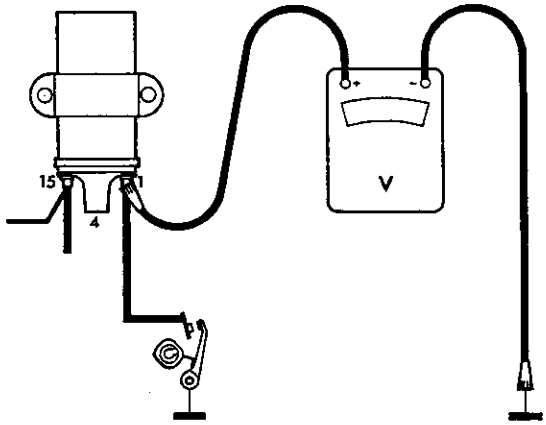
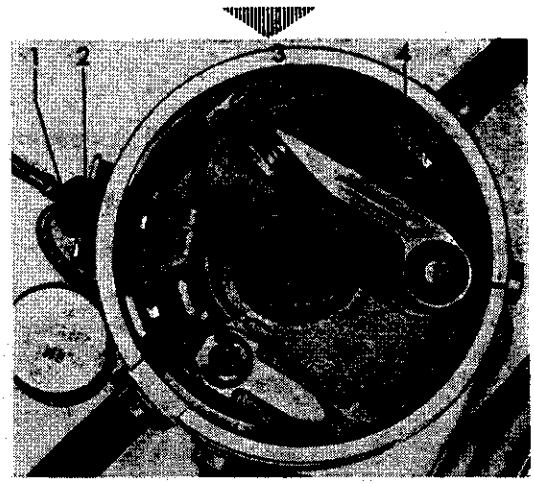
Checking contact breaker points (electrically)

Connect voltmeter to terminal 1 on the coil and ground. Turn engine until points in distributor are closed. The meter needle should move. When the points are open, the meter needle should not move.

If the meter needle does not move when points are closed, the points are either dirty or burned.



If the meter needle moves when the points are open, there is a short circuit in the distributor. Check the following points when this happens:



1 - Condenser
2 - Cable entry
3 - Cable
4 - Insulation on breaker arm spring

Checking condenser

The condenser plays an important part to reach the high voltage necessary for the ignition system. It also reduces arcing and premature burning of the points when they open.

A defective condenser causes badly burned points, a poor spark with starting difficulty or complete loss of ignition spark.

Defective condensers are extremely rare.

The condenser can be tested for short circuit with a test lamp:

Pull cable 1 to distributor off at coil. Connect a test lamp between terminal 15 on the coil and cable 1 on the distributor. When the points are open and the ignition is switched on, the lamp should not light up. If it does light, there is a short in the condenser.

There are condenser testers that test the insulation resistance, the capacity and the series resistance of a condenser. These testers should be used in accordance with the manufacturer's instructions.

Only condensers of the prescribed type should be used as replacements. Condensers with different capacities will reduce the service life of the points (see Parts List.).

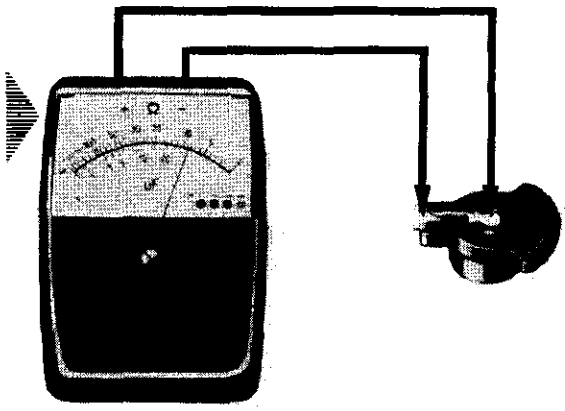
Checking suppression resistances

The resistance of the copper-cored cables is too low to conform to the radio interference suppression regulations in some countries. For this reason, suppression resistors are fitted in the plug connectors and in the rotor. In addition, there are resistors needed when a radio is installed.

Failure of any of these resistors can cause misfiring.

1 - Check rotor with an ohmmeter.

The suppressed rotor has a moulded-in resistor which has a resistance value of up to 10 kΩ. If the resistance is higher, the rotor must be replaced.



2 - Check plug and distributor connectors with an ohmmeter.

The resistance of a plug connector or cable connector must not be more than 5—10 kΩ.

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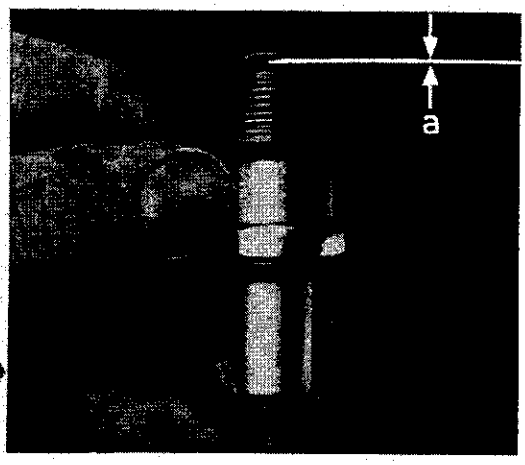
Checking ignition parts

Checking spark plugs

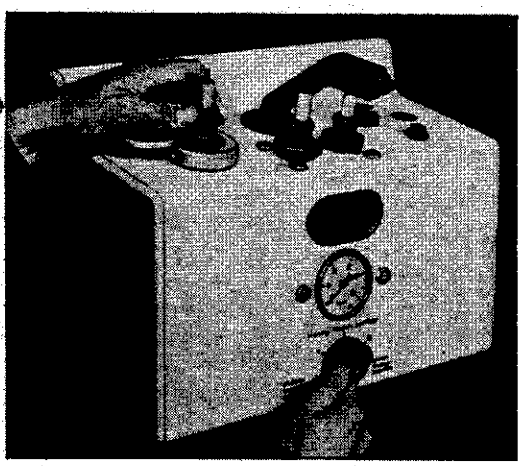
When in operation, the plug electrode gap tends to increase due to natural burning. When the gap becomes too large, the plug will start to misfire. Furthermore, dirty plugs can cause ignition and starting difficulties.



The gap is checked with a spark plug gauge and adjusted to the correct gap "a" by bending the ground electrode.

"a" = .028 in. (0.7 mm)

With a spark plug tester the plugs can be tested under a pressure of 85—114 psi (6—8 kg/cm²). The sparking can be seen through an inspection hole. The same tester can be used to clean the plugs. Older testers work on a sandblast principle while modern appliances use a special cleaning agent.



Plugs should always be cleaned with such an appliance. Steel wire brushes and other tools are unsuitable for this purpose.

Checking distributor on a test stand

On a distributor test stand, the cam offset, the vacuum advance, the centrifugal advance and the dwell angle can be checked. There are various types of test stand on the market, but they all have the following equipment in common:

Variable speed motor, tachometer, vacuum pump and a vacuum measuring gauge which must have a range of 0—100 mm Hg for distributors installed on VW engines.

The recommended test sequence is as follows:

1 - Clamp distributor in position and ensure that it runs smoothly.

2 - Check the dwell angle (see M 3.3/1-2). It may be necessary to adjust the contact gap and thus the dwell angle.

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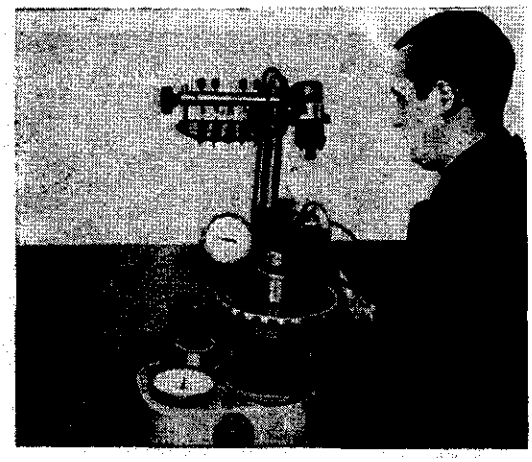
3 - Set speed to 500 rpm and note that at this speed the centrifugal advance mechanism has not started operating.



4 - Connect hose between vacuum pump and vacuum unit on distributor. Generate full vacuum with pump.

5 - Check vacuum unit for leakage. A vacuum of 100 mm Hg should remain constant for about 1 minute with vacuum line sealed.

6 - With a falling vacuum, measure the vacuum advance. Check the vacuum to vacuum unit at as many points as possible and read off the actual advance figures obtained on the test stand scale. The values must be inside the shaded area of the advance curves. If they are outside this area, repeat the test with a new vacuum unit.

7 - Run off the speed sensitive advance curves on the test stand. These values must also be within the shaded area.

No.	Description	Special tool	Remarks
1	Extractor for starter bushing	VW 228 b	

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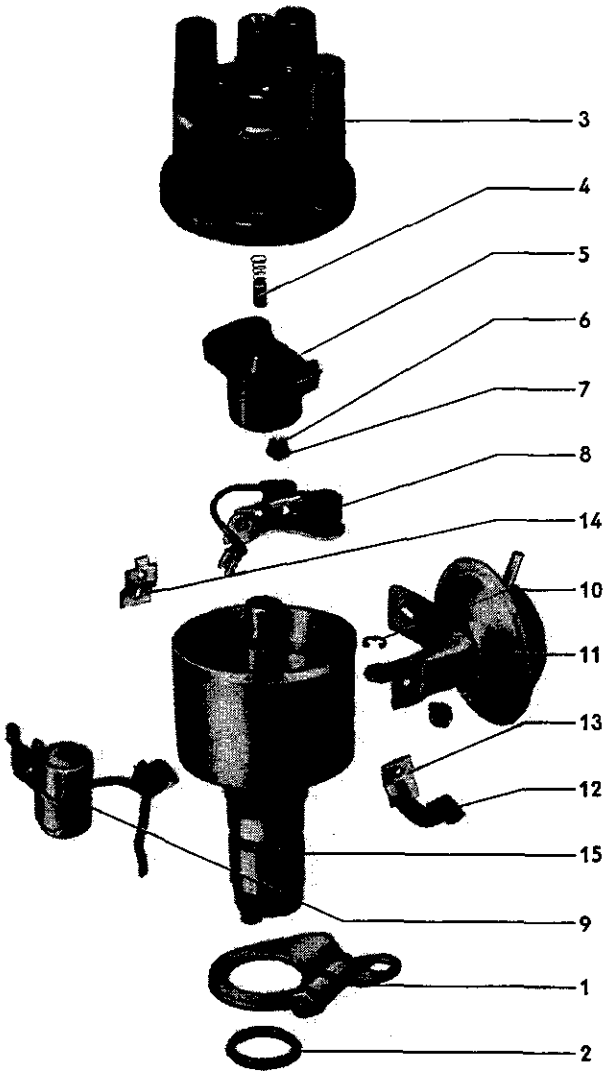

3.4 1-2 **Disassembling and assembling distributor**

No.	Description	Qty.	Note when disassembling	Note when assembling	Special instructions see
1	Clamp	1			
2	Rubber sealing ring	1		replace	
3	Distributor cap	1		check for cracks, tracking and condition of carbon brush	
4	Carbon brush and spring	1		check correct position	
5	Rotor	1			
6	Screw	2			
7	Washer	1			
8	Contact points	1	disconnect wire remove screw	make sure that the contact points are clean and correctly adjusted. Lubricate contact pivot with one drop of oil; Lubricate cam and fiber block with multi-purpose grease.	3.3/2 3.3/1
9	Condenser	1			3.3/3
10	Clip for pull rod	1			
11	Vacuum unit	1		check for leakage	
12	Retaining clip	2			
13	Tab for retaining clip	2			
14	Tab with boss for retaining clip	2		install near cut-out in distributor body	
15	Distributor body	1		if radial play between shaft and housing is excessive, replace shaft or complete distributor.	3.4/1

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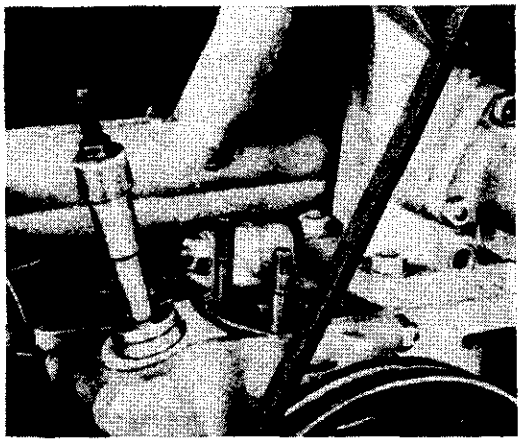
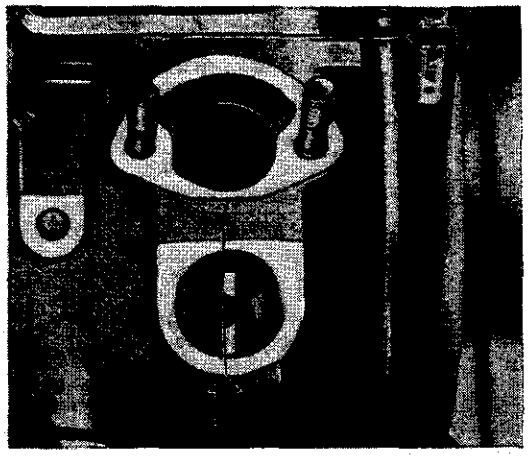




Removing and installing distributor drive shaft

1 - Withdraw drive shaft with removal tool turning shaft to left as it comes out.

2 - Remove washer under drive shaft. **Be careful not to drop it into the engine.** For removal use a magnet. If the engine is on an engine stand, turn the engine to let the washer fall out.

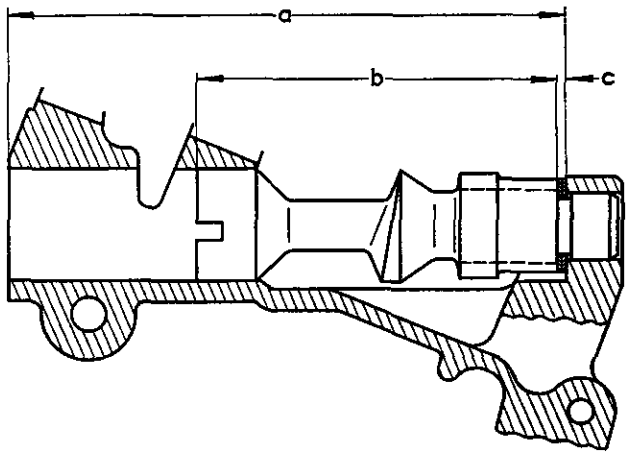
3 - Insert drive shaft.

The smaller segment must face the pulley.

Note

Due to various modifications in production and reworking of the bore for the distributor drive shaft during unit reconditioning, several combinations between crankcases, distributor drive shafts and shims have resulted.

The correct pairing of parts is of importance especially for the assembly of short block engines that are supplied without distributor drive shafts and shims. Details are given in the following table:

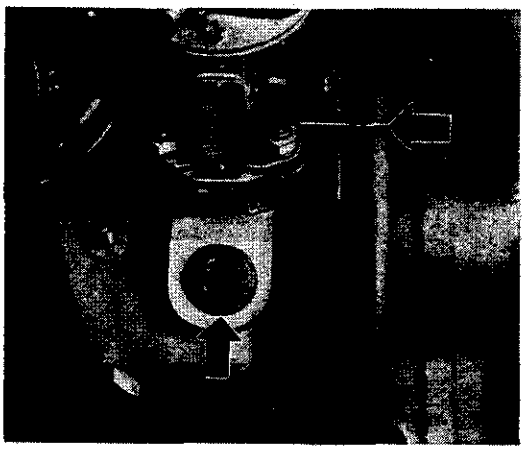


a - Depth of bore for the distributor drive shaft in mm (in.)		126.1 (4.964)	126.8 (4.991)	131.1 (5.157)		133.5 (5.255)
b - Length of distributor drive shaft up to shoulder in mm (in.)		80.3 (3.16)	80.3 (3.16)	80.3 (3.16)	85.3 (3.357)	85.3 (3.357)
c - Thickness of shims in mm (in.)	upper	0.6 (0.023)	0.6 (0.023)	6.3 (0.248)	0.6 (0.023)	0.6 (0.023)
	lower	0.6 (0.023)	1.25 (0.049)	—	0.6 (0.023)	3.0 (0.118)

Installing distributor

1 - Set No. 1 cylinder to firing point.

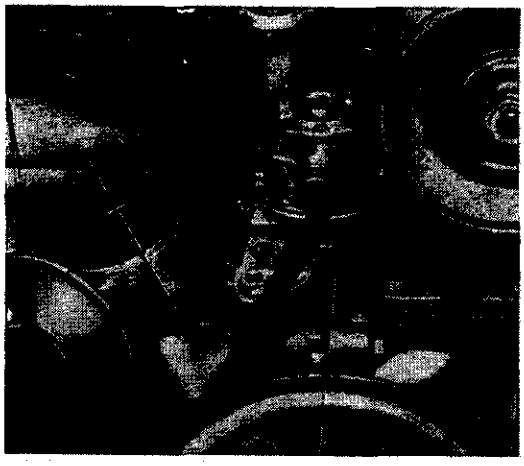
The offset slot in the distributor drive shaft must be **at a right angle** to the crankcase joint. The smaller segment must face the pulley.



2 - Turn rotor in distributor until it is pointing to the No. 1 cylinder mark on distributor housing.

3 - Insert distributor.

4 - Set timing.



Note

From August 1970 rubber sealing caps were installed on the plug connectors, coil and distributor due to the absence of the water drain plate in the engine compartment lid.

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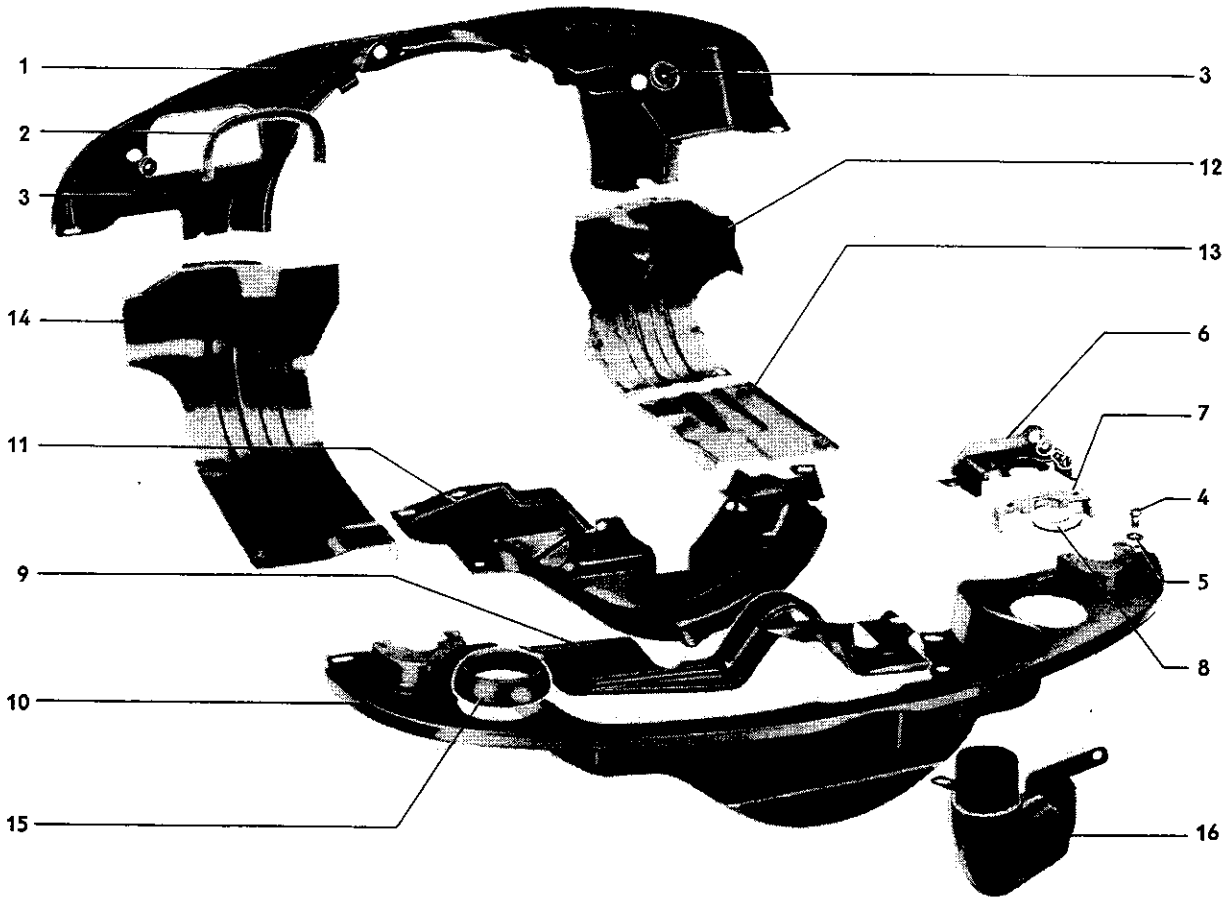

No.	Description	Qty.	Note when removing	Note when installing	Special instructions see
1	Cover plate, front	1			
2	Rubber seal	1			
3	Cable grommet	2			
4	Screw M 6×10	14			
5	Washer	14			
6	Pre-heating pipe protection plate	2	right and left differ		
7	Half-round gasket, front	2		when damaged, replace	
8	Half-round gasket, rear	2		when damaged, replace	
9	Crankshaft pulley cover plate	1			only up to July 1972
10	Cover plate, rear	1			
11	Cover plate below pulley	1			
12	Warm air duct lower part, right	1			
13	Warm air duct lower part rear, right	1			
14	Warm air duct lower part, left	1			
15	Grommet for heater hose	2			
16	Elbow	1			

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Carburetor preheating chart

Type	Special characteristics
1/1500, 1600 1/Automatic Stick Shift 2/1600	Warm air taken from below the right cylinder head (thermostatically controlled flap)
3/1600	Warm air taken from right heat exchanger (weight balanced flap)

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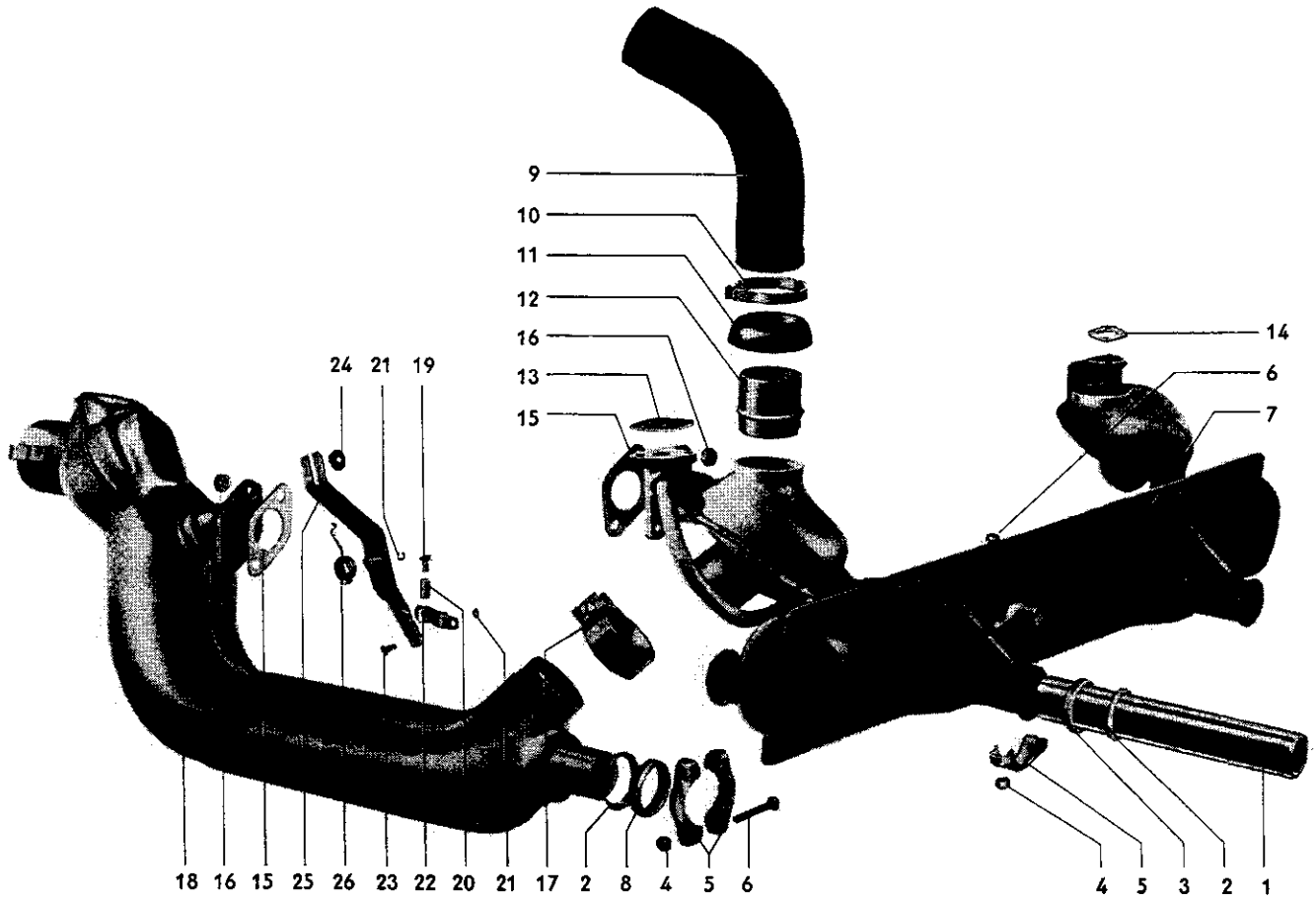

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No.	Description	Qty.	Note when disassembling	Note when assembling	Special instructions see
1	Tail pipe	2		note insertion depth	M 4.2/2
2	Retaining ring, 35 mm dia.	4			
3	Seal, 35 mm dia.	2		replace	
4	Nut M 6 self locking	8			
5	Clamp	8			
6	Bolt M 6×43	8			
7	Muffler	1	check for leaks and damage		
8	Seal, 35 mm dia, for heat exchanger	2	marked white	replace	
9	Heater hose	2	left and right differ		
10	Hose clamp, 9 mm wide	4			
11	Heater hose grommet	2			
12	Connecting pipe	2			
13	Preheating pipe gasket (left)	1	interchangeable	replace	
14	Preheating pipe gasket (right)	1		replace	
16	Nut M 8 self blocking gasket	8		replace	
16	M 8 nut, selflocking	8		torque to 2.2 mkg (16 ft. lb.)	
17	Clamp, 25 mm wide	2			
18	Heat exchanger	2	left and right differ; check for damage; check heater flap for freeness		M 4.2/2
19	Bolt M 5×10	2			
20	Pin	2			
21	C-clip	4			
22	Link	2			
23	Pin	2			
24	Clip	2			
25	Heater flap lever	2	left and right differ		
26	Return spring	2	left and right differ		

Removing

1 - Bend up edges of cover plate for warm air opening and take plate off.

2 - Drill out spot welds that secure outlet pipe to heat exchanger casing with a 6 mm ($^1/_4$ in.) diameter drill.

3 - Bend up lip that holds heat exchanger casing together.

4 - Bend casing apart slightly and remove outlet pipe.

Installing

1 - If necessary, rework heater flap shaft hole in casing and cover plate.

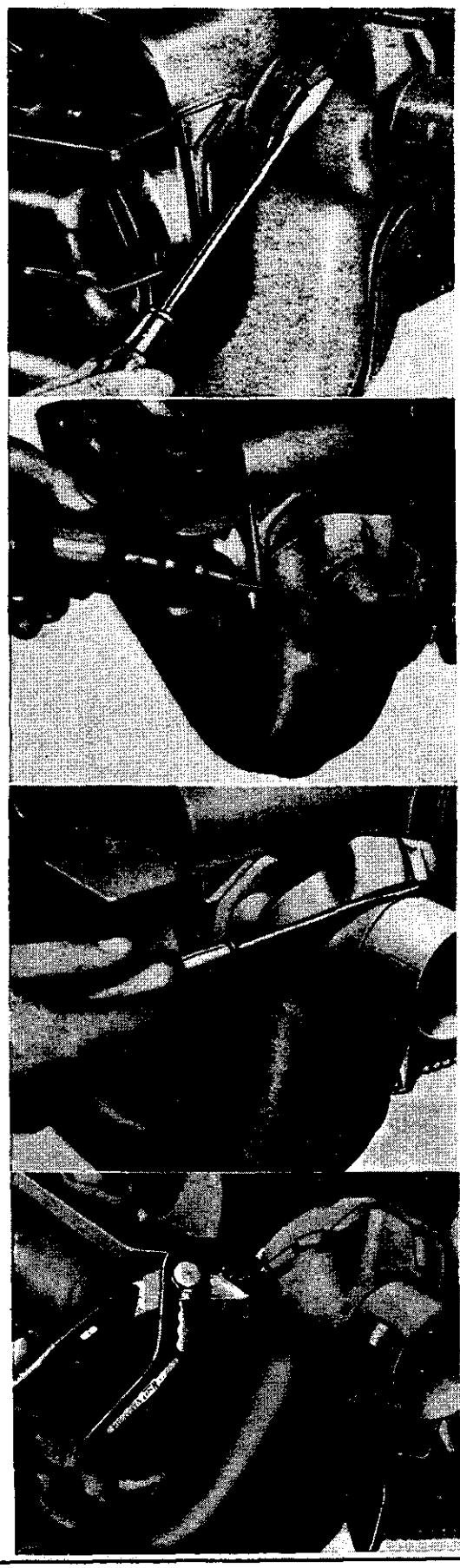
2 - Install new outlet pipe and bend back lip of casing.

3 - Install cover plate and press edges together.

4 - Tack weld outlet pipes to heat exchanger casing. Heater flaps should be opened when doing this.

5 - Check flaps for freeness.

6 - Paint new outlet pipes with cold zinc paint.



Removing and installing flap of heat exchanger **4.2** 2-1

Exhaust muffler with preheating tube in tailpipe mounting (for California only up to July 1973)

Installing

When installing the tailpipes in the muffler, it is essential to make sure that they are inserted to the correct depth.

If the tailpipes are inserted too far into the muffler there is a risk that high back pressure will be set up in the muffler and cause engine damage due to overheating.

The depth of insertion depends on the preheating pipe of the muffler (arrow).

Preheating tube, left:

first adjust the left tailpipe (see table) and than the right one accordingly.

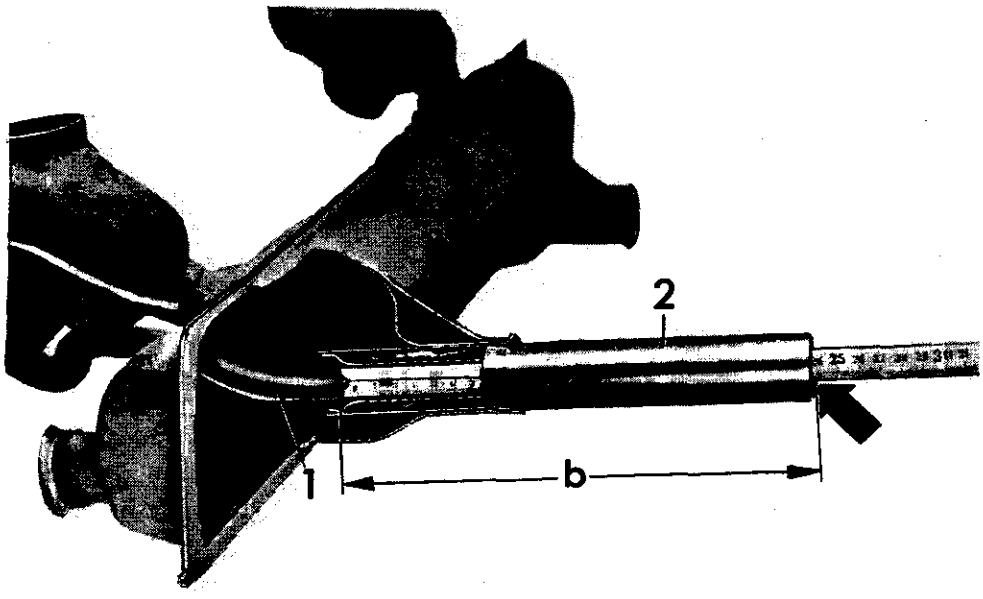
Preheating tube, right:

first adjust the right tailpipe (see table) and than the left one accordingly.

Length of tailpipe in mm (in.)	Dimension "b" in mm (in.)
276 ($10^{7}/_{8}$)	270 ($10^{5}/_{8}$)
249 ($9^{13}/_{16}$)	243 ($9^{9}/_{16}$)
226 ($8^{29}/_{32}$)	220 ($8^{21}/_{32}$)

Adjust dimension "b" as follows:

Insert ruler into the tailpipe (2) so that it rests against the preheating tube (1). Then move tailpipe until the dimension "b" (see table) is obtained.



No.	Description	Qty.	Note when disassembling	Note when assembling	Special instructions see
1	Pulley securing bolt	1		torque to 4.5 mkg (32.5 ft. lb.)	
2	Dished washer	1		concave side faces crankshaft	
3	Crankshaft pulley	1	pull off with VW 203 b/d	check seating and belt surfaces, clean oil return thread and oil, check for run-out	Fig. 1
4	Pulley nut	1		torque to 6 mkg (43 ft. lb.)	
5	Special washer	1			
6	Pulley half, rear	1			
7	Spacer washer	8			
8	V-belt	1	check for wear	adjust tension	M 4.3/2
9	Pulley half, front	1			
10	Woodruff key	2			
11	Generator	1			
12	Nut M 8, galvanized	1			
13	Strap	1			
14	Bolt M 8×25, galvanized	1			
15	Bolt M 6×10	4			
16	Lock washer	4			
17	Fan cover, outer	1			
18	Reinforcement flange	1			
19	Fan cover, inner	1		note installation position	M 4.3/3
20	Lock washer	2			
21	Nut M 6	2			
22	Fan hub	1			
23	Shim	3			
24	Fan	1	check for loose vanes (5 mm wider vanes, from August 1970)	gap between housing approx. 1.8 mm (0.07 in.)	M 4.3/3
25	Lock washer	1			
26	Special nut	1		torque to 6 mkg (43 ft. lb.)	
27	Fan housing	1	check for damage and loose plates		M 4.3/3
28	Washer, galvanized	2			
29	Screw M 6×10	2			
30	Return spring	1			
31	Spring	4			
32	Washer	8			
33	Cooling air regulator, left	1			
34	Cooling air regulator, right	1			
35	Cooling air regulator connecting rod	1			
36	Washer	8			

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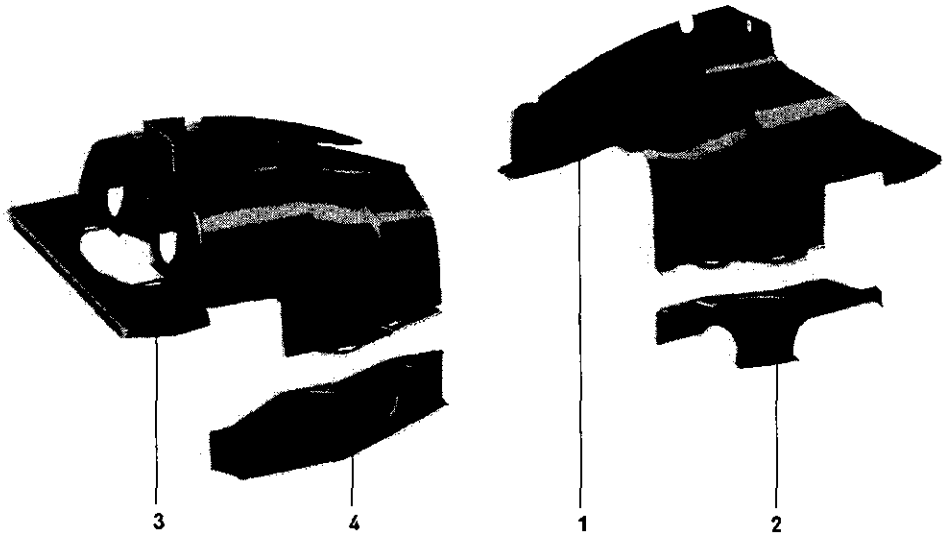
No.	Description	Qty.	Note when disassembling	Note when assembling	Special instructions see
37	Screw M 6×12	8			
38	Lock washer	1			
39	Washer	1			
40	Connecting rod	1			
41	Thermostat bracket	1		adjust	M 4.3/3
42	Thermostat	1		check in water	M 4.3/3
43	Lock washer	1			
44	Bolt M 8×15	1			
45	Lock washer	6	from August 1970		
46	Washer	6			
47	Regulating link	2			
48	Connecting rod for cooling air regulator	1			
49	Air deflector for oil cooler	1			
50	Moulded seal	1			
51	Air duct for oil cooler	1			



No.	Description	Qty.	Note when disassembling	Note when assembling	Special instructions see
1	Cylinder cover plate, right	1			
2	Deflector plate, right	1			
3	Cylinder cover plate, left	1			
4	Deflector plate, left	1			

Checking

1 - Place holding bar on V-belt (see illustration).

2 - Place tension tester on top of the V-belt above the contact tongue of the holding bar.

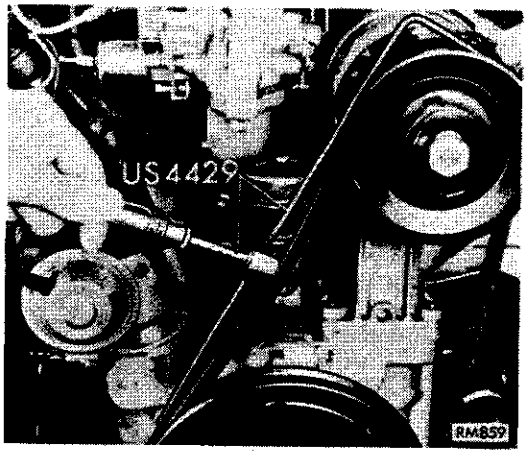
3 - Apply force on tension tester until the inside of the V-belt is flush with the contact tongue.

4 - Read deflection force on tension tester.

The recommended deflection force is:

a) for newly installed belts = 12—14 lbs

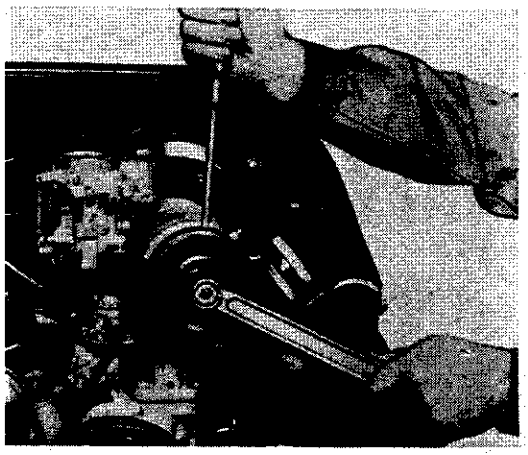
b) for used belts = 8—10 lbs
(after running more than 30 minutes).



Length of belt in mm		Remarks
900		standard
from August 1970	900 or 905	Designated DA and XDA (low stretch)

Adjusting

1 - Remove nut from generator shaft pulley.



2 - Arrange spacer washers as required to correct belt tension.

The tension of the belt is adjusted by varying the number of washers between the pulley halves.

Adding washers loosens the belt tension and removing them tightens it.

3 - All the spacer washers not installed between the pulley halves should be installed between the rear pulley half and the nut so that all spacer washers are retained on pulley hub.

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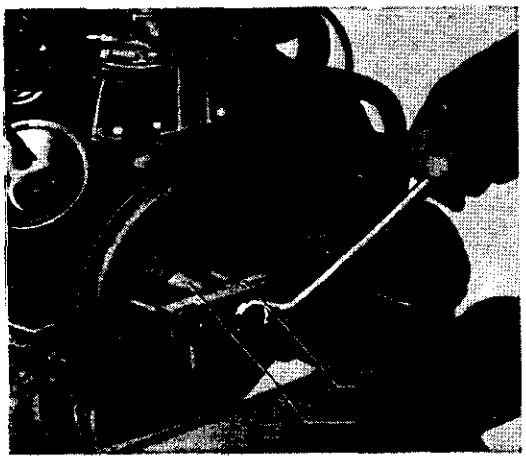
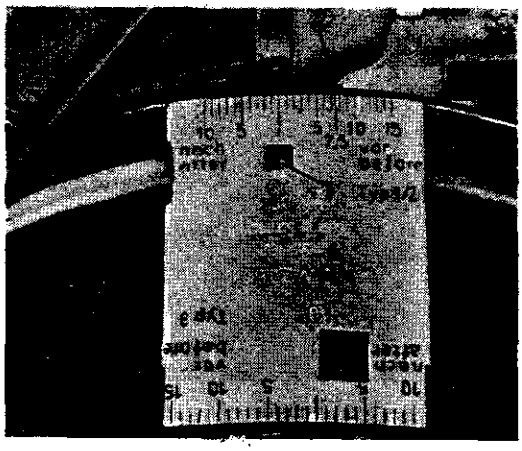


Removing crankshaft pulley

Marking ignition timing notch

From October 1971 the replacement crankshaft pulley has only the TDC mark.

The ignition timing mark must be made when the pulley is installed, using a template and a three-cornered file.



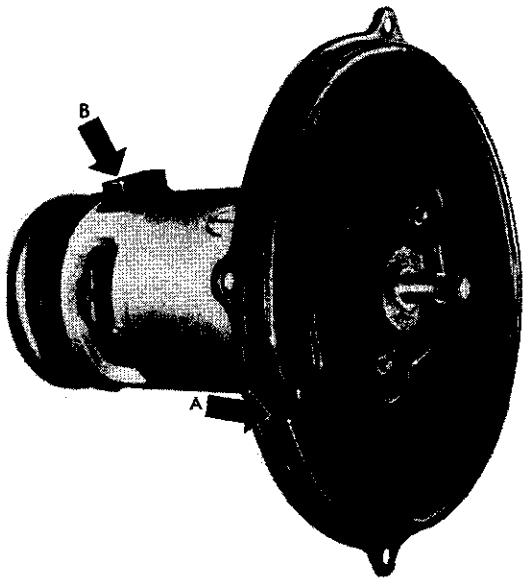
1 - Place template on pulley and align square hole with the TDC mark (1).

2 - Make the timing mark with the aid of the template (2).

3 - Paint notch white.

Installing

1 - Assemble generator (105 mm dia.) and fan covers so that the cooling air slots of the inner cover face downward on installation in fan housing (arrow "A").



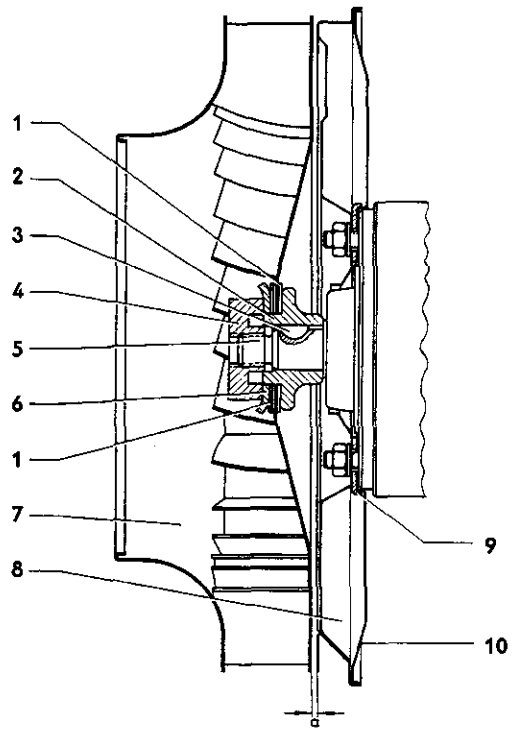
A - Cooling air slots

B - Connections

2 - Check distance of fan to cover (a = 1.8 mm/ 0.07 in.). This distance is achieved by inserting spacer washers between hub and fan. Surplus washers should be installed between dished washer and fan.

a = about 1.8 mm (0.07 in.)

1 - Spacer washers
2 - Hub
3 - Woodruff key
4 - Special nut
5 - Generator shaft
6 - Dished washer
7 - Fan
8 - Fan cover, inner
9 - Reinforcement flange
10 - Fan cover, outer



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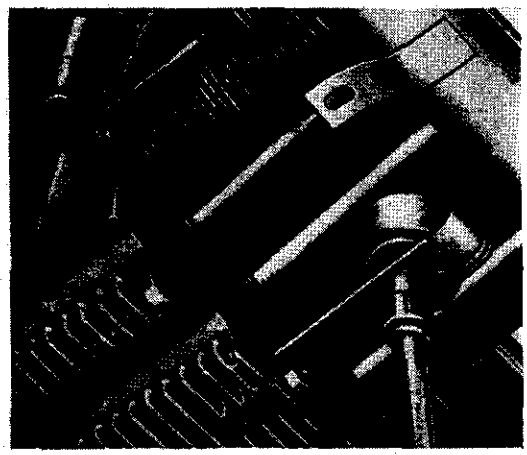


Removing

1 - Remove rear, right warm air duct lower part.

2 - Remove thermostat from bracket and disconnect from connecting rod.

3 - From August 1970.
Take off oil cooler duct and connecting rod for cooling air regulation.

4 - Remove fan housing.

Note

The fan housing can also be removed with the engine installed, after the rear hood has been removed.

Installing

1 - Check fan housing for damage and loose air deflector plates.

2 - Insert thermostat connecting rod into hole in cylinder head and lower fan housing.

3 - Fan housing must fit properly on cylinder cover plates to prevent loss of cooling air. If necessary, cover plates must be bent slightly.

4 - Adjust throttle flaps.

Adjusting

1 - Screw thermostat onto connecting rod.

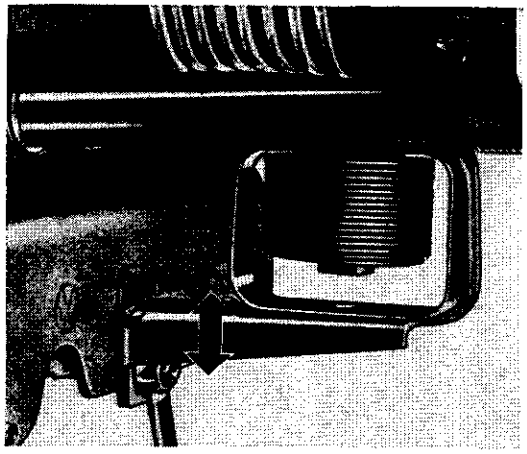
2 - Loosen nut securing thermostat bracket.

3 - Push thermostat upward so that flaps are in open position.

4 - Move thermostat bracket so that thermostat contacts bracket at upper stop (arrow).

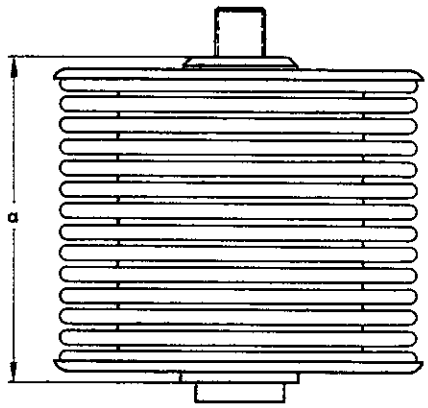
5 - Check operation of flaps by moving thermostat up and down.

6 - Secure thermostat to bracket.



Checking thermostat

At a temperature of 65–70° C (149–158° F) in water, the length of the unit should be at least "a" = 46 mm ($1^{13}/_{16}$ in.).



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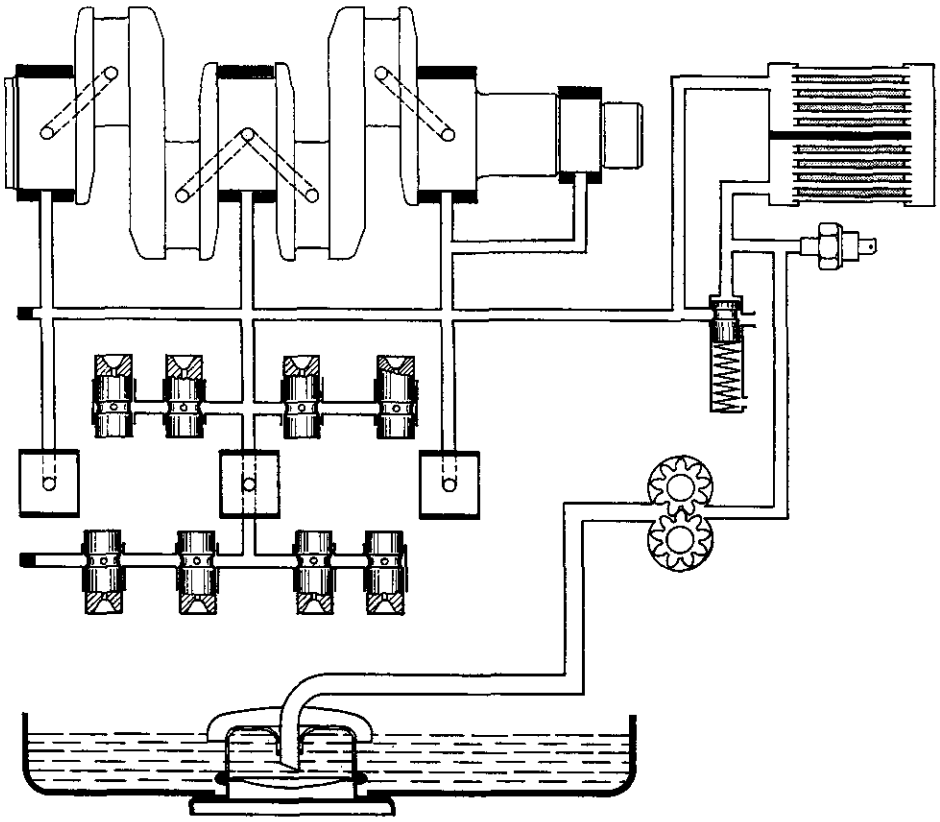
up to July 1969



The oil pump draws oil from the crankcase through the oil strainer and pumps it through the oil cooler into the passages in the crankcase. Part of the oil passes to the main bearings and from there through drillings in the crankshaft to the connecting rod journals. A further part of the oil flows to the camshaft bearings. The remainder of the oil passes through the hollow push rods into the drillings in the rocker arms and lubricates these bearings. Splash oil and oil mist lubricates the valve stems and then flows through the push rod tubes into the crankcase. Cylinder walls, pistons and piston pins are lubricated by splash. The oil drains down to the bottom of the crankcase from all points and is picked up by the pump to be recirculated.

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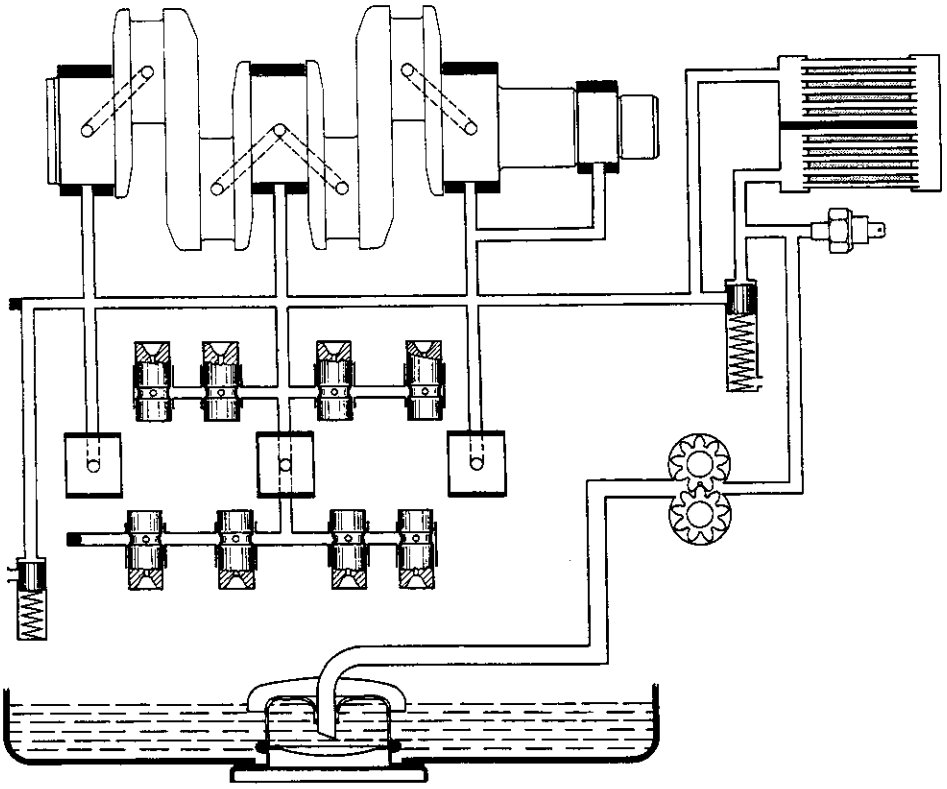
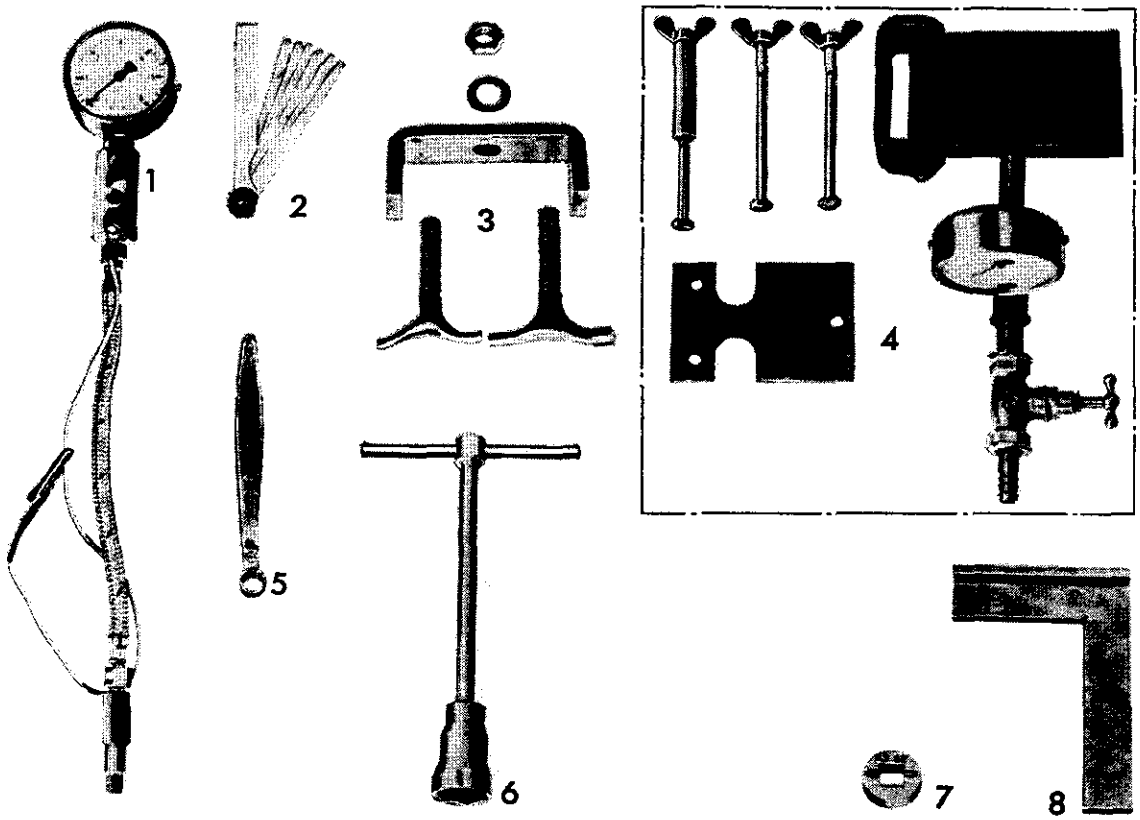
from August 1969



From August 1969, the engine oil system was modified by installing an oil pressure control valve behind the main bearings. This keeps the pressure at the main bearings constant.



No.	Description	Special tool	Special instructions see
1	Oil pressure gauge, or similar	VW 662/2	
2	Feeler gauge		
3	Oil pump extractor	VW 201	
4	Oil cooler testing device	VW 661/2	
5	Box wrench, 10 mm	VW 109	
6	Oil pressure switch wrench	VW 159	
7	Socket, oil filler retaining ring	VW 170	
8	Steel square		

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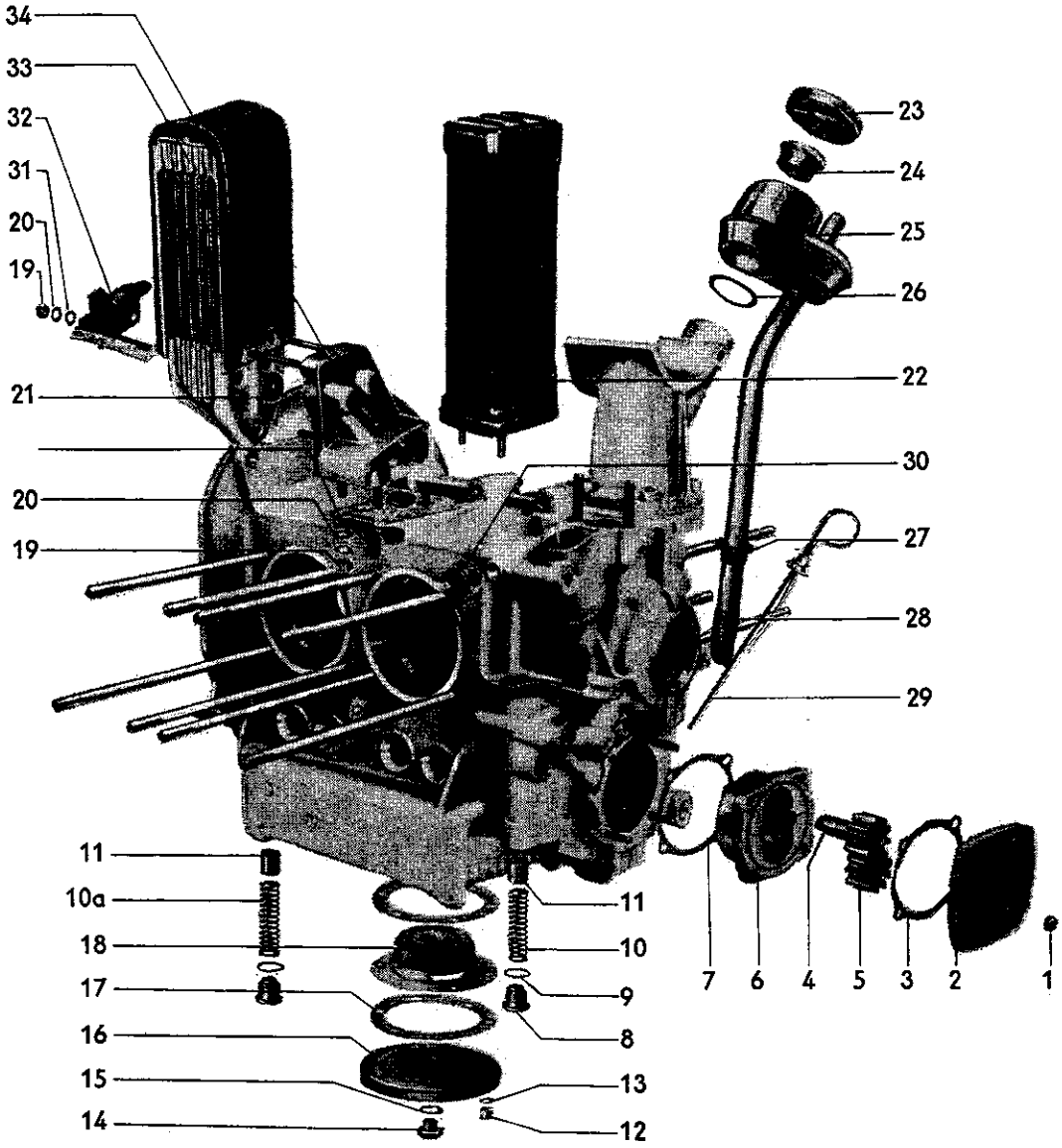
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No.	Description	Qty.	Note when removing	Note when installing	Special instructions see
1	Sealing nut M 8	4		seal foces inward; tighten to 2 mkg (14 lb. ft.)	
2	Oil pump cover	1		If cover surface is scored, replace cover or grind. Note alignment of oil pump housing	
3	Oil pump cover gasket	1		replace	
4	Drive shaft	1		check for wear, axial play: max. 0.1 mm (0.004 in.) without gasket	M 5.1/3-1 Fig. 2
5	Oil pump gear	1		check for wear, backlash 0,0—0,2 mm (0.0—0.008 in.)	M 5.1/3-1
6	Oil pump housing	1	pull out with VW 201	check for wear, align to crankcase by turning the crankcase approx. 2 times	M 5.1/3-1 Fig. 1
7	Oil pump housing gasket	1		replace	
8	Plug M 18×1.5	2			
9	Seal	2		replace	
10	Spring for oil pressure relief valve	1		check for tension, length under load of: 5,6—7,3 kg = 44,1 mm (12.3—16.0 lbs. = 1.73 in.)	
10a	Spring for oil pressure control valve	1		check for tension, length under load of: 3,1—3,8 kg = 20,2 mm (6.8—8.4 lbs. = 0.795 in.)	
11	Piston for oil pressure relief and control valve	2		check for wear	
12	Cap nut M 6	6			
13	Seal	6		replace	
14	Oil drain plug	1	discontinued from August 1972	tighten to 3.5 mkg (25 lb. ft.)	
15	Seal	1	discontinued from August 1972	replace	
16	Oil strainer cover	1	from August 1972 without drain plug	sealing surface must be flat	
17	Gasket	2		replace	
18	Oil strainer	1		clean	
19	Nut M 6	3			
20	Spring washer	3			
21	Oil cooler seal	2		replace	

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No.	Description	Qty.	Note when removing	Note when installing	Special instructions see
22	Oil cooler	1	on installed engines remove and install with box wrench VW 109; check for damage and leaks with VW 661/3 at a pressure of 6 kg/cm² (85 psi)		Fig. 3 Fig. 5
23	Oil filler neck cap	1			
24	Retaining nut for breather	1	use socket VW 170	tighten to 5.5 mkg (40 ft. lbs.)	Fig. 6
25	Oil filler and breather	1	from August 1972 the breather pipe and the breather rubber valve have been discontinued		
26	Seal	1		replace	
27	Grommet	1			
28	Breather rubber valve	1		check for damage, button must engage	
29	Dipstick	1			
30	Oil pressure switch	1		tighten to 1 mkg (7 lb. ft.)	M 5.1/4-1
31	Washer	6			
32	Sealing frame	1			
33	Oil cooler	1	from August 1970 instructions as under No. 22		Fig. 4 Fig. 5
34	Mounting flange	1			

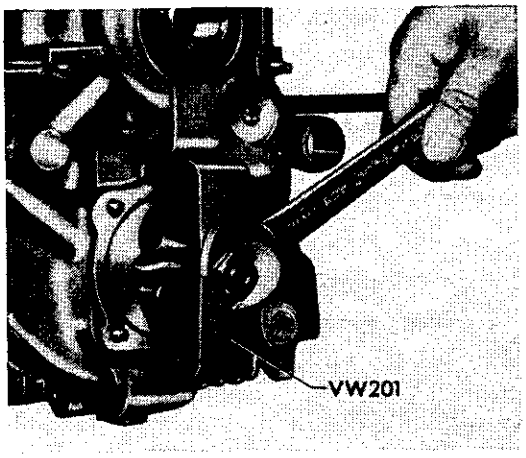

Fig. 1

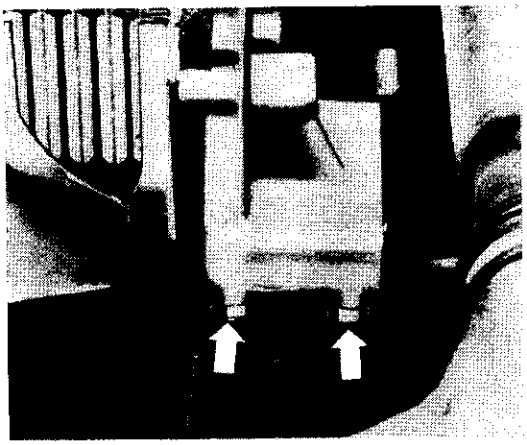

Fig. 4

Fig. 2

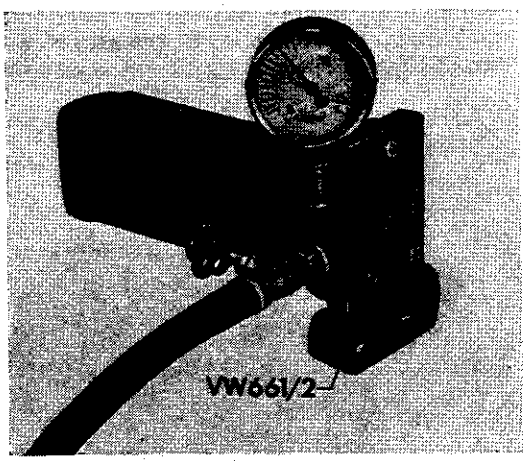

Fig. 5

Fig. 3

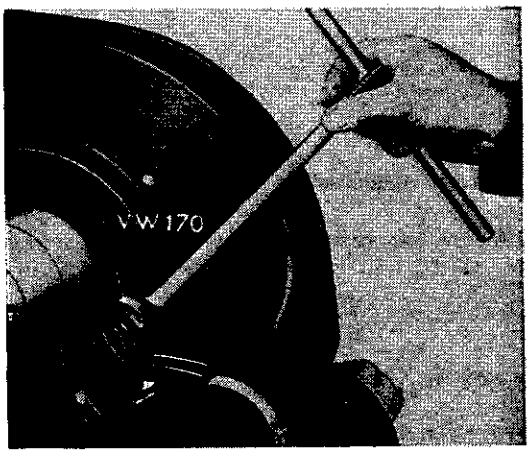

Fig. 6

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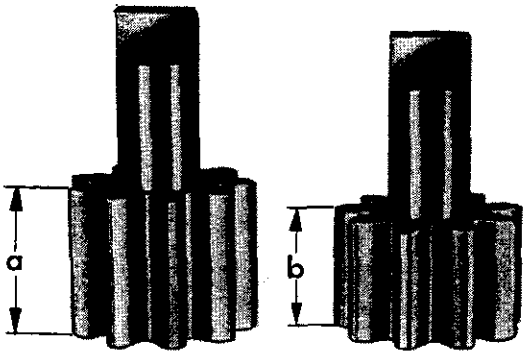
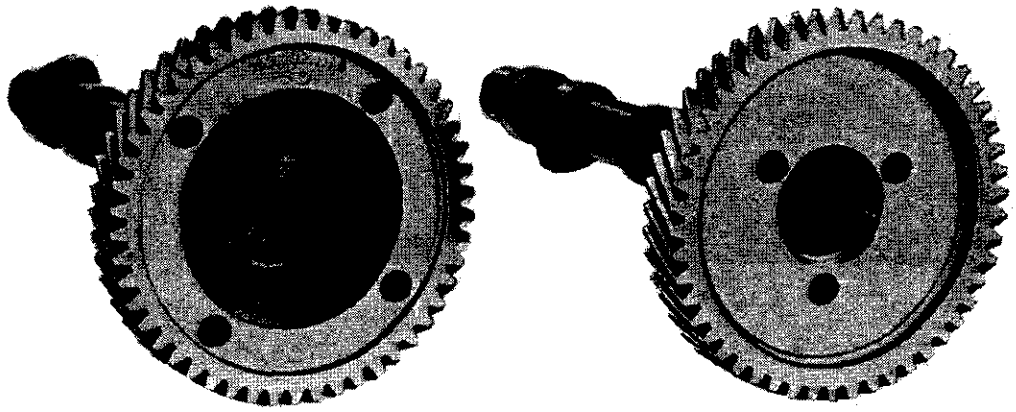
To increase the delivery capacity of the oilpump, gears with wider teeth were installed from April 1971.



new a = 26 mm (1.023 in.)

previously b = 21 mm (0.827 in.)

The oil pump housing has been widened to suit the new gears. A new camshaft with a deeper slot for the oil pump drive is used. The gear on the new camshaft is secured with 4 rivets. It can be easily identified as the previous gear was secured with 3 rivets.



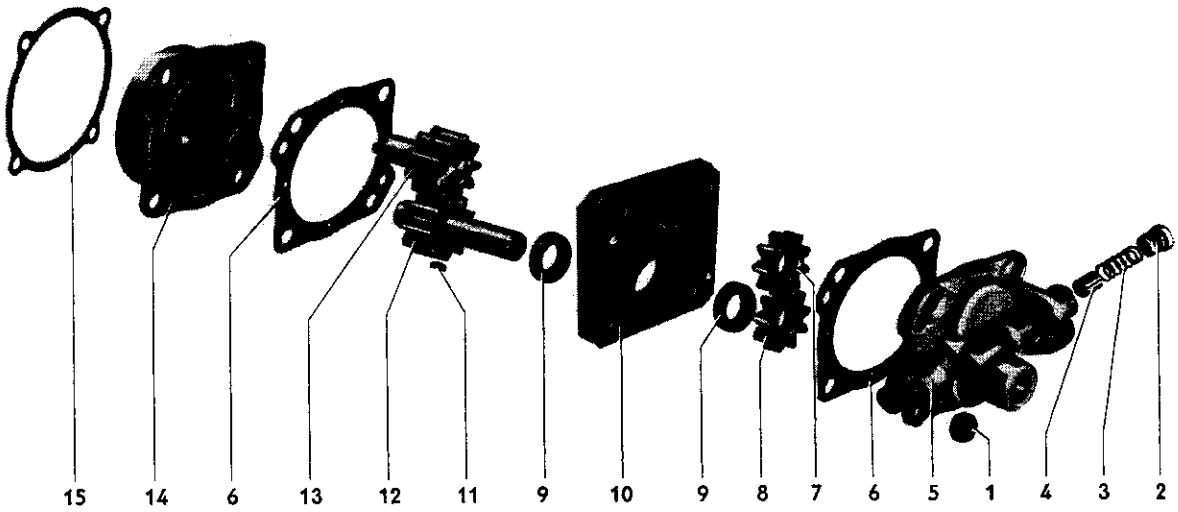
new previously

Service installation

All the new spare parts must be used when installing in earlier engines.

Caution

An old type oil pump cannot be installed in an engine with new camshaft because the oil pump drive shaft does not engage properly in the camshaft slot.



1 - Sealing nut M 8
2 - Plug
3 - Spring
4 - Piston
5 - Cover
6 - Gasket for intermediate plate and cover
7 - Outer, upper gear
8 - Outer, lower gear
9 - Oil seal for plate
10 - Intermediate plate
11 - Woodruff key
12 - Lower shaft with inner gear
13 - Upper shaft with inner gear
14 - Oil pump housing
15 - Gasket for housing

Removing

To avoid damage to the seals in the intermediate plate, remove Woodruff keys before withdrawing plate.

Checking

Replace the complete pump if the oil pump housing, the intermediate plate or the pump cover is damaged. Gaskets and seals can be replaced if the pump is leaking.

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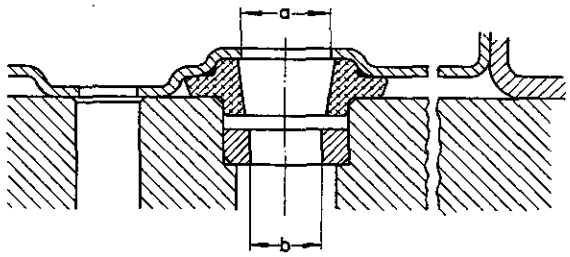
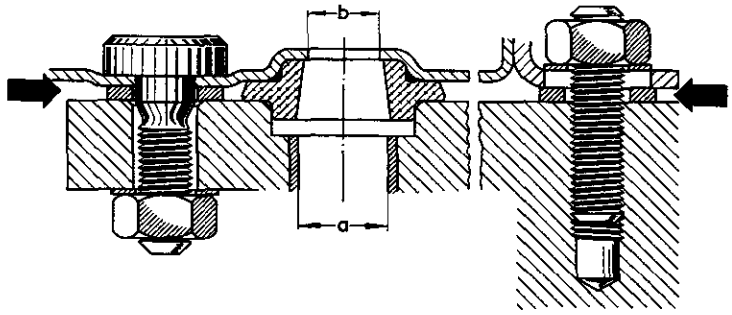
Oil passages in oil cooler and crankcases up to July 1969: b = 8 mm (5/16 in.) diameter from August 1969: a = 10 or 12 mm (3/8 or 15/32 in.) diameter.

When assembling a new oil cooler or crankcase with parts of the previous type, install **green** seals for the oil cooler and spacer washers, if necessary, as shown in the illustrations. The parts are contained in SP set – 111 198 029.



New oil cooler installed on previous type crankcase.



Previous type oil cooler installed on new type crankcase.

Install the 3 washers – N 11 533 2 – supplied in SP set (see arrows).

Note

From August 1970 the oil cooler was moved forward by installing a light alloy mounting flange. The flange is bolted to the crankcase with 8 mm bolts and the oil drillings are sealed with the usual rubber sealing rings.

Only the new crankcase will be supplied as a spare part.

When replacing the crankcase of an older engine (manufactured before August 1970), a stepped M 8/M 6 stud must be used to secure the oil cooler. To centralize the cooler, a bushing – 113 101 145 A – must be installed in one of the holes.

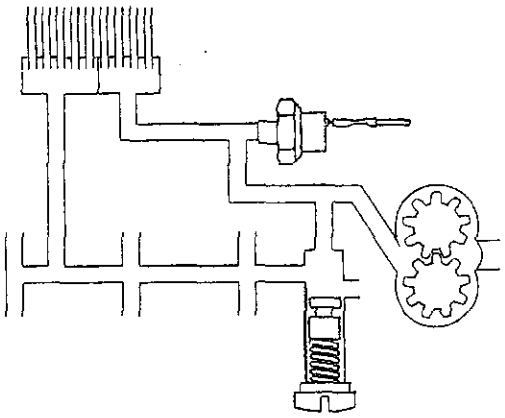
The flow of oil through the oil cooler is regulated by the oil pressure relief valve as follows:

a - Oil is thick and cold:

Oil pressure is high.

Piston is in lowest position.

Oil flows directly to the bearings and part goes back into the crankcase.

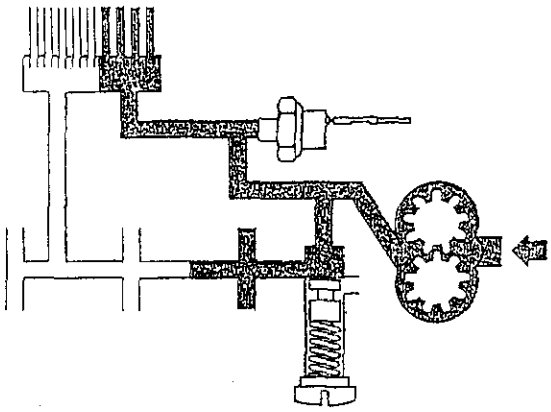


b - The oil warms up and starts to thin out:

Oil pressure drops.

Piston closes the return port.

Oil flows directly to bearings and through the oil cooler to bearings.

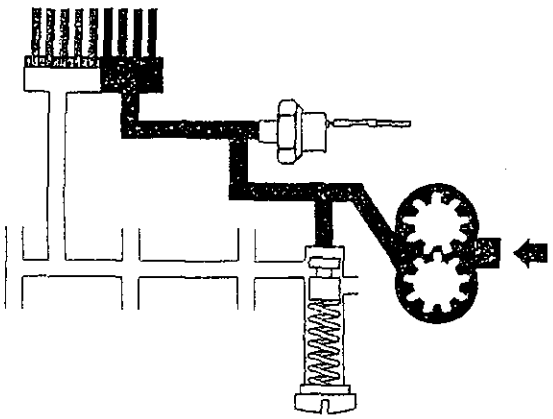


c - Oil is at operating temperature and is thin:

Oil pressure is low.

Piston is in highest position.

All oil has to pass through the oil cooler to the bearings.



Note

From August 1969 the oil pressure is kept constant by the oil pressure control valve located at the end of the system (see M 5.1/1-2).

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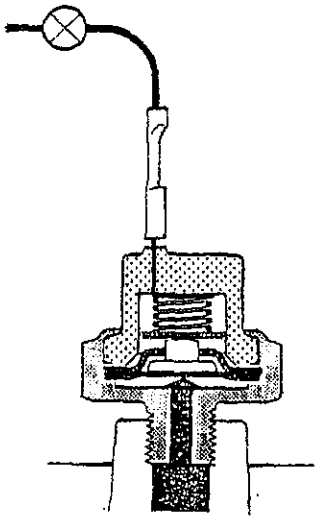
The oil pressure switch indicates the oil pressure in the engine. It is located in the oil pressure line between oil pump and oil cooler. When the engine is not running, the contact on the diaphragm is held closed by spring pressure. When the ignition is switched on, the battery current flows from terminal 15 of the starter switch via the red warning lamp and the oil pressure switch to ground. The red warning lamp lights up.

When the engine is running, the oil pressure actuates the diaphragm, opens the contact and the red warning lamp goes out.

a - Pressure rises when engine is started:

Contact opens 0.15—0.45 kg/cm² (2—6 psi);

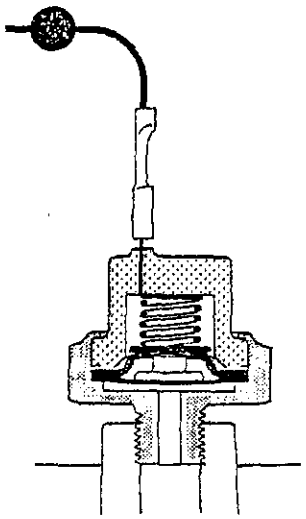
Warning lamp goes out.



b - Pressure is too low when engine is running:

Contact closes;

Warning lamp lights up.



Installing

1 - Sealing is effected by the tapered thread.

To avoid damaging the thread, do not use excessive force when tightening the switch.

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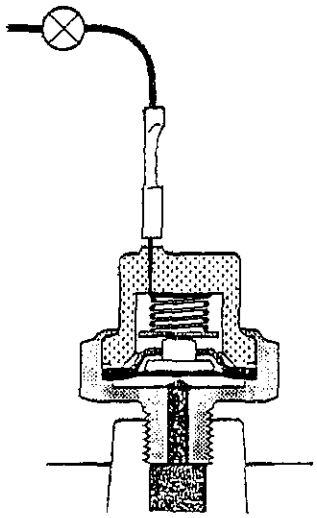
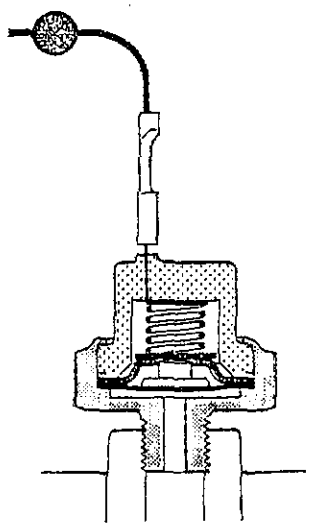
Oil pressure switch

The oil pressure switch indicates the minimum oil pressure in the engine. It is located in the oil pressure line between oil pump and oil cooler. When the engine is not running, the contact on the diaphragm is held closed by spring pressure. When the ignition is switched on, the battery current flows from terminal 15 of the starter switch via the red warning lamp and the oil pressure switch to ground. The red warning lamp lights up.

When the engine is running, the oil pressure actuates the diaphragm, opens the contact and the red warning lamp goes out.



a - Pressure rises when engine is started:
Contact opens (2—6 psi/0.15—0.45 kg/cm²)
Warning lamp goes out.

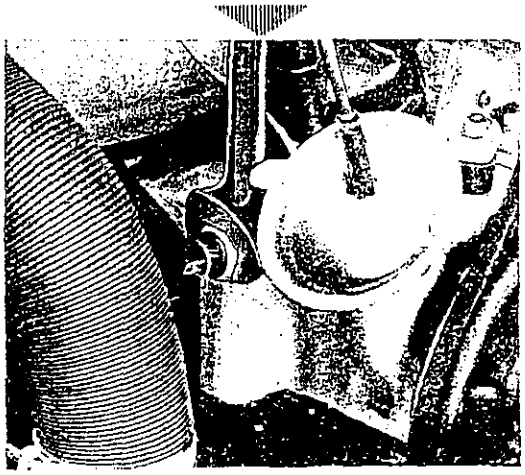


b - Pressure is too low when engine is running:
Contact closes
Warning lamp lights up.

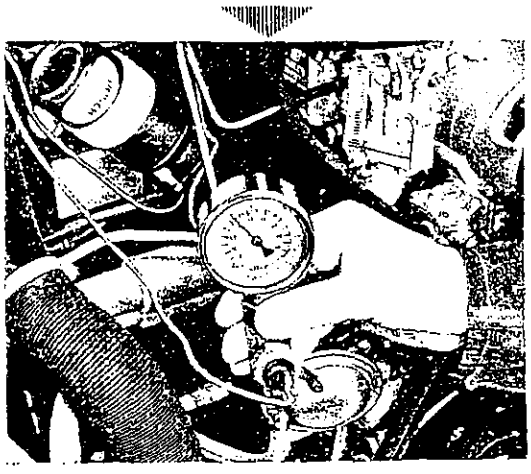
Testing

The oil pressure switch can be tested on the engine, using a simple testing device with gauge VW 622/2 and a test lamp, after the engine oil is at operating temperature.

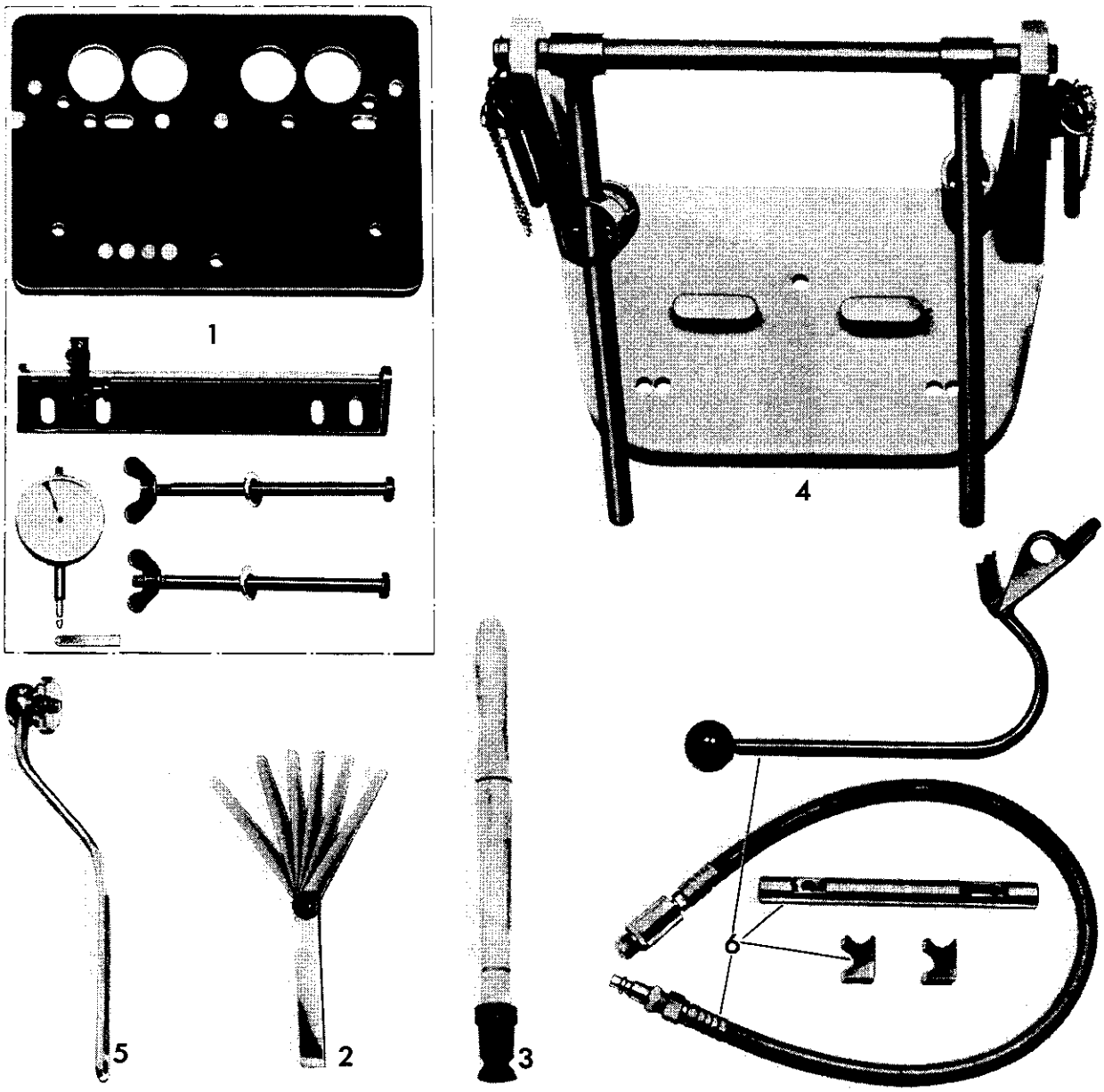
1 - Remove oil pressure switch and screw it into testing device.



2 - Screw testing device into seat for oil pressure switch on crankcase and connect test lamp to oil pressure switch and to terminal 15 of ignition coil. When the ignition is switched on, the test lamp should light up. If the lamp does not light up, the switch is defective and must be replaced.



Testing oil pressure switch



No.	Description	Special tool	Remarks
1	Valve guide wear measuring appliance	US 4420	
2	Feeler gauge		
3	Valve grinding tool		
4	Valve extractor	VW 311 h	
5	Valve clearance adjusting tool		
6	Valve spring compressor	VW 653/2	

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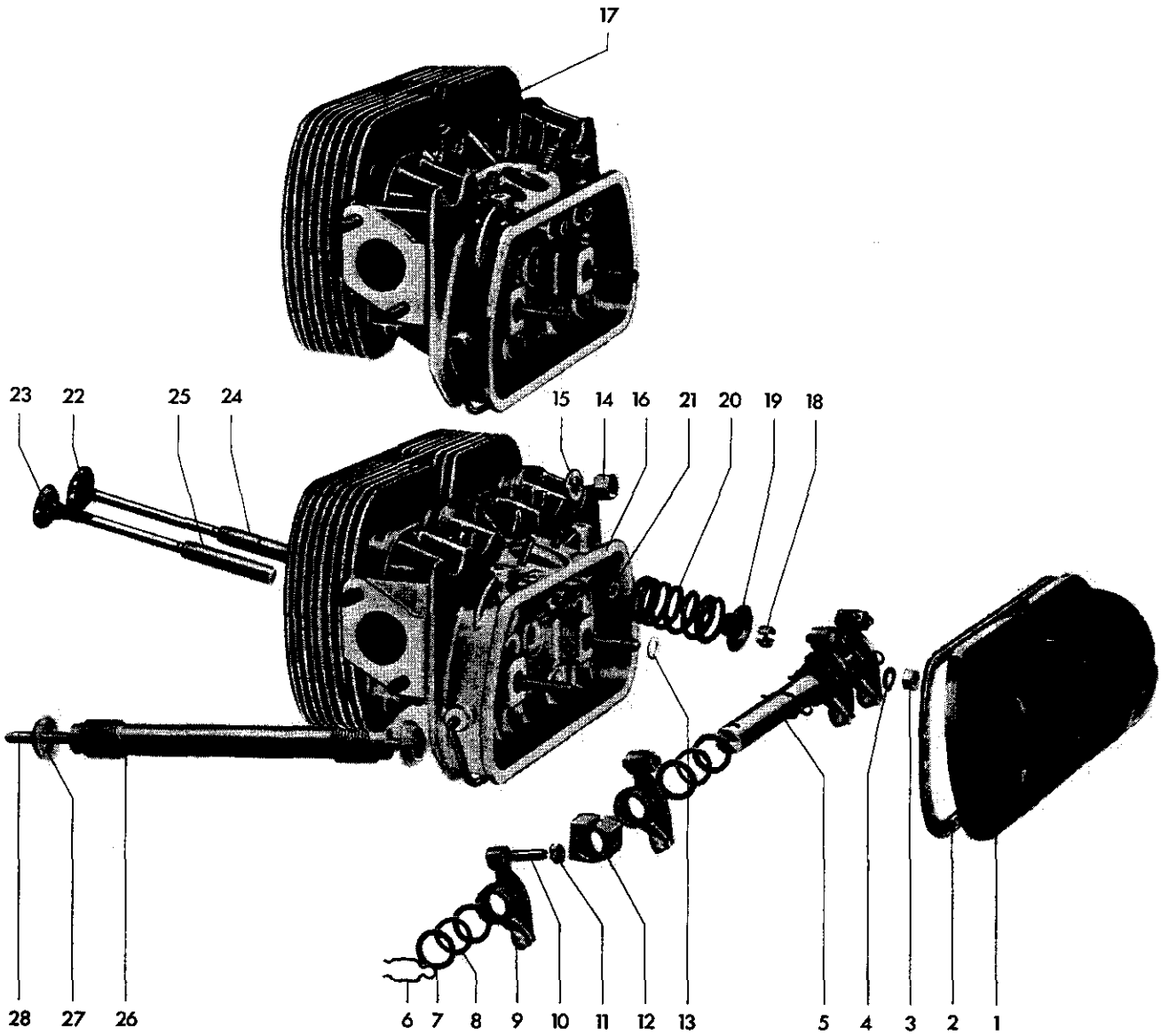
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No.	Description	Qty.	Note when disassembling	Note when assembling	Special instructions see
1	Cylinder head cover	2			
2	Gasket for cylinder head cover	2		replace if damaged or leaking	
3	Nut, M 8×1.25	4		copper plated tighten to 18 lb. ft. 2.5 mkg	
4	Spring washer	4			
5	Rocker shaft	2		check for wear and grooves 17.97–17.99 mm (0.7073–0.7081 in.) diameter wear limit: 17.95 mm (0.7065 in.) diameter	
6	Clip	8			
7	Thrust washer	16			
8	Spring washer	8			
9	Rocker arm	8		check for wear and grooving 18.00–18.02 mm (0.7086—0.7088 in.) diameter wear limit: 18.04 mm (0.7090 in.) diameter	
10	Adjusting screw	8		check for easy turning	
11	Nut, M 8×1	8		check for easy turning	
12	Support	8		check for wear slot must face upward	Fig. 8
13	Seal for stud	4		replace	
14	Nut, M 10	16		note tightening sequence, tighten to 3.2 mkg (23 lb. ft.)	Fig. 6 Fig. 7
15	Washer	16			
16	Cylinder head	2	check cylinder heads for cracks in combustion chambers and exhaust ports and for signs of leakage on cylinder contact surfaces. Check spark plug thread and studs for damage and tightness. If necessary, fit Heli-Coil inserts. when installing cylinder head, make sure that oil seals at ends of push rod tubes are properly seated.		M 6.1/3-4
17	Cylinder head	2	from August 1970 twin intake port		
18	Valve cotter	16		replace if clearance too large	
19	Spring cap	8			
20	Valve spring	8		check valve spring tension Length loaded: 31.0 mm (1.22 in.) Load: 53.2–61.2 kg (117.2–134.8 lb.) Small end of spring faces cylinder head.	Fig. 3
21	Oil deflector ring	8		replace	
22	Intake valve	4	use VW 311 h;	check valve seats for wear. Reface, intake valves only with a valve refacing machine to seat width d = max. 0.5 mm (0.02 in.). Reface exhaust valves by grinding only.	Fig. 1 Fig. 2 Fig. 4
23	Exhaust valve	4	use VW 311 h;	check valve seats for wear. Reface, intake valves only with a valve refacing machine to seat width d = max. 0.5 mm (0.02 in.). Reface exhaust valves by grinding only.	Fig. 1 Fig. 2 Fig. 4
24	Intake valve guide	4	check with measuring device VW 689/1		M 6.1/3-1
25	Exhaust valve guide	4	check with measuring device VW 689/1		M 6.1/3-1
26	Push rod tube	8		pretension, seam faces upward	Fig. 5
27	Sealing ring	8		replace	
28	Push rod	8		check for run-out max. 0.3 mm (0.012 in.)	M 6.1/2-1

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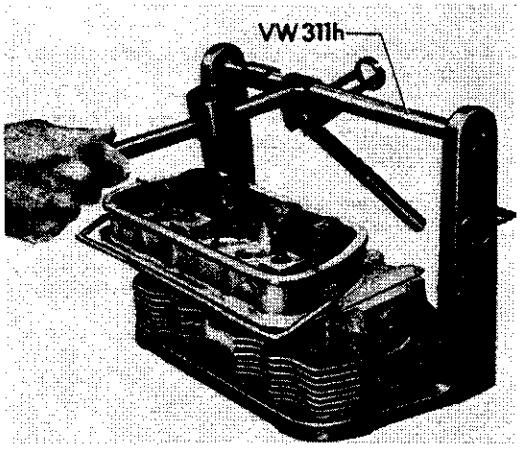


Fig. 1

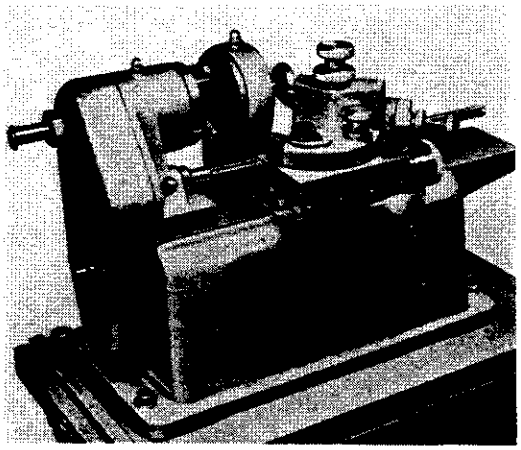


Fig. 2

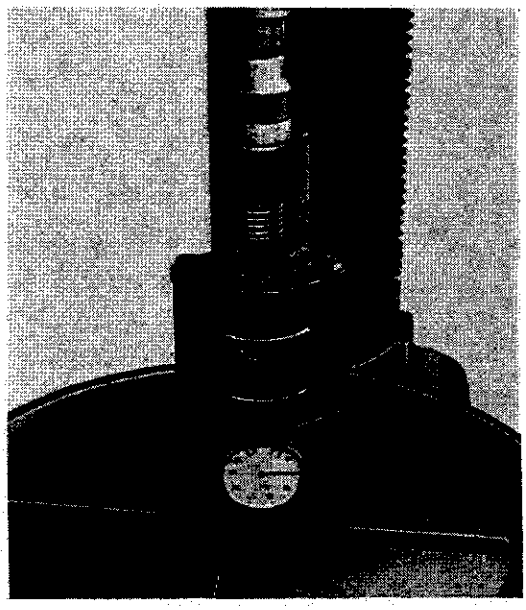


Fig. 3

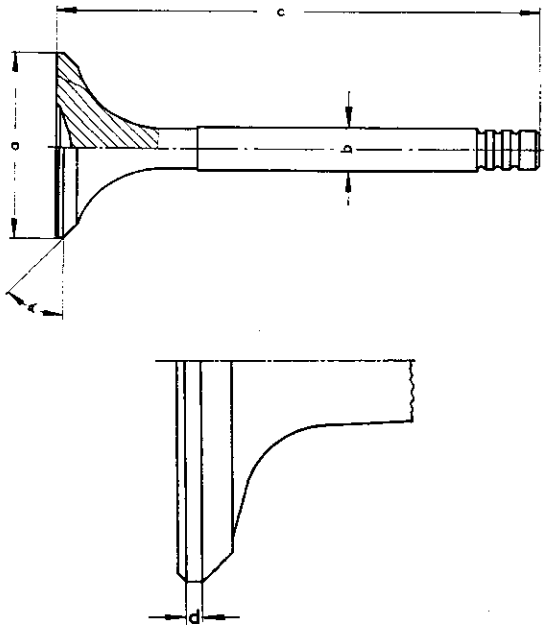
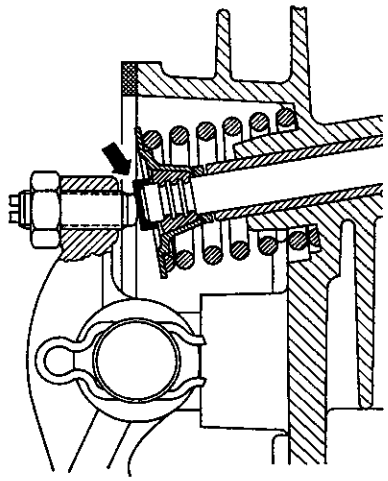


Fig. 4

	Intake valve	Exhaust valve
a	35.6 mm (1.301 in.) diameter	32.1 mm (1.263 in.) diameter
b	7.94–7.95 mm (0.312 —0.313 in.) diameter	7.92–7.94 mm (0.312 —0.313 in.) diameter
c	112 mm (4.4 in.)	112 mm (4.4 in.)
α	44°	45°

Note



Valves with worn stem ends can be used again by installing caps (113 109 621) on the stems (arrow). The caps are placed on the stems before the rocker arms are installed.

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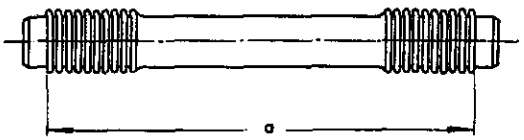


Fig. 5 a = 190—191 mm (7.4—7.52 in.)

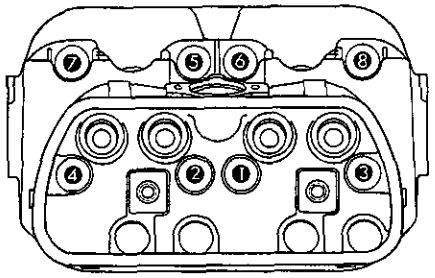


Fig. 6 Preliminary tightening sequence

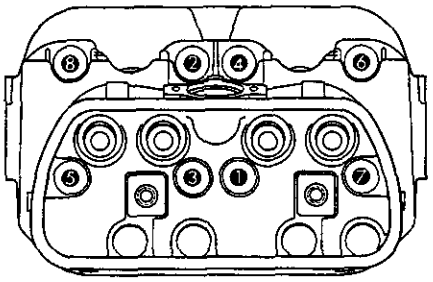


Fig. 7 Final tightening sequence

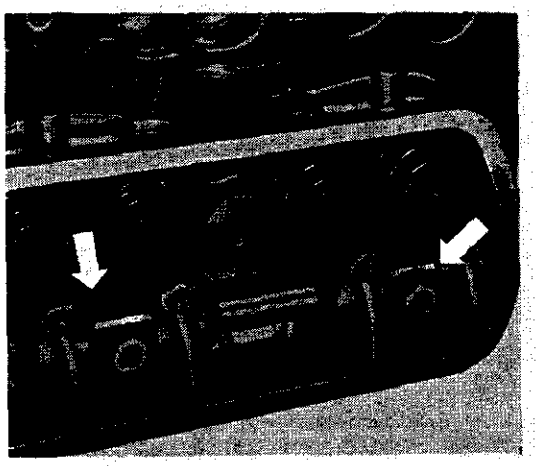


Fig. 8

Note

The cylinder head reconditioning system in the factory is being changed.

Only 1.0 mm (0.04 in.) thick **steel** shims are installed in exchange engines. This shim will not be available as a spare part.

For manufacturing reasons, steel shims are only produced in one thickness — 1 mm (0.04 in.).

For repairs on earlier engines, aluminium shims of thicknesses 0.8, 1.0 and 1.5 mm (0.03, 0.04 and 0.06 in.) will remain available as spare parts.

When repairing or replacing valves, it is necessary to check the valve guides for wear. Worn valve guides should be replaced.

Checking

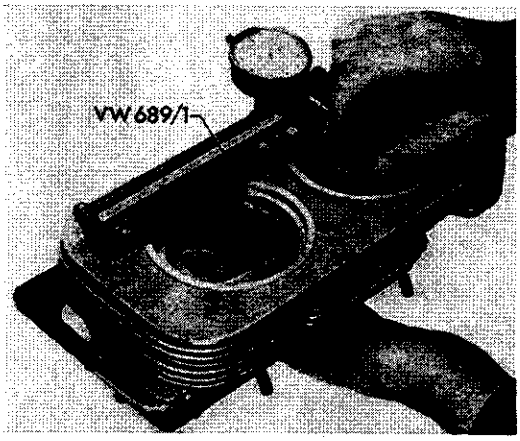
1 - Remove deposits with a reamer.

2 - Place cylinder head on mounting plate VW 689/1 with the combustion chamber upward and fasten it with the guide.

3 - Insert dial gauge into bracket and attach dial gauge extension.

4 - Insert new valve into guide to be measured and hold it so that valve stem end is flush with end of valve guide.

5 - Set dial gauge and determine amount of rock.



	Intake valve guide	Exhaust valve guide	Wear limit
Rock	0.21–0.23 mm (0.0082–0.0090 in.)	0.23–0.27 mm (0.0090–0.0106 in.)	0.8 mm (0.031 in.)
Inside diameter	8.00–8.02 mm diameter (0.3149–0.3156 in.)		8.06 mm (0.3172 in.)

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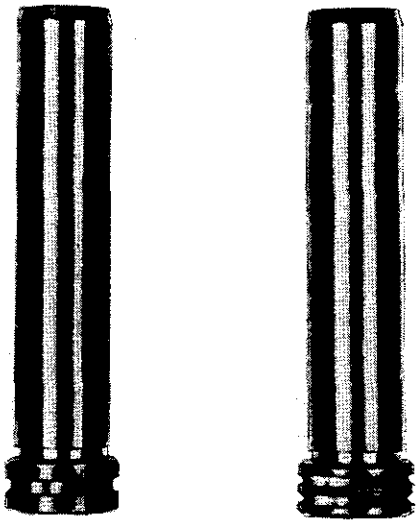


Worn or damaged valve guides can be replaced with the universal cylinder head repair device. Replacement oversize valve guides are available.

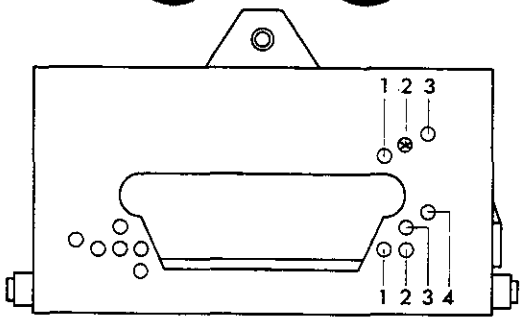
1st oversize: 1 groove

2nd oversize: 2 grooves

Means of identification:

Intake: Inside diameter **not** turned out

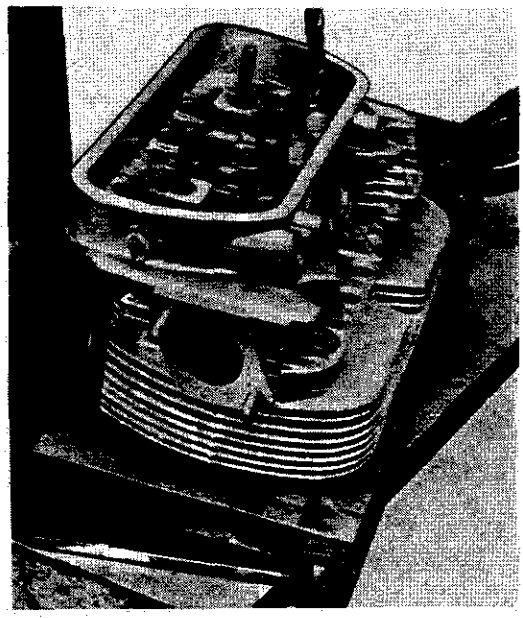
Exhaust: Inside diameter turned out (arrow)



Repair instructions

1 - Place head on device with combustion chambers facing the mouting plate.

2 - Adjust angle of plate to 9° 30′.

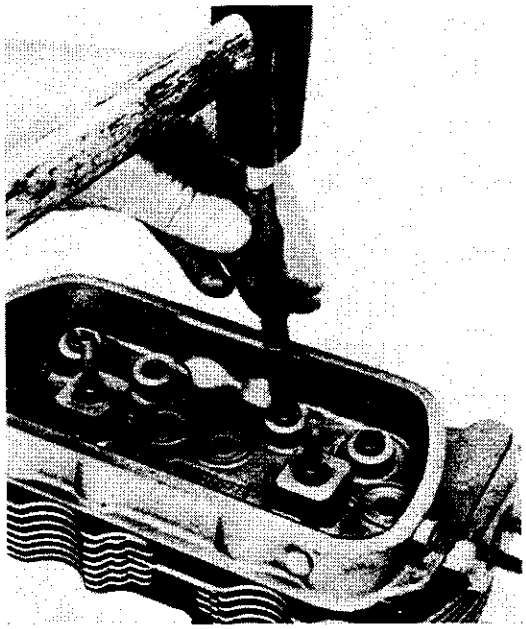


3 - Align plate on drill press table.

4 - Drill guides with shouldered drill to a depth of 40–50 mm (1½–2 in.).

(Drill speed: approximately 100 rpm)

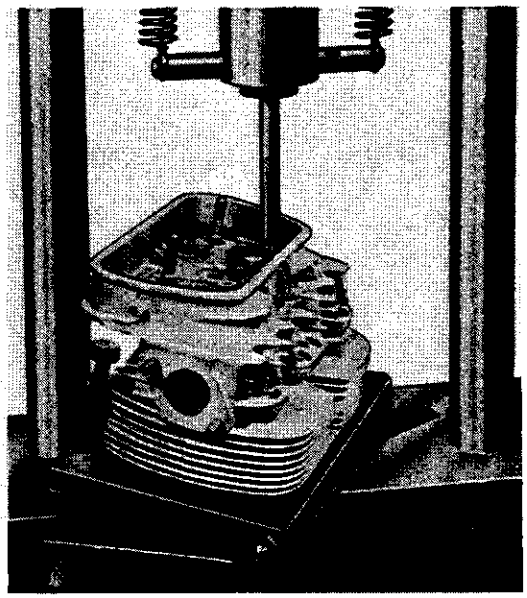
5 - Knock guides out with drift.



6 - Coat 1st oversize guide with engine oil and press it in.

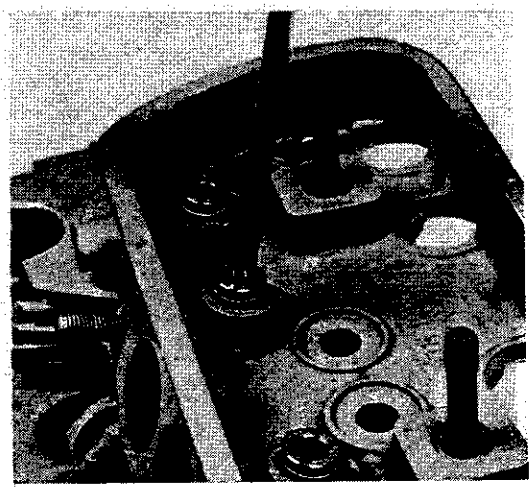
Note

The pressure required should be between 1 and 2 tons. If the pressure is under 1 ton a 2nd oversize guide should be installed.



7 - Ream guides out. Use coolant when reaming.

8 - Check reamed guides for size.



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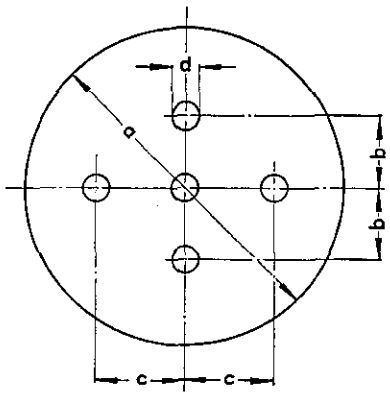


Testing devices needed:

a - A small measuring burette of 100 cc capacity.

b - A transparent plastic plate of 10 mm (0.4 in.) thickness manufactured according to sketch.

a = 93 mm (3.66 in.) diameter
b = 40 mm (1.6 in.)
c = 50 mm (2 in.)
d = 7 mm (0.3 in.)

Testing

When measuring, valves must seal properly and spark plugs must be installed.

1 - Remove carbon deposits from combustion chamber. Especially clean surface on which the plastic plate is to be placed.

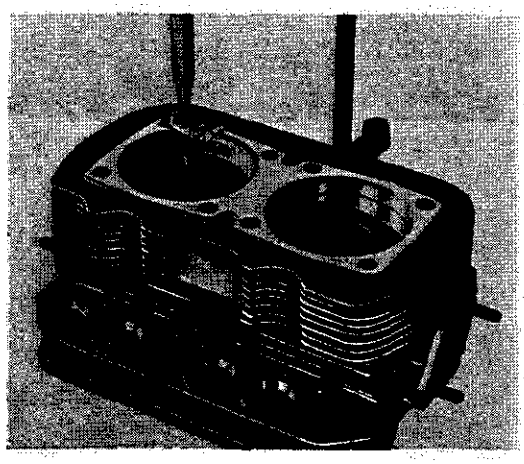
2 - Place the cylinder head in a horizontal position with the combustion chamber facing upward.

3 - Lightly coat contact surface of plastic plate with multipurpose grease.

4 - Place plastic plate in cylinder head and press firmly in position.

5 - Fill burette to zero mark with fuel, naphtha or soapy water.

6 - Fill combustion chamber up to the upper edges of the five holes in the plastic plate with the measuring fluid, ensuring that no air bubbles form. (If necessary, tilt cylinder head slightly.)



Combustion chamber capacity	=	quantity of fluid put in minus 2 cm³ (0.122 cu. in.) *)

*) The capacity of the five holes (7 mm [0.3 in.] diameter × 10 mm [0.4 in.] deep) amounts to 2 cm³ (0.122 cu. in.).

Combustion chamber capacity of one cylinder in the cylinders heads:

Type/Model	Combustion chamber capacity in cm³
up to July 1970	48.0–50.0 cm³ (2.93–3.05 cu. in.)
from August 1970	50.0–52.0 cm³ (3.05–3.17 cu. in.)

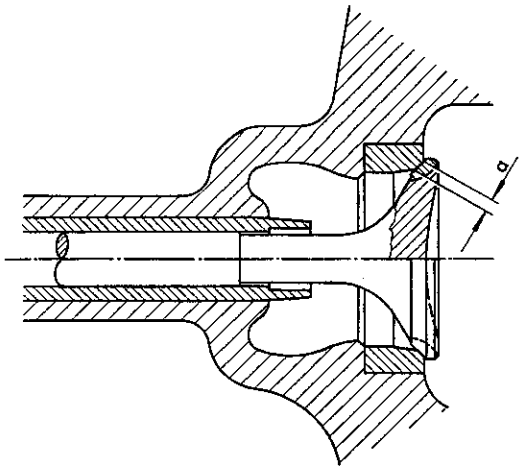
Damaged or burnt seats may be reconditioned as long as the permissible width for the seat is maintained. The outer edge of the 15° chamfer should not exceed the outer diameter of the valve seat insert. If the dimensions are no longer true, the cylinder head has to be replaced. Replacement of valve seats is beyond the scope of a normal workshop, as they are shrunk (chilled) into position.

Seat width (a):

new: Intake = 1.4–2.5 mm (0.055–0.10 in.)
Exhaust = 1.4–2.5 mm (0.055–0.10 in.)

when repairing:

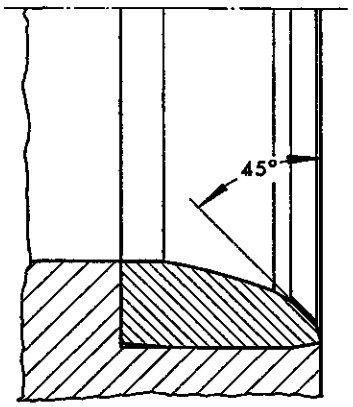
Intake = 1.3–1.6 mm (0.051–0.063 in.)
Exhaust = 1.7–2.0 mm (0.067–0.079 in.)



Sequence of operations

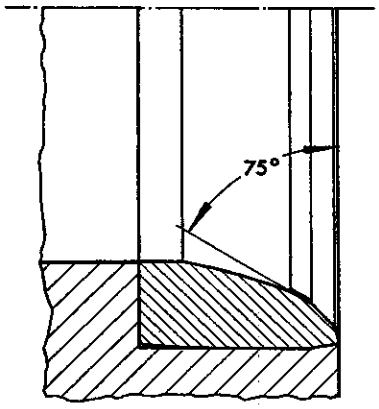
1 - Cut 45° faces.

Cut valve seat inserts carefully to obtain a perfectly concentric seating surface. Remove only the minimum of metal, otherwise the life of the inserts will be adversely affected. Stop grinding as soon as the whole surface is cut.



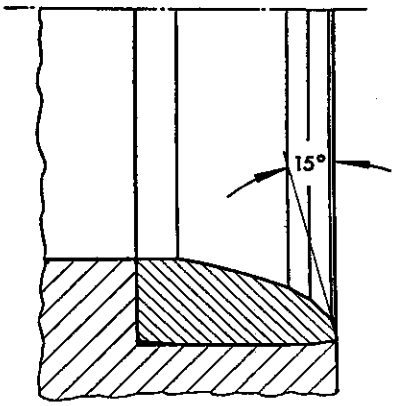
2 - Cut 75° face.

Slightly chamfer lower edge of exhaust valve seat insert.



3 - Cut 15° face.

Chamfer upper edge of valve seat insert until correct seat width is reached.



4 - The valve seats can be checked with a new valve.

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Checking valve seating

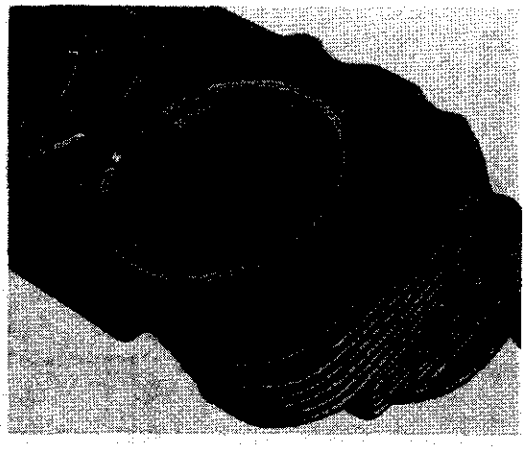
With accurately refaced valve seats and new valves it is usually not necessary to lap the valves.

Preparing contact pattern

1 - Lightly coat the valve with Prussian blue.

2 - Insert valve into valve quide. Apply light pressure and turn the valve approximately 1/4 turn on the valve seat.

3 - Carefully remove valve. The contact pattern will show which parts are not seating properly. If necessary lap valves.



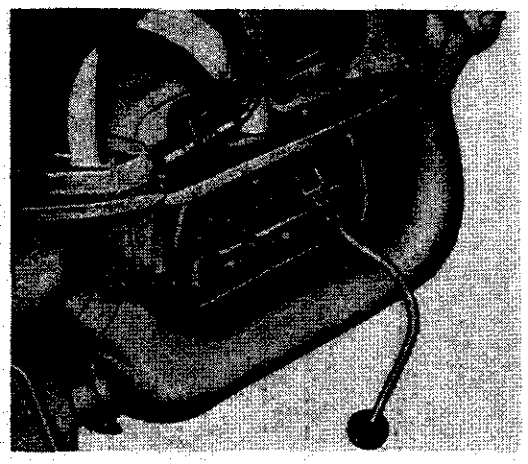
Lapping valves

1 - Coat valve seat with a fine valve grinding compound and insert valve into guide.

2 - Place plunger on valve head and lap valve seat by turning the plunger handle. Lift valve frequently. Turn it evenly to avoid grooves in seating surfaces

Note

After lapping, thoroughly clean off all traces of lapping compound.



Removing and installing a valve spring (engine installed)

Removing

1 - Remove rocker shaft with rocker arms and sealing rings.

2 - Install tool VW 653/2 in place of rocker shaft.

3 - Install compressed air hose adapter into spark plug hole and apply pressure.

4 - Press spring cap down.

5 - Remove cotters, spring cap and valve spring.

Installing

1 - Check valve spring.

2 - Check cotters.

Valve clearance

The valve clearance must only be checked or adjusted with the engine cold.

Valve clearance:

Intake 0.15 mm (0.006 in.)

Exhaust 0.15 mm (0.006 in.)

The clearance **increases** at first as the engine warms up and then goes back to the proper setting when engine is really warm. It should be carefully checked at the prescribed intervals.

Valve adjustment gives the desired result only if the valves seal tightly, there is no undue clearance in the valve guides, and the stem end is not worn.

Insufficient valve clearance causes:

Burning of valves and valve seats.
Distortion of valves.
Poor performance due to reduced compression.
Uneven engine running.
Altered valve timing.

Excessive valve clearance causes:

Noisy timing mechanism.
Uneven engine running.
Altered valve timing.
Poor performance resulting from insufficient cylinder charge.

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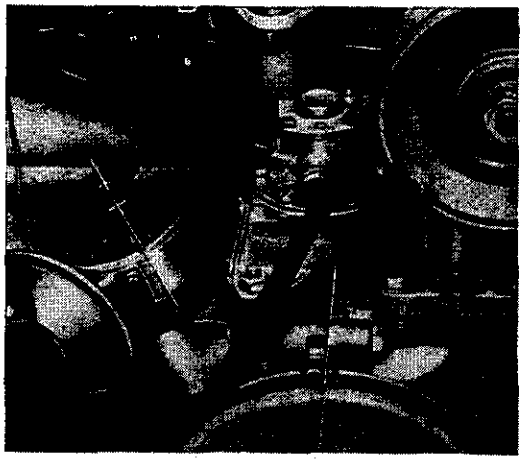
Adjusting valves

The valve clearance is adjusted in cylinder sequence 1–2–3–4.

The piston of the cylinder to be adjusted must be at TDC of the compression stroke, as the two valves are then closed.

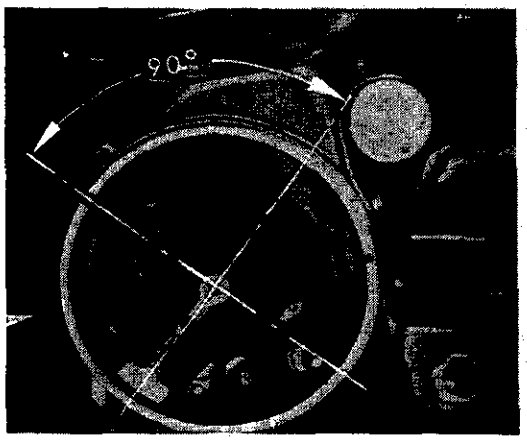


1 - Set No.1 cylinder to firing position.

2 - Check valve clearance with a feeler gauge.

3 - Adjust clearance with special wrench and a feeler gauge.

The clearance is correct if the feeler blade slides between screw and stem quickly and smoothly.



4 - When adjusting the valves of No.2, 3 and 4 cylinders, the crankshaft must be turned to the left until rotor arm has moved 90° each time.

No.	Description	Qty.	Note when removing	Note when installing	Special instructions see
1	Cylinder	4	Before removing cylinders, mark them so that they can be installed in the same location. If necessary, replace by another matched cylinder and piston of the same size.	Check cylinders for wear. Cylinder seating surface on crankcase and in cylinder head, cylinder seating shoulders and gaskets must be perfectly clean on installation. Foreign matter at this point could cause cylinder distortion and leaks. Oil the cylinder wall. Compress the rings with the compressing tool. The crankcase studs must not contact the cylinder cooling fins.	M 6.2/4.1 Fig. 3 Fig. 5
2	Sealing ring between cylinder and crankcase	4		replace	
3	Upper piston ring	4	use piston ring pliers	Fit rings by checking gap with a feeler gauge. The mark "Top" on the rings must point toward the piston crown. Make sure that the ring gaps are equally offset.	Fig. 2 M 6.1/3-1 M 6.2/3-2
4	Lower piston ring	4			
5	Oil scraper ring	4			
6	Spring clip	8	remove with VW 122 b		Fig. 4
7	Piston	4	mark before removing	Check for wear, note matching with cylinder; warm to fit piston pin; oil; note weight, max. 10 g.	M 6.2/4-1 Fig. 1
8	Piston pin	4	use VW 207	oil piston, if necessary warm up piston	M 6.2/3-2
9	Deflector plate	2			

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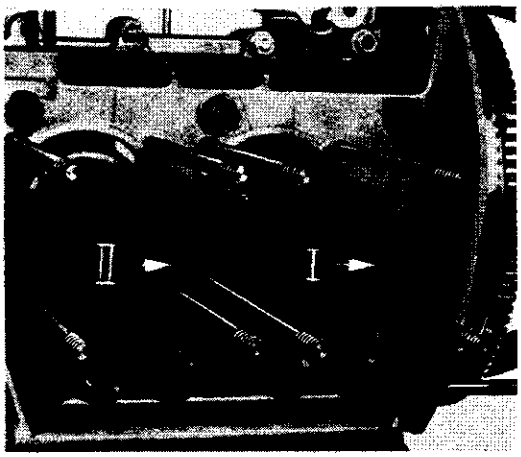

Fig. 1

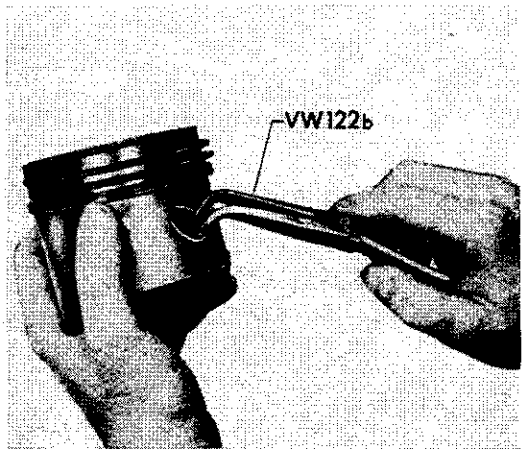

Fig. 4

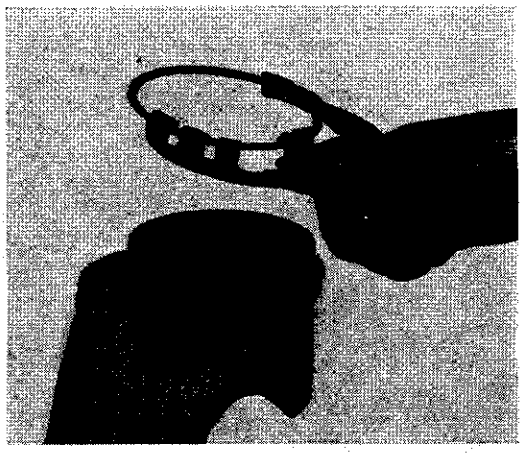

Fig. 2

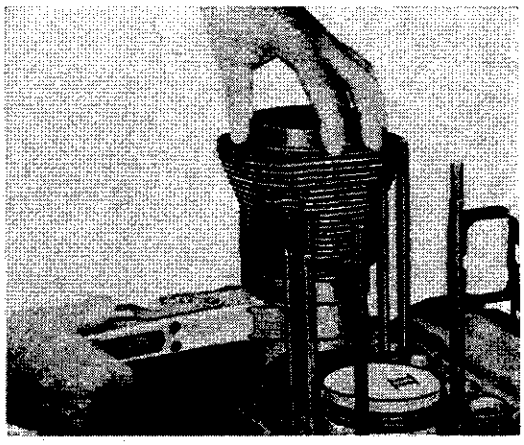

Fig. 5

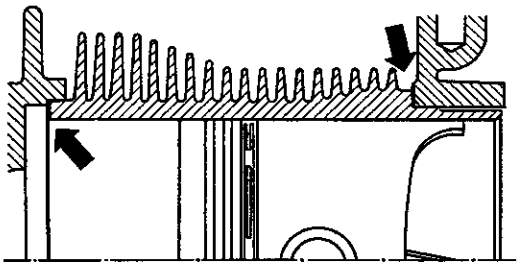

Fig. 3

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Marking of pistons

A - The letter near the arrow corresponds to the index of the part number of the piston concerned. It serves as an identification mark.

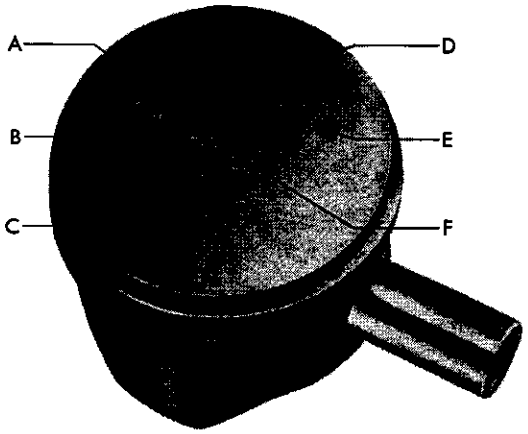
B - Arrow must point towards the flywheel when piston is installed.

C - Paint spot indicating matching size (blue, pink, green).

D - Details of weight grading (+ or −).

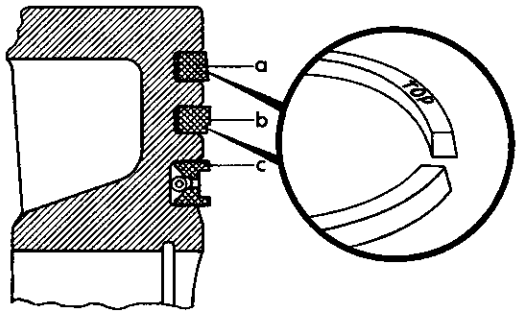
E - Paint spot indicating weight grading (brown = − weight, gray = + weight).

F - Piston size in mm.



Types of piston rings

Upper ring	Ferrox insert, thickness: 2 mm (0.08 in.)
Lower ring	narrow face, thickness: 2 mm (0.08 in.)
Oil scraper ring	with coil spring

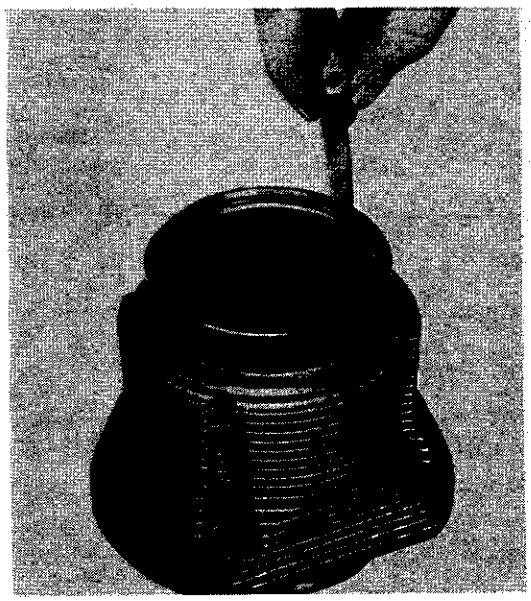


a - Upper ring

b - Lower ring

c - Oil scraper ring

	Gap mm (in.)	Wear limit mm (in.)
Upper ring	0.30–0.45 (0.012–0.018)	0.90 (0.035)
Lower ring	0.30–0.45 (0.012–0.018)	
Oil scraper ring	0.25–0.40 (0.010–0.016)	0.95 (0.037)



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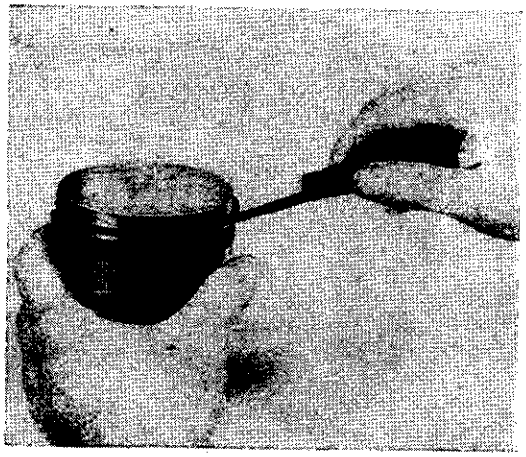
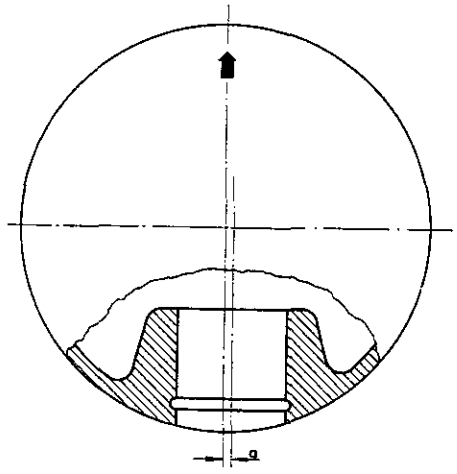


	Clearance mm (in.)	Wear limit mm (in.)
Upper ring	0.07–0.10 (0.0027–0.004)	0.12 (0.005)
Lower ring	0.05–0.07 (0.002–0.0027)	0.10 (0.004)
Oil scraper ring	0.03–0.05 (0.001–0.002)	



Offset of piston pin bore

"a" = 1.5 mm (0.06 in.)

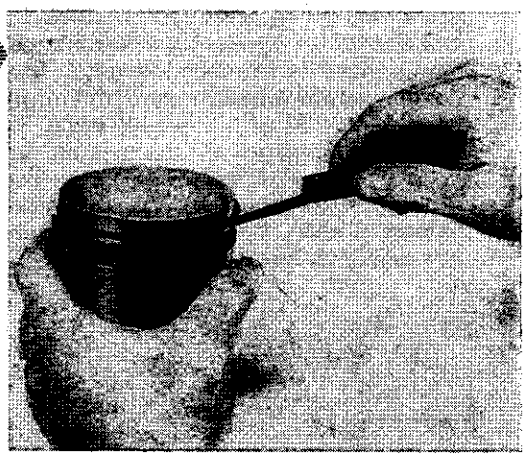
Piston pin and connecting rod bushing

Check and fit piston pin. Depending on the combination of tolerances between piston pin and bearing, the pin may be found to be a light finger-push fit in the piston without heating the piston. This condition is quite normal, even if the piston pin should slide out of the piston under its own weight. There is no reason whatsoever to replace piston pin, piston, or both, in this connection.

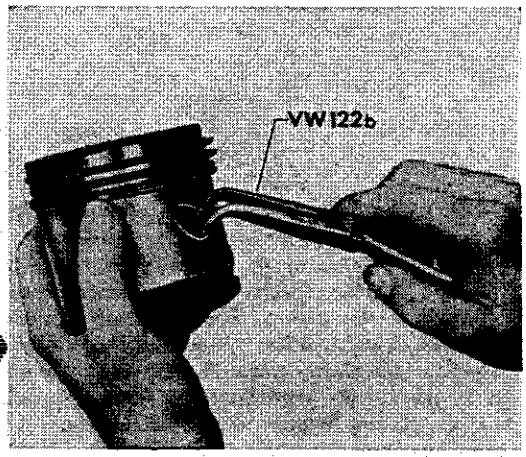
	Diameter mm (in.)	Clearance mm (in.)	Wear limit mm (in.)
Piston pin bushing	22.008–22.017 (0.8664–0.8667)	0.008–0.021 (0.0003–0.0008)	0.04 (0.0016)
Piston pin	21.996–22.000 (0.8658–0.8661)		
Bore in piston	21.997–22.002 (0.8660–0.8668)		

If the clearance between pin and bushing is near the wear limit of 0.04 mm (0.0015 in.), fit a new pin and a new bushing in the connecting rod.

5 - Check the ring clearance in the grooves with a feeler gauge.



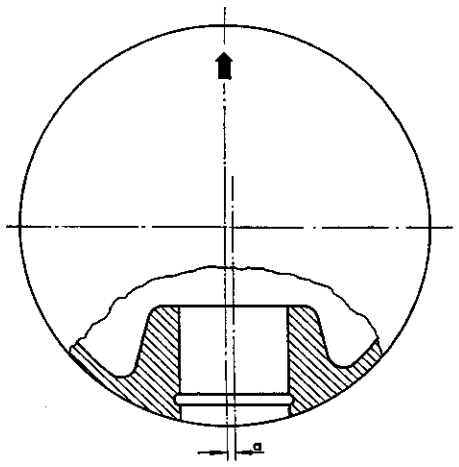
	Clearance mm (in.)	Wear limit mm (in.)
Upper ring 1/1500, 1600 — 2/1600 — 3/1600	0.07—0.10 (.0027—.004)	0.12 (.005)
Lower ring 1/1500, 1600 — 2/1600 — 3/1600	0.05—0.07 (.002—.0027)	0.10 (.004)
Oil scraper ring 1/1500, 1600 — 2/1600 — 3/1600	0.03—0.05 (.0012—.002)	



6 - Install circlips on the flywheel side of pistons for cylinders 1 and 2 and on the opposite side of pistons for cylinders 3 and 4.

Offset of piston pin bore

The piston pin eye in the piston is offset. When installing the pistons ensure that the arrow or the word "vorn" is toward the flywheel.



Type/Model	"a"
1/1500, 1600 — 2/1600 — 3/1600	1.5 mm

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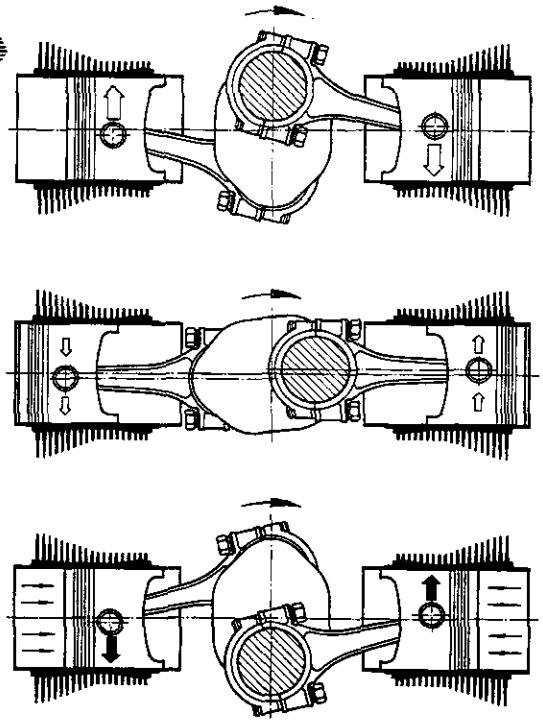
Due to the piston pin offset, the connecting rod changes its angle and with it the pressure contact area before reaching TDC. Combustion has not yet taken place at this point and the side thrust is relatively small. The piston tilts gently toward the opposite side of the cylinder wall, thus avoiding the usual slapping noise caused by the piston, tilting especially when clearance between piston and cylinder is large.



7 - Check and fit piston pin. Depending on the combination of tolerances between piston pin and bearing, the pin may be found to be a light finger-push fit in the piston without heating the piston. This condition is quite normal, even if the piston pin should slide out of the piston under its own weight. There is no reason whatsoever to replace piston pin, piston, or both, in this connection.

If the clearance between pin and bush is near the wear limit of .0015 in. (0.04 mm), fit a new pin and a new bush in the connecting rod.

Pistons should be heated in all cases where the piston pin is not a push fit. The piston is heated to approximately 176° F (80° C). The pin is then pushed fully home as far as the circlip in one movement with the drift VW 207 or VW 207 c.

8 - Insert second circlip. The circlips must seat correctly in their grooves.

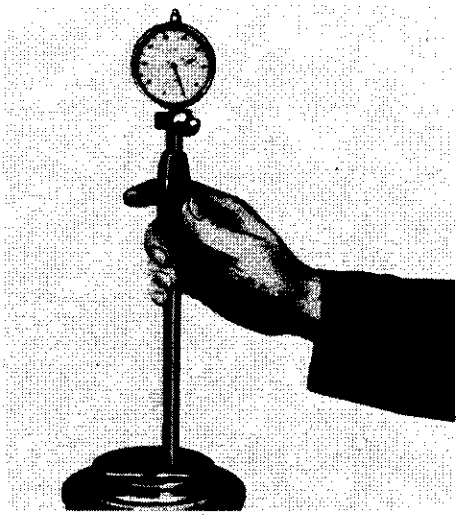
	1/1500, 1600 — 2/1600 — 3/1600 mm dia.	Clearance mm	Wear limit mm
Piston pin bush	20.008—22.017	0.008	0.04
Piston pin	21.996—22.000	0.021	
Bore in piston	21.997—22.002		

The clearance should be determined by measuring cylinder and piston and not with a feeler gauge.

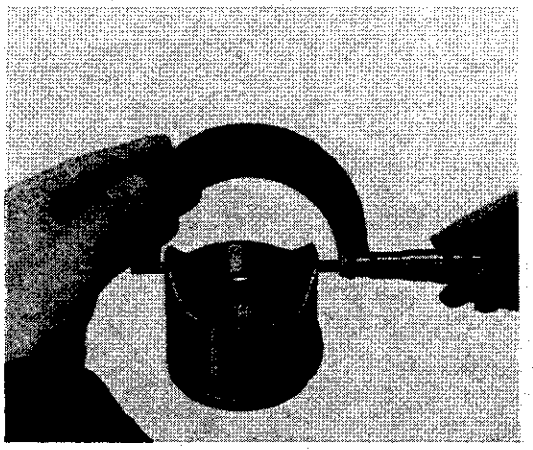
The cylinder is measured with a special dial gauge which is adjusted with micrometer gauge to the size of the cylinder.

The cylinder should be measured 10–15 mm (0.4–0.6 in.) below the upper edge.

New part	Wear limit
0.04–0.05 mm (0.00157–0.00196 in.)	0.2 mm (0.008 in.)



The nominal diameter is stamped on the piston crown. The reading must be taken at the bottom of the skirt at right angles to the piston pin axis.



The size gradings of the cylinders and matching pistons are as follows:

Gradings	Color	Cylinder diameter mm	Matching piston diameter mm
Standard size	Blue	85.492–85.508	85.45
Nominal dimension 85.5 mm diameter	Pink	85.502–85.518	85.46
1st Oversize	Blue	85.992–86.008	85.95
Nominal dimension 86 mm diameter	Pink	86.002–86.018	85.96
2nd Oversize	Blue	86.492–86.508	86.45
Nominal dimension 85.5 mm diameter	Pink	86.502–86.518	86.46

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If measurement of piston and cylinder shows that the clearance is near 0.2 mm (0.008 in.), the piston and cylinder should be replaced by a set of the same size grading (normal or oversize).

The difference in weight between the pistons in **one** engine must not exceed 10 grams. Pistons must not be replaced individually if the cylinders to which they belong show signs of wear.

If the cylinder of a damaged piston shows no signs of wear it is usually sufficient to install a new piston of the appropriate matching size.

Since the compression ratio must not be affected when installing reconditioned cylinders, the distance from the crown to the piston pin eye of the oversize piston is reduced accordingly.

Note

The clinders and pistons in one engine must be of the same size grading.

Besides wear, the oil consumption of the engine is an important factor in deciding whether or not a new cylinder and piston must be installed.

Oil consumption is considered excessive if it is more than 2 pints per 600 miles.

If measurement of piston and cylinder shows that the clearance is near 0.2 mm (.008 in.), the piston and cylinder should be replaced by a set of the same size grading (normal or oversize). The difference in weight between the pistons in **one** engine must not exceed 10 grams. Pistons must not be replaced individually if the cylinders to which they belong show signs of wear. If the cylinder of a damaged piston shows no signs of wear it is usually sufficient to install a new piston of the appropriate matching size.

Since the compression ratio must not be affected when installing reconditioned cylinders, the distance from the crown to the piston pin eye of the oversize piston is reduced accordingly.

Important

The cylinders and pistons in one engine must be of the same size grading.

Beside the wear, the oil consumption of the engine is an important factor in deciding whether or not a new cylinder and piston must be installed. Oil consumption is considered excessive if it is more than 2 pints per 600 miles (1 liter per 1000 km), on Type 2/1600, 3 pints per 600 miles (1.4 liter per 1000 km).

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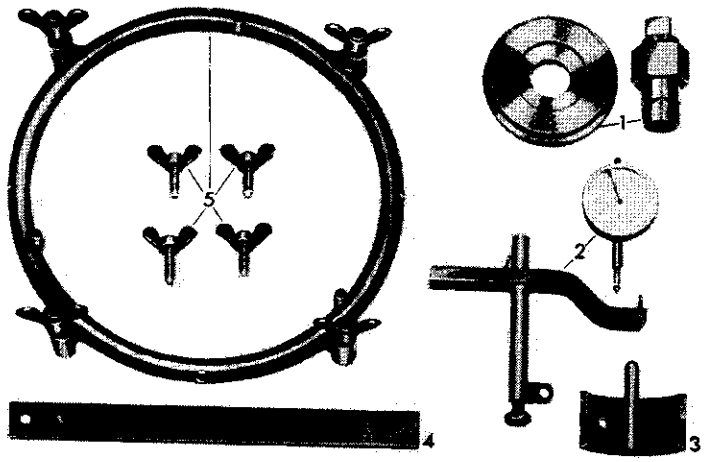

No.	Description	Special tool	Remarks
1	Installing tool for crankshaft oil seal	VW 204 b	
2	Dial indicator bracket	VW 659/2	
3	Retainer for flywheel	VW 215 c	
4	Stop bar, carrier plate	VW 802	
5	Drive plate retainer	VW 184	

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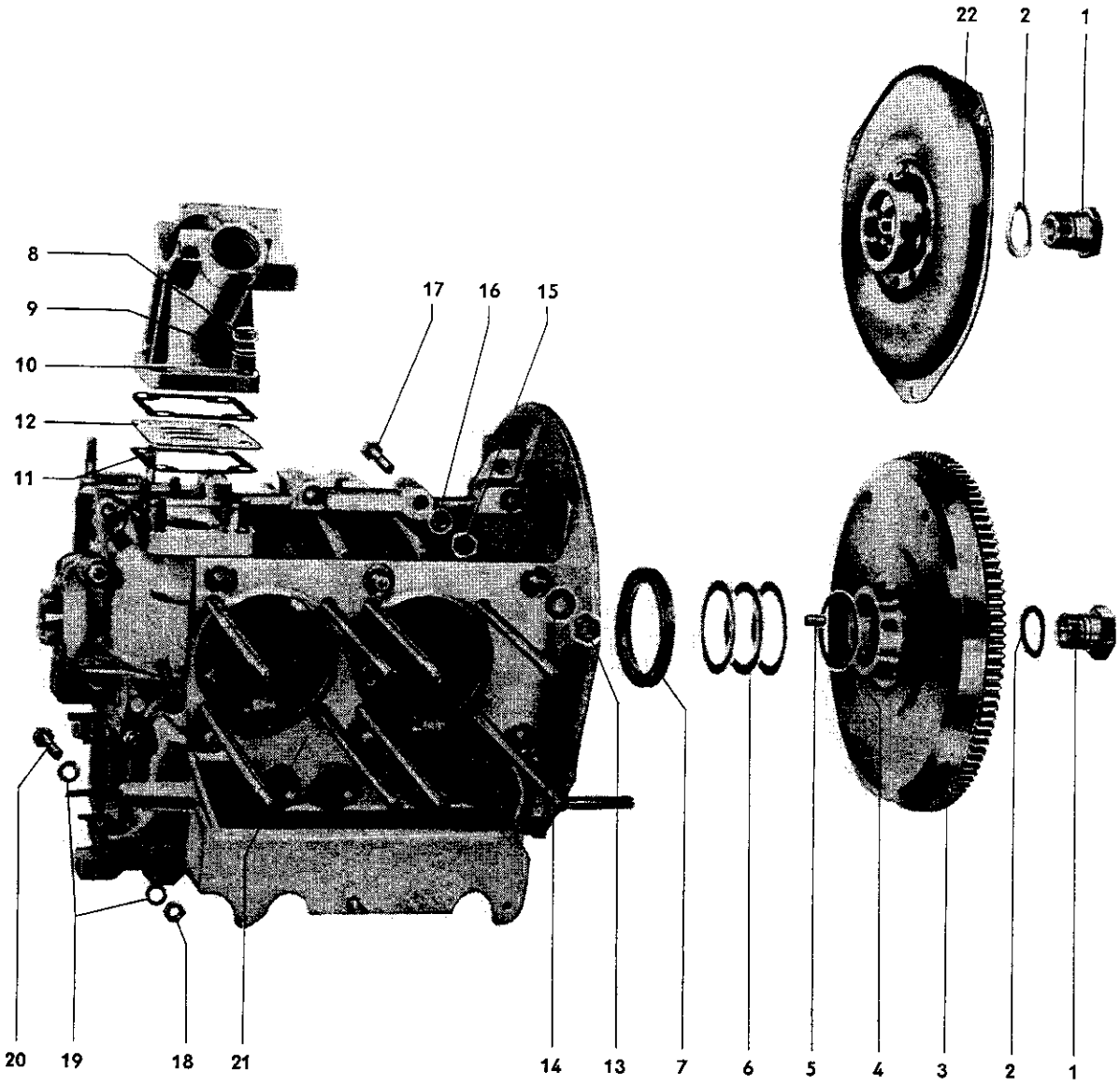
22
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No.	Description	Qty.	Note when disassembling	Note when assembling	Special instructions see
1	Gland nut *)	1		torque to 35 mkg (253 ft. lb.)	M 7.1/2
2	Lock washer	1			
3	Flywheel	1	mark installation position and note when installing	friction surface must be free of oil and grease	M 7.1/2
4	Rubber seal	1		replace, oil lightly	
5	Flywheel dowel pin	4		check; replace if necessary	
6	Shim	3		use dial gauge bracket VW 659/2 determine thickness by setting axial play 0.07–0.13 mm (0.003–0.005 in.)	M 7.1/2
7	Crankshaft oil seal	1		replace; install with VW 204 b	M 7.1/3-1
8	Nut M 8, galvanized	4			
9	Lock washer, galvanized	4			
10	Generator support	1			
11	Generator support gasket	2		replace, if present	
12	Oil deflector plate	1		replace, if raised edge type; note installation position	M 7.1/2
13	Nut M 12×1.5	6		torque to 3.5 mkg (25 lb. ft.)	
14	Washer, 12.2×22	6			
15	Nut M 8, galvanized	6		torque to 2 mkg (14 lb. ft.) note sequence	
16	Lock washer, galvanized	6			
17	Bolt M 8×50, galvanized	1			
18	Nut M 8	9		torque to 2 mkg (14 lb. ft.) note sequence	
19	Lock washer	11			
20	Bolt M 8×50	2			
21	Crankcase	1		check for wear, clean joints, break edges of bearing bores	M 7.1/2
22	Plate	1			M 7.1/2

*) Type 1/Automatic Stick Shift gland nut without needle bearing and felt ring, 6 mm thinner hex.

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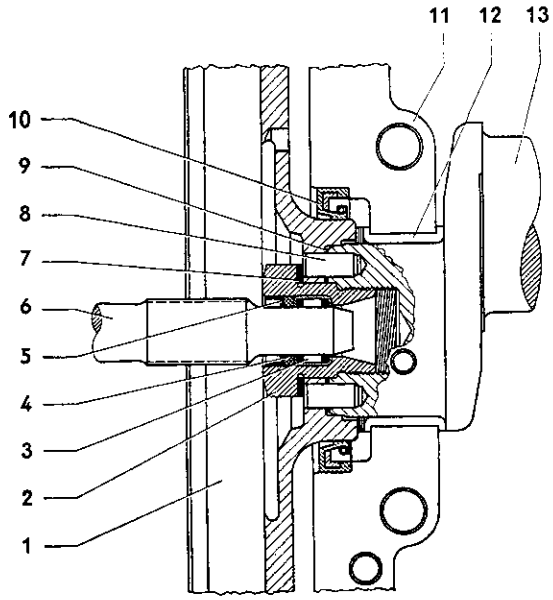
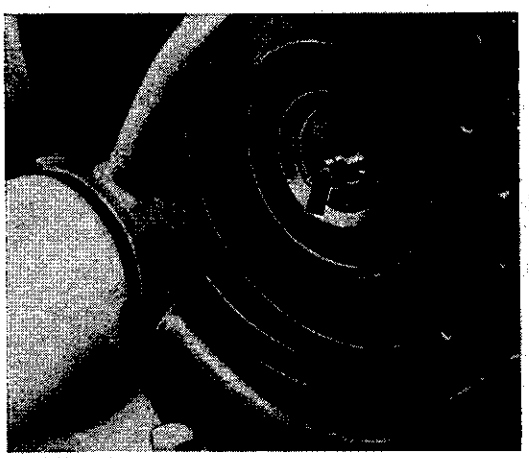
1 - Flywheel
2 - Gland nut
3 - Needle bearing
4 - Felt ring
5 - Retaining ring
6 - Main drive shaft
7 - Lock washer
8 - Dowel pin
9 - Rubber sealing ring
10 - Crankshaft oil seal
11 - Shims
12 - Crankshaft bearing
13 - Crankshaft

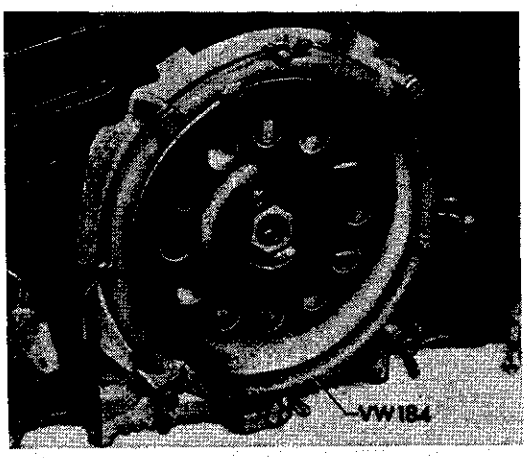


Removing

1 - When new engines have been assembled they are balanced. For this reason, mark position of flywheel (arrow) so that it is not too much out of balance when installed again.



2 - On engines of Automatic Stick Shift vehicles, the drive plate is held with VW 184 when unscrewing the gland nut.



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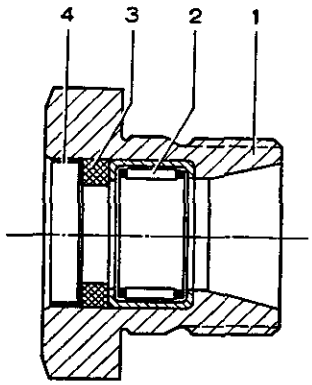


1 - Gland nut
2 - Needle bearing
3 - Felt ring
4 - End ring

Checking flywheel

1 - Check flywheel teeth for wear and damage. A maximum of 2 mm (0.078 in.) can be removed from a damaged gear ring on the clutch side. After deburring, chamfer the teeth.

2 - Check dowel pin holes in the crankshaft for wear.

3 - Check needle bearing for wear.

Installing

1 - Lubricate needle bearing with a small amount of multipurpose grease only if has been washed. Oil felt ring. Wipe excess lubricant off.

2 - Note mark denoting unbalance.

3 - Adjust axial play of crankshaft.

Disassembling crankcase

Use a rubber hammer to loosen the right-hand crankcase half. Do not insert sharp tools, such as screwdrivers etc., between the joining faces.

Checking

Note

Both halves of crankcase are machined together and must be replaced together.

1 - Flush the oil passages and blow them out with compressed air.

2 - Check studs for tightness. If the tapped holes are worn, Heli-Coil inserts can be installed.

Note

When replacing the crankcase of an engine manufactured before August 1970, various other parts will have to be replaced as well (see Parts Bulletin 1–12).

If the old cylinder head studs are to be used again in the new crankcase, the front stud above cylinder No. 3 must be replaced by a longer stud (see Parts Bulletin 1–12).

Assembling

1 - Spread an even film of sealing compound on the jointing faces of the crankcase halves. Be extremely careful not to let any sealing compound enter oil passages of crankshaft and camshaft bearings.

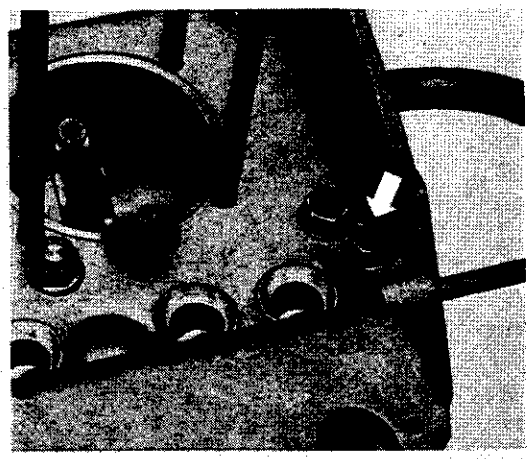
2 - Assemble housing halves.

3 - First tighten M 8 nut next to M 12 stud of main bearing No. 1 (arrow).

Then tighten M 12 nuts. This tightening sequence must be adhered to.

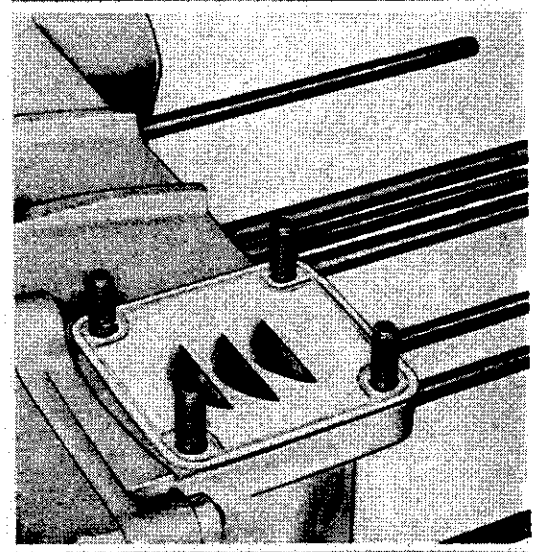
4 - Tighten M 8 and M 6 nuts.

5 - Turn the crankshaft to check for ease of movement.



6 - Install oil deflector plate between crankcase and generator support or breather support.

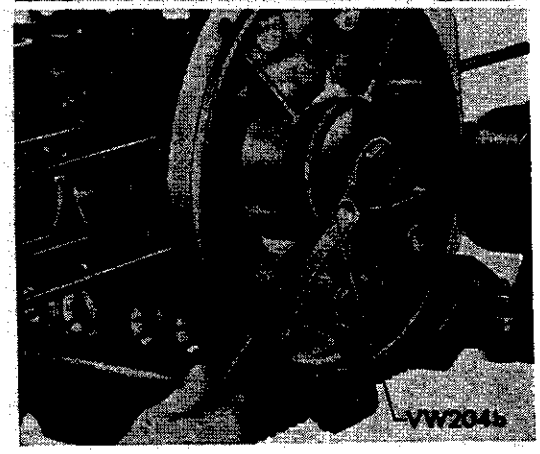
The three louvers in the oil deflector plate face downward and the slightly longer end of the louver faces rearward. The upper face of the plate is marked "top".



Installing crankshaft oil seal

Clean oil seal recess in crankcase and coat it with a thin film of sealing compound. If necessary, slightly chamfer the outer edge with a scraper to prevent the outer surface of the oil seal from being damaged. Remove metal shavings.

The oil seal must bed squarely in the crankcase recess.



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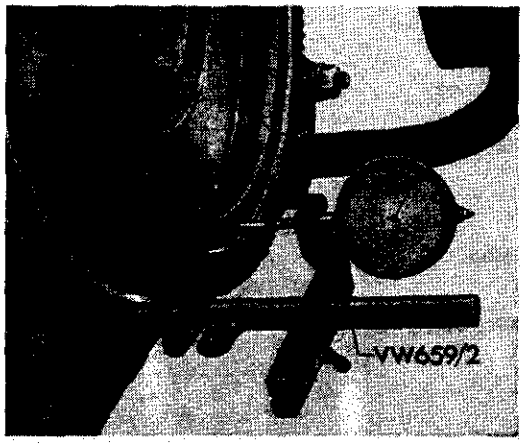

Checking

Crankshaft end play:

New – 0.07 to 0.13 mm (0.0027 to 0.005 in.)
Wear limit – 0.15 mm (0.006 in.)

Move crankshaft in and out and read axial play directly from dial gauge.

Adjusting end play

1 - Install flywheel with two shims but without the seals for crankshaft and flywheel.

2 - Attach dial gauge bracket VW 659/2 and dial gauge to crankcase.

3 - Move crankshaft in and out. Read end play off dial gauge.

4 - Determine thickness of third shim:

Dial gauge reading

– 0.10 (mean end play)

= third shim

5 - Remove flywheel.

6 - Insert seals for crankshaft and flywheel.

7 - Install flywheel and all three shims.

8 - Check end play again.

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

Three shims of the required total thickness are to be installed.

Available shims:	Inside diameter in mm	Thickness in mm
	53.6	0.24
		0.30
		0.32
		0.34
		0.36

No.	Description	Qty.	Note when disassembling	Note when assembling	Special instructions see
1	Camshaft	1	Check rivets and wear on bearings, journals and cams. Check gearwheel for wear and contact pattern.	Check run-out, max. when new 0.02 mm (0.0007 in.), wear limit: 0.04 mm (0.0015 in.) (measured at center bearing). Check axial play at thrust bearing: 0.04 to 0.13 mm (0.0015 to 0.0051 in.), wear limit: 0.16 mm (0.0062 in.). Watch matching and fitting position. Check backlash on full circumference of gearwheel.	M 7.2/2 Fig. 1 Fig. 2 Fig. 3 M 5.1/3
2	Crankshaft and connecting rods	1		edges of oil holes in crankshaft journals and bearings must be chamfered	M 7.2/2-2
3	Main bearing no. 1	1		check for wear apply oil; hole for dowel pin faces flywheel. Bearing play with housing pre-load: new — 0.04 to 0.10 mm (0.0015 to 0.0039 in.) wear limit: 0.18 mm (0.007 in.)	
4	End cap for camshaft bore	1		install with sealing compound; on engines with Automatic Stick Shift transmissions, base faces camshaft	
5	Camshaft no. 1 bearing shell	1			
6	Camshaft no. 2 bearing shell	1		check for wear apply oil; tabs engage in recesses in crankcase	
7	Left shell for no. 3 camshaft bearing (with thrust shoulder)	1			
8	Cam follower	4		check for wear, oil	
9	Shell for crankhsaft no. 2 bearing	1		check for wear, oil bearing play with housing pre-load: new — 0.03 to 0.09 mm (0.001 to 0.003 in.) wear limit: 0.17 mm (0.006 in.)	
10	Dowel pin for crankshaft bearing	4		check for tightness	Fig. 4
11	Crankcase joint seal	6		replace	
12	Left crankcase half	1			

The following parts are not shown in the illustration but they are installed in right-hand half of crankcase before assembly:

(13)	Dowel pin for crankshaft bearing no. 2	1		check for tightness	
(14)	Shell for crankshaft bearing no. 2	1		check for wear, oil	
(15)	Shell for camshaft bearing no. 1	1			
(16)	Shell for camshaft bearing no. 2	1		check for wear, tabs engage in recess in crankcase; oil	
(17)	Shell for camshaft bearing no. 3	1			
(18)	Cam follower	4		check for wear apply oil; hold with spring clips VW 171	

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Note

The backlash between camshaft and crankshaft gears should be: 0.00–0.05 mm (0.00–0.002 in.).

The camshaft gear size is correct if the backlash is hardly noticeable and the camshaft does not lift when crankshaft is turned backward.

To assist in obtaining the specified backlash camshafts are available with various sized timing gears under different part numbers.

The camshaft gears are marked, for example −1, 0, +1, +2 on their inner face. The digits indicate in $^1/_{100}$ mm how much the pitch radius departs from the standard pitch radius which is denoted by "0".

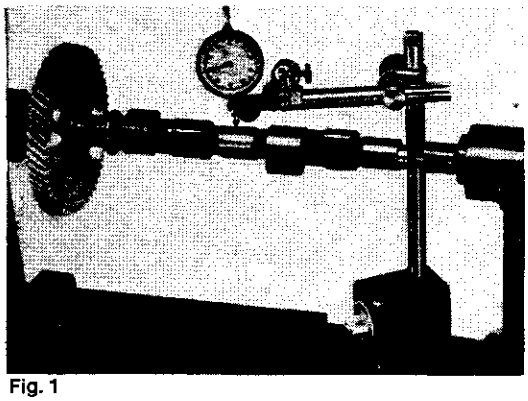

Fig. 1

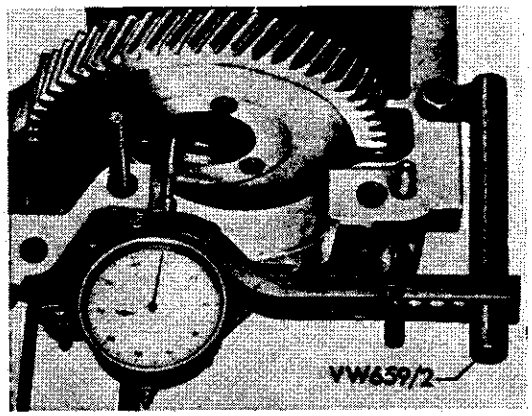

Fig. 2

Caution

The mark "0" (arrow) on the outer face of each camshaft timing gear is to ensure correct timing and must not be confused with the markings on the inner face.
The crankshaft timing gear is obtainable in one size only and has no special marking.

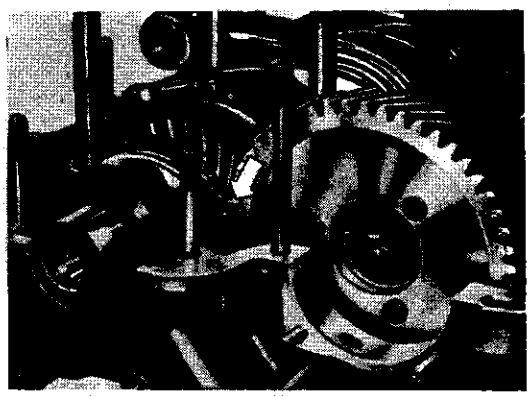

Fig. 3

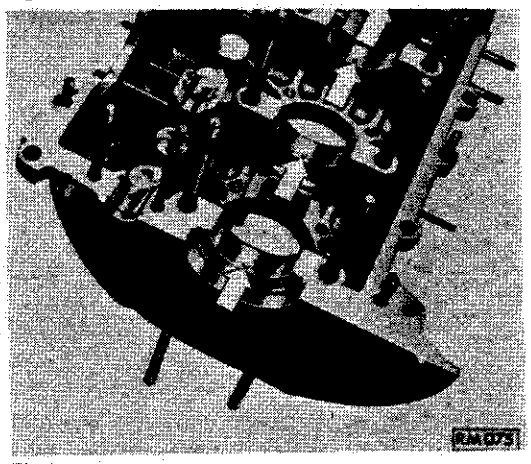

Fig. 4

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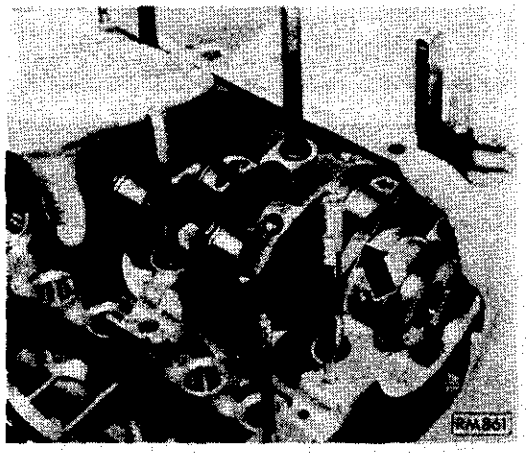
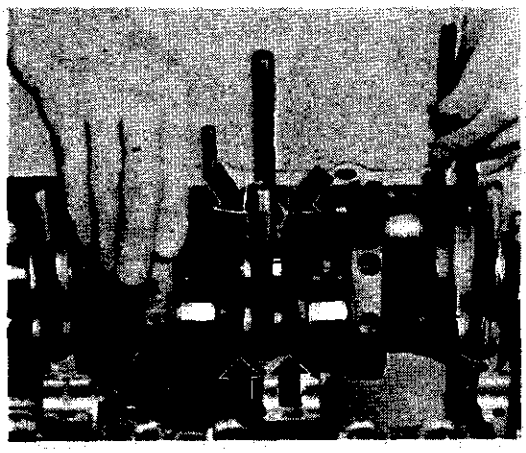
Note

If a new crankcase (with threaded inserts) is to be used as a replacement for an old crankcase (without threaded inserts) and the same crankshaft is to be reused, note the following:

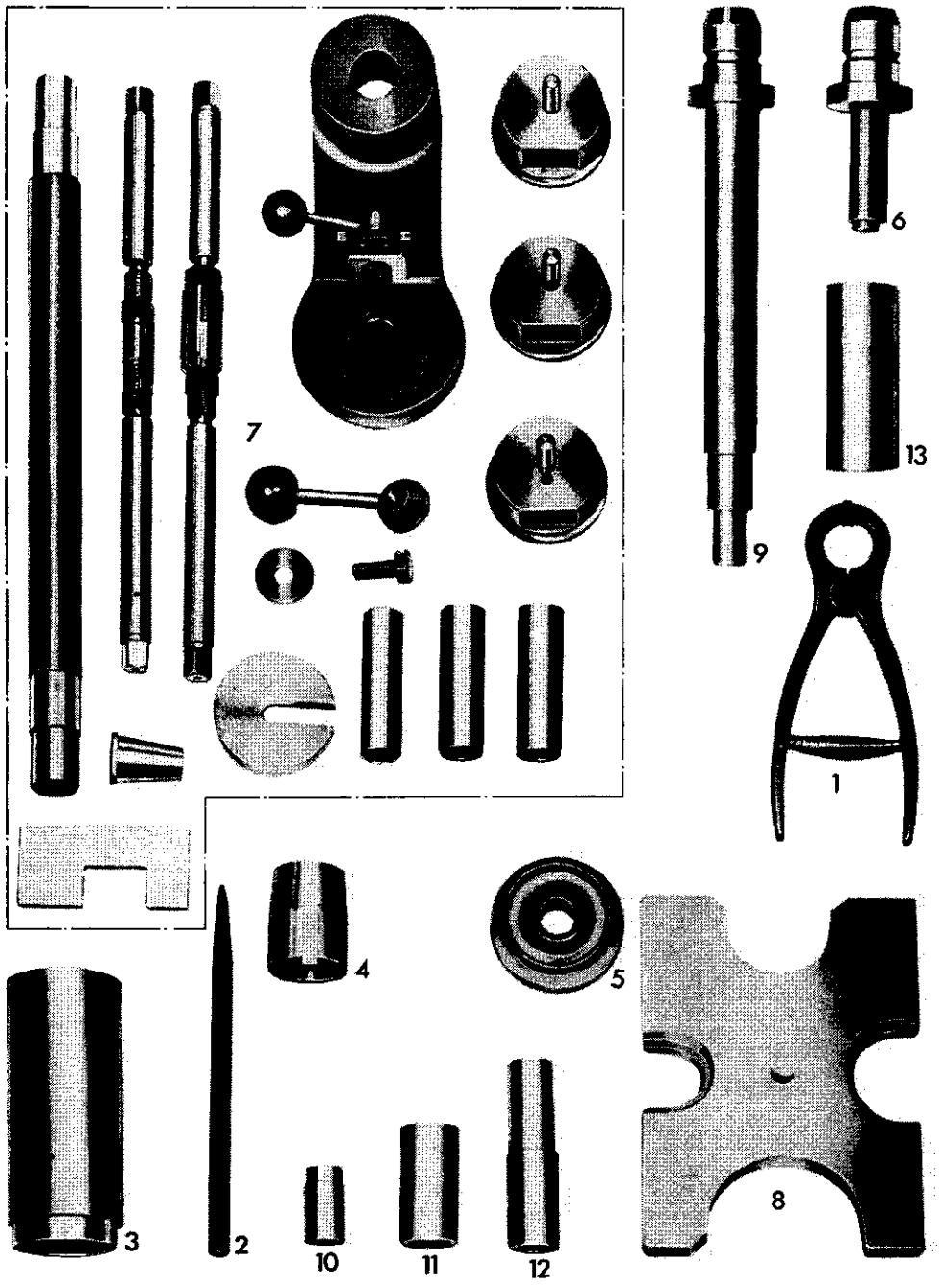
1 - Place the crankshaft with bearings in the left half of the crankcase.



2 - Push a 0.5 mm (0.020 in.) feeler gauge blade between main bearing I and the crankshaft (arrow).



3 - Turn the crankshaft, under light pressure, against the feeler gauge blade and note the clearance at main bearing web II. If the crankshaft contacts the housing (arrow), both crankcase halves must be ground off at the locations concerned.



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No.	Description	Special tool	Remarks
1	Circlip pliers	VW 161 a	
2	Peening chisel	VW 124 a	
3	Tube, 60 mm diameter	VW 415 a	
4	Guide sleeve, tapered	VW 428 a	
5	Thrust pad	VW 442	
6	Punch	VW 409	
7	Connecting rod repair tool	VW 214 f	
8	Thrust plate (converted)	VW 402	
9	Punch	VW 408 a	
10	Arbor	VW 434	
11	Tube, 31,5 mm diameter	VW 418 a	
12	Tube, 28 mm diameter; 100 mm	VW 421	
13	Tube, 37 mm diameter	VW 416 b	

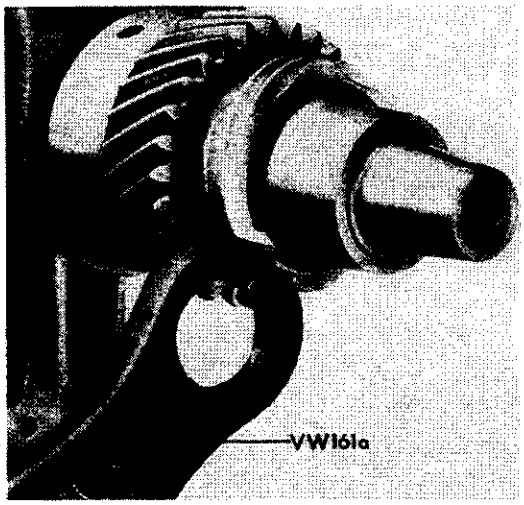


Fig. 1

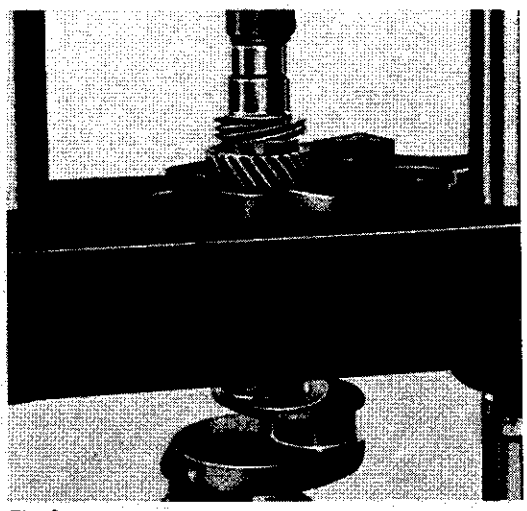


Fig. 2

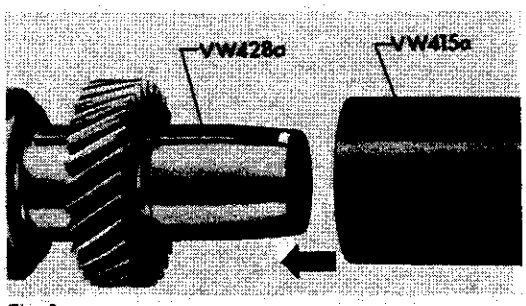


Fig. 3

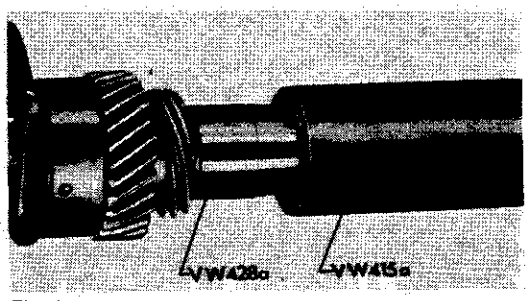


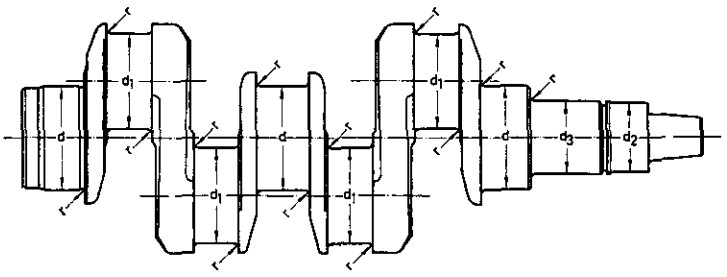
Fig. 4

Regrinding crankshaft

For reconditioning the following measurements should be obtained:

	Main journals Nos. 1, 2 and 3 (d)		Connecting rod journals (d_1)		Main journal No. 4 (d_2)	
	Nominal diameter	Lapped diameter	Nominal diameter	Lapped diameter	Nominal diameter	Lapped diameter
Standard	55.00 mm 2.1653 in.	54.990 mm 2.1648 in. 54.971 mm 2.1642 in.	55.00 mm 2.1653 in.	54.996 mm 2.1654 in. 54.983 mm 2.1653 in.	40.00 mm 1.5748 in.	40.00 mm 1.5748 in. 39.984 mm 1.5742 in.
1st Undersize	54.75 mm 2.1555 in.	54.740 mm 2.1551 in. 54.721 mm 2.1544 in.	54.75 mm 2.1555 in.	54.746 mm 2.1555 in. 54.733 mm 2.1550 in.	39.75 mm 1.5650 in.	39.750 mm 1.5650 in. 39.734 mm 1.5643 in.
2nd Undersize	54.50 mm 2.1457 in.	54.490 mm 2.1453 in. 54.471 mm 2.1445 in.	54.50 mm 2.1457 in.	54.496 mm 2.1459 in. 54.483 mm 2.1451 in.	39.50 mm 1.5550 in.	39.50 mm 1.5551 in. 39.484 mm 1.5545 in.
3rd Undersize	54.25 mm 2.1358 in.	54.240 mm 2.1353 in. 54.221 mm 2.1347 in.	54.25 mm 2.1358 in.	54.246 mm 2.1352 in. 54.233 mm 2.1347 in.	39.25 mm 1.5453 in.	39.250 mm 1.5452 in. 39.234 mm 1.5446 in.

Thorough grinding of the radii is of great importance to the life of the crankshaft. Try to get a radius of 2.5 mm. Repolish the radii.



On no account must the bearing shells be re-machined.

After grinding, remove sharp edges on oil passages by slightly chamfering them.

Crankshaft timing gear and distributor drive gear must be a press fit on the crankshaft $\frac{42.006 \text{ mm}}{41.995 \text{ mm}}$ dia. $\frac{1.6538 \text{ in.}}{1.6533 \text{ in.}}$

Where the gears are worn from being removed and installed several times, the press fit can be restored by chromium plating or metal spraying.

To make sure the crankshaft is free from internal cracks, perform a "ringing test" prior to installation. The crankshaft must then be checked for run-out.

$d_3 = \frac{42.006}{41.995}$ mm dia. $\frac{1.6538}{1.6533}$ in.

$r = \frac{2.5}{2.0}$ mm $\frac{0.10}{0.08}$ in.

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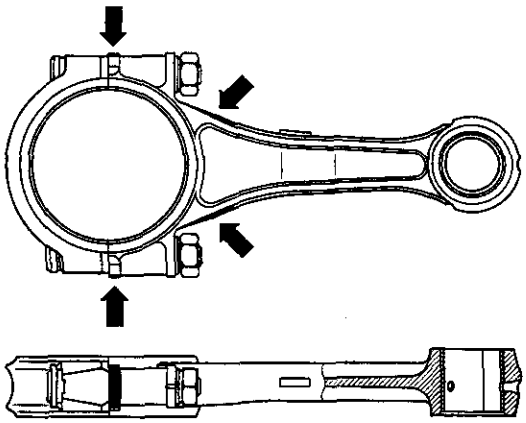


Checking

1 - Check connecting rods for external damage.

Note

Connecting rod bolts must be driven or pressed out. If connecting rod bolts are damaged, the complete connecting rod must be replaced.

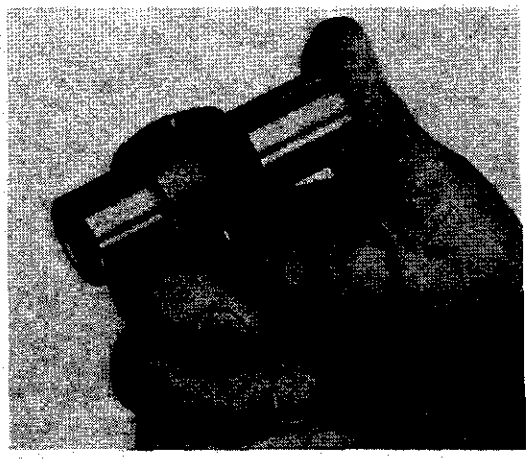
2 - Check weight of connecting rods:

The difference in weight between the connecting rods in an engine must not exceed 10 grams. If one or more connecting rods are replaced, all of them must be re-weighed, as connecting rods in two weight ranges only are supplied as spare parts (see table).

If necessary, metal should be removed from the heavier connecting rods at the points indicated in the drawing. A reduction of approximately 8 grams in weight can thus be obtained.

Weight class brown in grams	Weight class gray in grams
580–588	592–600

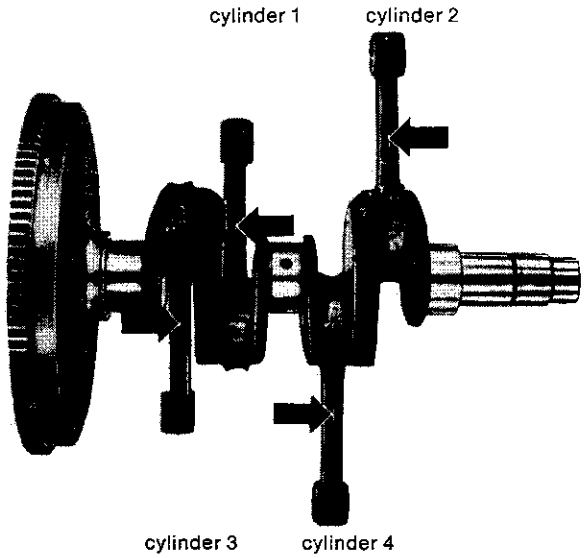
The connecting rod weight is the weight of a complete connecting rod without bearing shells.



3 - Check piston pin bushing. At room temperature the piston pin should be a push fit in a new bushing.

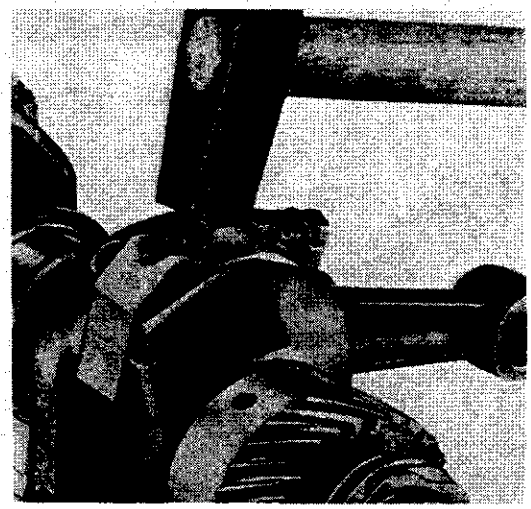
4 - Check connecting rod in appliance. If necessary, correct alignment.

Installing



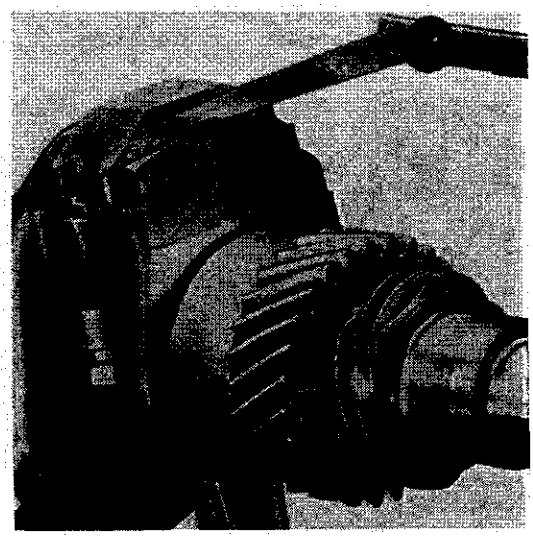
1 - The figures near the joint of the connecting rod and cap must be on the same side.

2 - The forged mark on the connecting rod must be upward on installation (arrows).



3 - Slight pretension between the bearing halves, which can occur when tightening the connecting rod bolts, can be eliminated by light hammer taps on both sides of the connecting rod.

The connecting rod must fall smoothly under its own weight. On no account is it permissible to scrape, ream or file the bearings.



4 - Measure axial play of connecting rods with a feeler gauge.

New: 0.1–0.4 mm (0.004–0.0016 in.)

Wear limit: 0.7 mm (0.028 in.)

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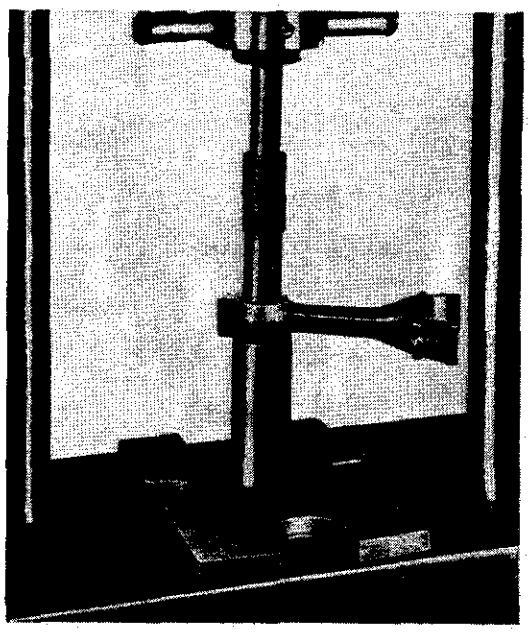
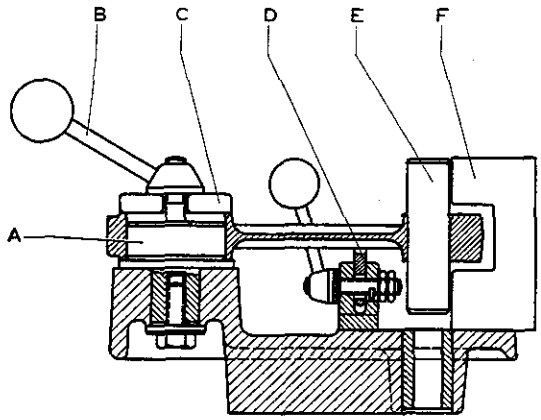


Connecting rods which are slightly bent can be straightened and the bushings can be replaced if worn.

1 - Press bushing out on press, using VW 402, VW 408 a and VW 416 b.



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

2 - Place mandrel (7 mm eccentric) in VW 214 f and attach connecting rod.

Turn mandrel "A" so that the flat is at right angles to center line of connecting rod.

3 - After inserting washer "C", tighten locking lever B until connecting rod can just be moved in both directions. Support "D" is not tightened.

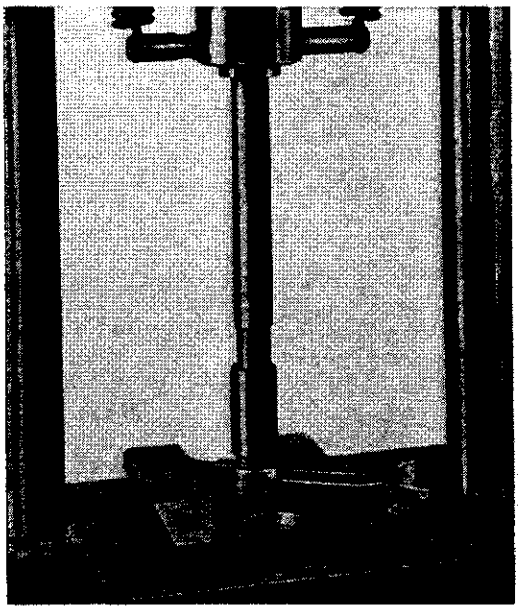
4 - Insert pin "E" into connecting rod and push it toward mandrel "A" with two fingers so that there is no tilt between mandrel and big end of connecting rod or between connecting rod eye and pin.

5 - Check connecting rod for twist and parallelism with the gauge "F".

(The picture shows the parallelism check.)

If deviations occur, tighten locking lever and straighten connecting rod with the bar.

6 - Press bushing in, using press tools given in chart.



7 - Drill oil holes (3.5 mm diameter).

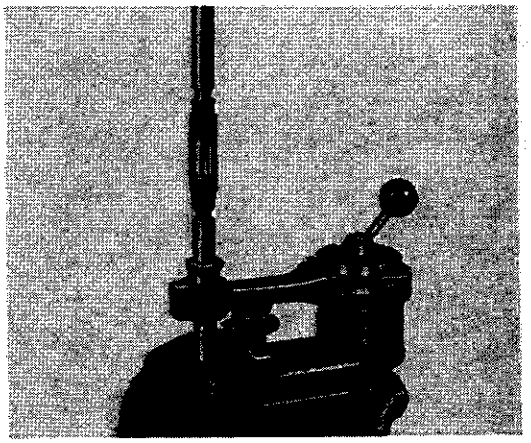
8 - Insert reamer through connecting rod eye and corresponding hole in device. The conical bushing ensures correct centering of piston pin bushing.

Tighten locking lever and support.

9 - Ream connecting rod bushing. Inside diameter:

22.009 to 22.017 mm (0.8664 to 0.8667 in.).

The bushing bore must be free from scores and chatter marks after reaming. Without applying oil, the piston pin must be a light push fit. It is not permissible to fit an oversize piston pin in order to eliminate excessive clearance between piston pin and bushing. A new bushing must, in all cases, be installed and reamed to size.



10 - Re-check connecting rod for parallelism and twist as mentioned previously, but this time with piston pin installed. Slight deviations can be corrected by inserting a bar into piston pin and straightening.

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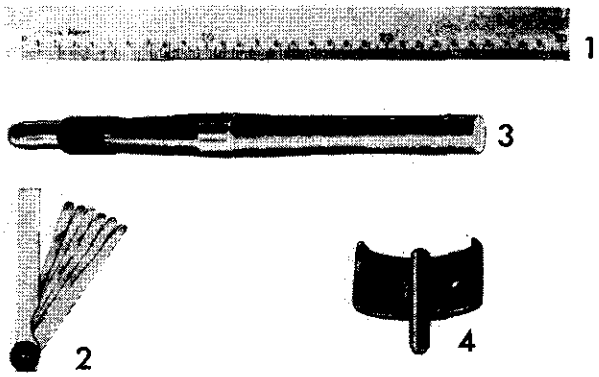

No.	Description	Special tool	Remarks
1	Straight edge		at least 200 mm long
2	Feeler gauge		
3	Drive shaft (part of)		
4	Flywheel retainer	VW 215 c	

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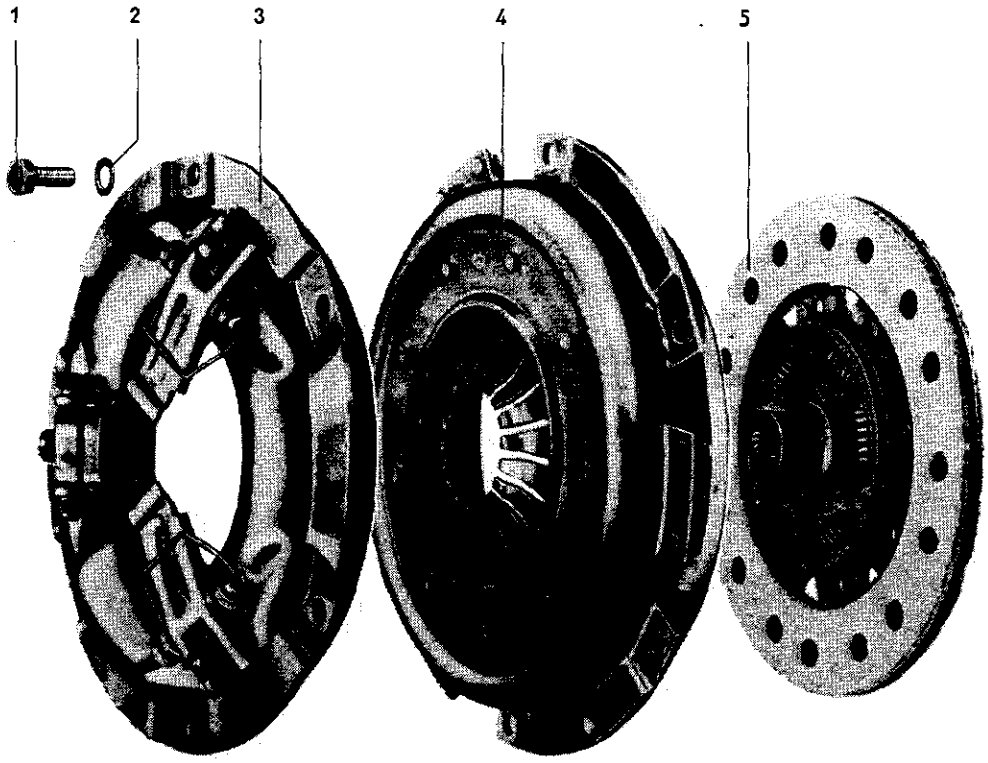

No.	Description	Qty.	Note when removing	Note when installing	Special instructions see
1	Bolt M 8×15	6	loosen diagonally	torque diagonally to 2.5 mkg (18 lb ft)	
2	Lock washer	6			
3	Disc spring clutch (up to July 1972, Chass. No. 112 2961 362)	1	mark position	(up to July 1970 with release ring) clean and check surface for wear	Fig. 1 Fig. 3
4	Diaphragm spring clutch (from Aug. 1972, Chass. No. 113 2000 011)	1	mark position	check tightness of rivets, clean and check surface for wear	Fig. 1 Fig. 3
5	Clutch disc	1		check for wear, check splines, plate must slide freely on the main shaft without excessive play check rivets and disc for run-out lubricate drive shaft splines with molybdenum disulfide powder	Fig. 2 Fig. 3

Removing

1 - New engines are balanced during factory assembly. To avoid imbalance after the engine has been reassembled, mark the position of the clutch on the flywheel (arrow).

2 - Loosen mounting bolts alternately and diagonally.

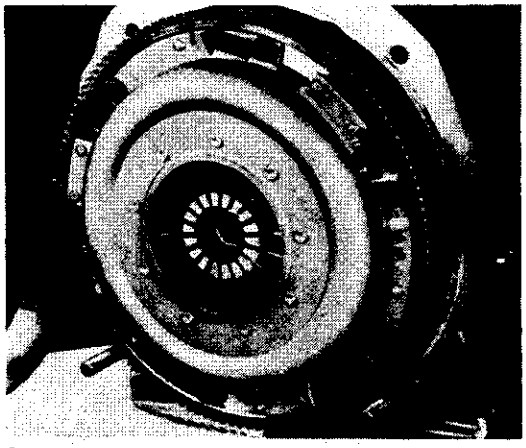

Fig. 1

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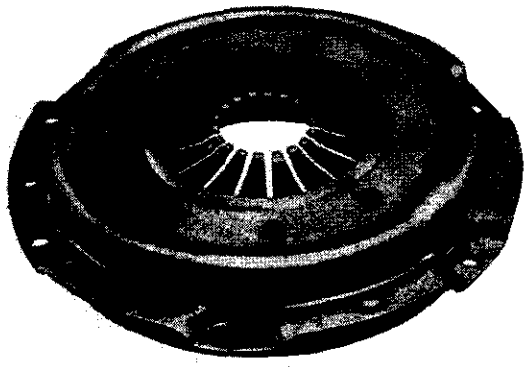
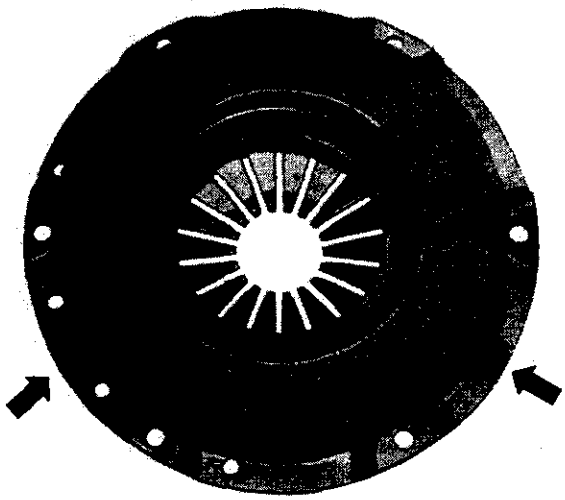


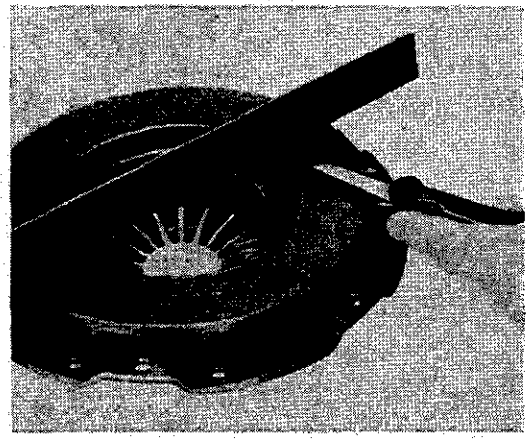


Checking

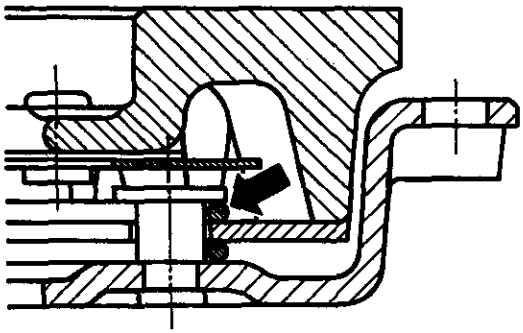
1 - Check ends of diaphragm spring (arrows) for scoring where the release bearing contacts. Scores up to a depth of 0.3 mm (0.012 in.) can be ignored.

2 - Check straps between pressure plate and cover for cracks. Check tightness of rivets (arrows).

Clutch with damaged or loose rivets should be replaced.



3 - Check pressure plate friction surface for cracks, burn marks and wear. Pressure plates on which the friction surfaces have an inward taper of up to 0.3 mm (0.012 in.) can be used again.



4 - The diaphragm spring is riveted to the clutch cover and held between two wire rings.

If the rivet heads or rings show signs of wear, the clutch should be replaced.

Checking clutch disc

Maximum run out: 0.5 mm (0.02 in.) measured at 195 mm (7.677 in.) diameter.

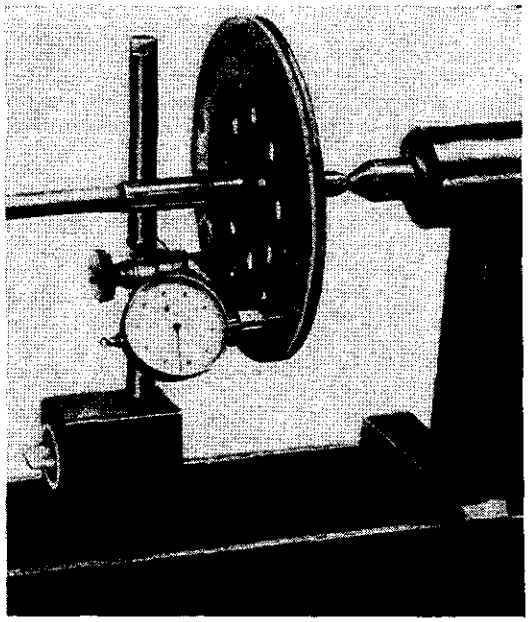


Fig. 2

Installing

1 - The needle bearing in the gland nut should only be lubricated after it has been washed in solvent. Use about 0.2 cm^3 of multi-purpose grease. Apply oil to felt ring. Wipe off excess lubricants.

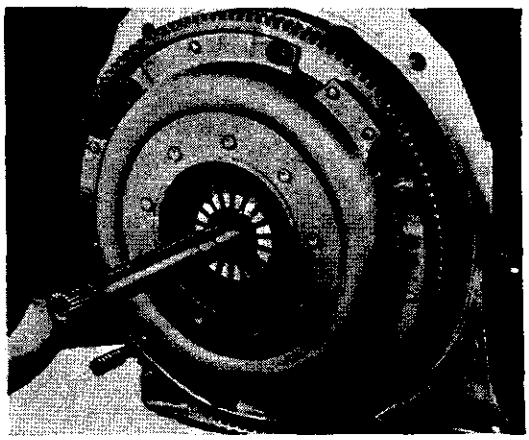
2 - Check clutch and clutch driven plate. Instructions on this are given in the sections "Clutch Checking" and "Clutch Driven Plate".

3 - Check drive shaft splines and lubricate sliding surfaces with molybdenum disulfide powder. The powder should be applied lightly with a brush or cloth.

The driven plate must slide freely on the splines without excessive clearance.

4 - Clean the release bearing by wiping with a clean cloth. Replace noisy and oily bearings. Make sure retaining springs are correctly positioned.

Grease guide bushing lightly with molybdenum disulfide paste (only on centrally located release bearing).



5 - Insert clutch plate into flywheel.
A shortened main drive shaft can be used to center the driven plate.

6 - Install clutch with marks aligned. New parts without marks can be installed in any position.

7 - Tighten bolts uniformly and diagonally to 2.5 mkg (18 lb ft).

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Installing

1 - Check release bearing. The ball bearing is maintenance-free. On no account must the bearing be washed with benzine or other cleaning fluids. Merely use a clean cloth to clean it. Replace internally noisy bearings.

2 - Roughen plastic ring with coarse emery cloth and apply molybdenum disulfide paste sparingly.

3 - Lightly coat the pivoting points between release bearing and operating shaft with multipurpose grease.

4 - Install retaining springs.

5 - Note that retaining springs are positioned correctly.

6 - Check clutch pedal free-play after the engine has been installed. Re-adjust if necessary.

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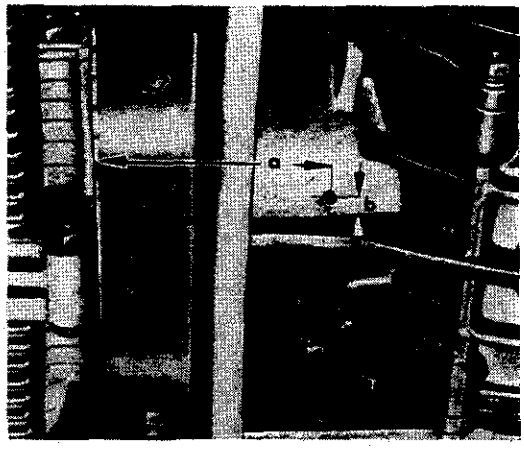
Lubricating plastic ring

Slight oscillation between the plastic ring on the release bearing and the clutch release ring can, under certain conditions, cause a whistling noise. The noise is harmless and does not affect the service life or the operation of the release bearing. Experience has shown that in such cases, lubricating the plastic ring with molybdenum disulfide based paste will stop the noise. Replacement of the bearing because of the noise described above is not justified.

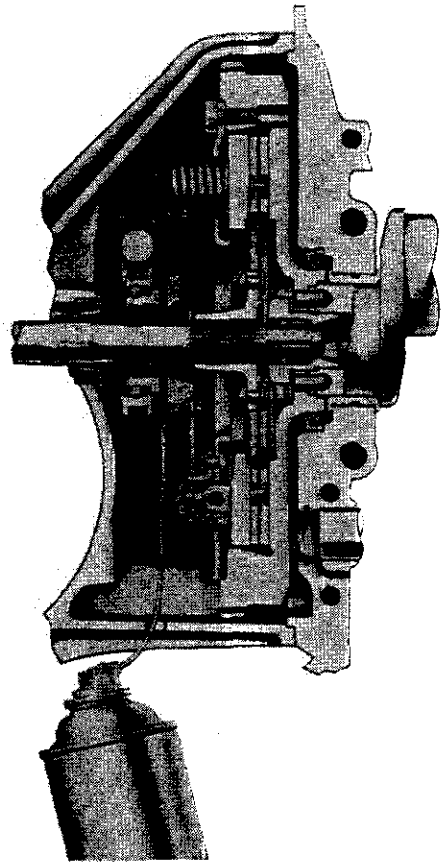


1 - Lift vehicle and drill a 10 mm ($^{23}/_{32}$ in.) hole in the transmission case at the point shown in illustration.

"a" = 67 mm ($2^{5}/_{8}$ in.)

"b" = 10 mm ($^{23}/_{32}$ in.)

2 - Increase the space between release bearing and release ring by unscrewing the adjusting nut on the clutch cable about 5 turns.



3 - Spray plastic ring on release bearing and release ring with a molybdenum disulfide based lubricant.

Spraying time – max. 2 seconds.

Note

Use only a spray compound with a molybdenum disulfide base which contains no oil or grease.

Use an extension for the spray can 140 mm (5.5 in.).

4 - Close the hole with rubber buffer, Part No. 211 843 749.

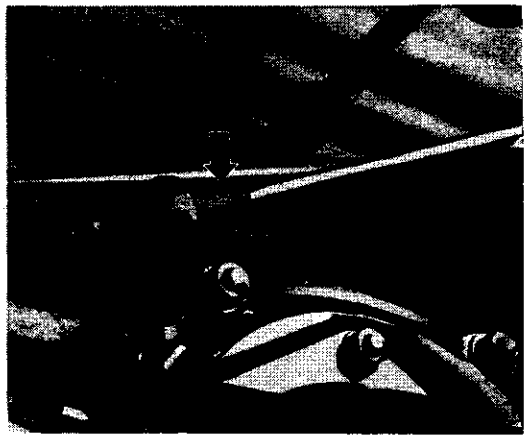
5 - Adjust clutch free play.

Removing

1 - Disconnect clutch cable from clutch operating lever.

2 - Withdraw rubber sleeve from guide tube and cable (arrow).

Remove pedal cluster (see B 2.7/1).



Installing

1 - Check threaded part of clutch cable for freeness and grease clutch cable with multipurpose grease.

2 - Insert clutch cable as shown in illustration.

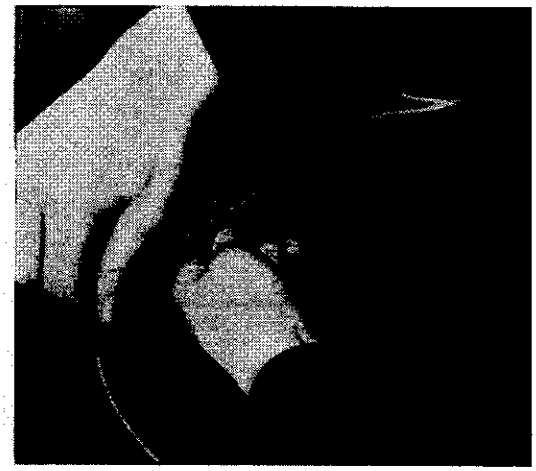
3 - Grease clutch cable eye and clutch pedal shaft with multipurpose grease.

4 - Note correct position of the rubber sleeve at the end of the guide tube.

5 - Adjust clutch play.

6 - Grease wing nut for clutch cable with multipurpose grease.

Install pedal cluster (see B 2.7/1).



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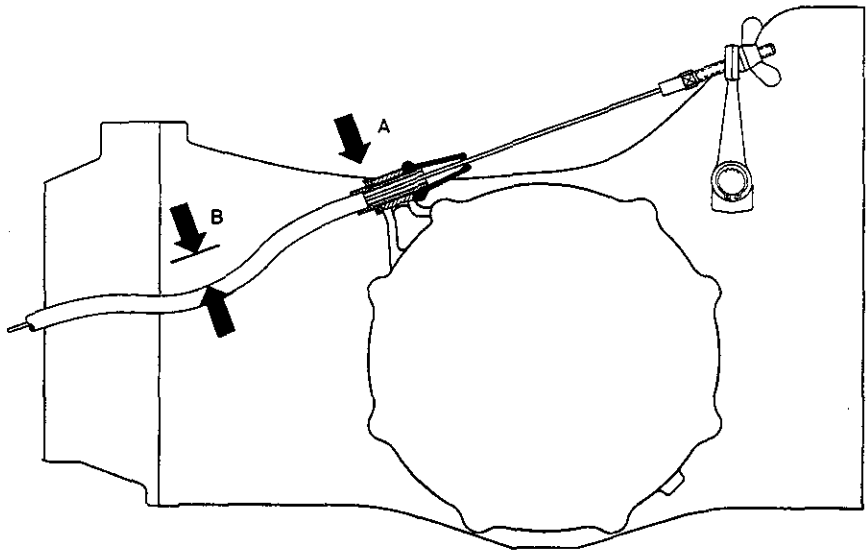
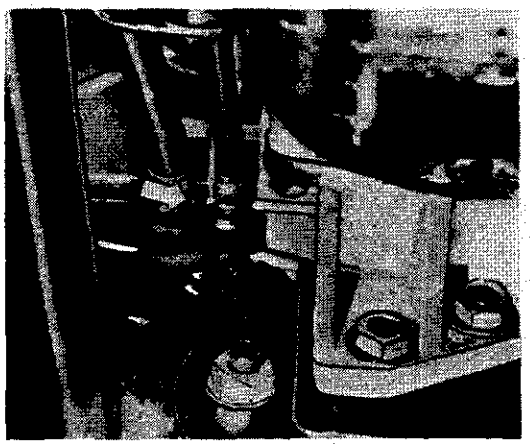
Note

The clutch cable guide tube should sag 25–45 mm (1–1 25/32 in.) (B). This preload is obtained by inserting washers between the bracket on the transmission and the end piece of the guide tube (A).

If the cable guide tube is bent down too much it will make the cable stiff in operation and can create noises or cause breakage of the cable. This trouble can be remedied by shortening the guide tube at the rear end after removing tube and cable.





The guide for the clutch cable has been provided with a hole (arrow) to lubricate the clutch cable.

If the clutch cable creaks, jams or is stiff in operation, it should be lubricated carefully via the lubrication hole.

Use a manual lever-type grease gun with the nozzle as used for the Type 1 door hinges.

After lubricating reinstall the sealing boot for the cable guide.

Clutch cable

From October 1971, Chassis No. 112 2205 116, the clutch linkage has been altered (see Workshop Manual H). In addition, the bow of the clutch cable has been increased to approximately 70 mm ($2^3/_4$ in.).

If the clutch cable is broken on a vehicle produced after this Chassis No. the following parts are to be used for the repair:

Clutch cable – Part No. 113 721 335 A
total length 2260 mm ($89^{31}/_{32}$ in.)

Clutch cable sleeve – Part No. 311 721 361
total length 330 mm (13 in.)

Washer – Part No. N 11 531.4

When installing these parts the bend in the clutch cable sleeve is reduced to 25–45 mm ($1–1^{25}/_{32}$ in.).

Note

The cable must be well greased before it is installed. Push the washer onto the rear end of the cable sleeve. Install the sleeve together with the rubber seal in the bracket on the transmission first. Ensure that it is installed properly on the guide tube.

Turn the lubricating hole downward and make sure that the sealing rubber is sitting correctly. Adjust the clutch pedal free play and coat the threaded end with grease.

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Clutch play:

Between clutch lever and wing nut = 1–2 mm ($^{1}/_{32}$–$^{3}/_{32}$ in.). Pedal free-play (a) = 10–20 mm ($^{13}/_{32}$–$^{13}/_{16}$ in.).

As the clutch linings wear, the clearance between release bearing and release ring is reduced. If there is no play, the clutch pressure is reduced which can lead to clutch slippage and the linings becoming burnt.

Adjusting

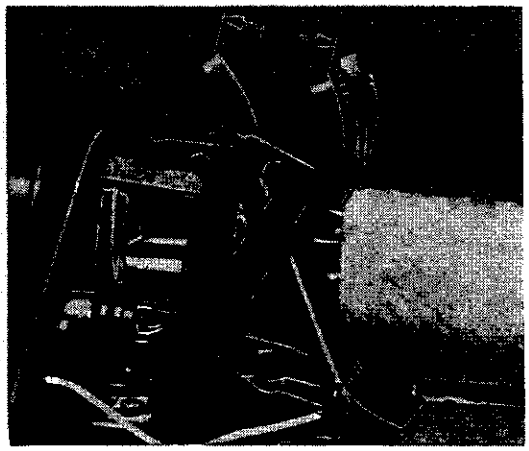
1 - Adjust the clutch by turning the wing nut (arrow) until the pedal free-play is

"a" = 10–20 mm ($^{13}/_{32}$–$^{13}/_{16}$ in.)

When the free-play is correct, there will be clearance of about 2 mm ($^{3}/_{32}$ in.) between clutch lever and wing nut.

2 - After adjusting, make sure that the two lugs of the wing nut engage into the cutouts in the clutch lever.

3 - Depress clutch pedal several times and check play again.



4 - Lubricate threads of clutch cable, wing nut and countersunk hole in clutch lever with multipurpose grease.

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Adjusting clutch play

Types 1, 2, 3

The clutch is to be adjusted so that there is a clearance of .04—.08 in. (1—2 mm) between the release bearing and the release ring with the clutch engaged. Measured at the clutch pedal, the free-play is between .4 and .8 in. (10 and 20 mm). The free-play is adjusted with the wing nut on the clutch operating lever.

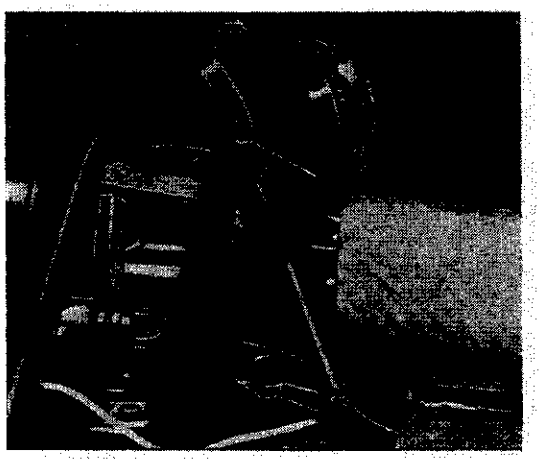
As the clutch linings wear, the clearance between release bearing and release ring is reduced. If there is no play at all, the clutch pressure is reduced which can lead to clutch slippage and the linings becoming burnt.

Adjusting

1 - Grip the clutch cable tightly with combination pliers and adjust the clutch by turning the wing nut until the pedal free-play is

a = .4—.8 in. (10—20 mm)

There will be clearance of about .08 in. (2 mm) between clutch lever and wing nut.



2 - After adjusting, ensure that the two lugs of the wing nut engage into the cutouts in the clutch lever.

3 - Depress clutch pedal several times and check play again.

4 - Lubricate threads of clutch cable, wing nut and countersunk hole in clutch lever with multipurpose grease.

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Repairing tapped holes

Damaged or broken threads, on cylinder head for example, can be made reserviceable by installing appropriate HELI-COIL thread inserts.

Sequence of operations

1 - Enlarge damaged tapped hole to nominal diameter.

2 - Cut new thread with appropriate HELI-COIL tap and clean.

HELI-COIL assortment for Volkswagen.

Thread sizes: M 6×1 (VW interference fit)
M 7×1
M 8×1.25 (VW interference fit)
M 10×1.5 (VW interference fit)
M 10×1.5
M 12×1.5
M 14×1.25
M 14×1.5

3 - Place insert into chamber of installing tool.

Caution

The tang of the insert must be at the bottom, as it engages the slot in the installing tool. As soon as the tang engages the slot in the tool, turn tool slowly until the insert is turned by the tensioning sleeve. Then place installing tool over newly tapped hole, screw thread insert in to required depth and withdraw installing tool. The insert should be $^1/_4$ to $1^1/_2$ threads below the surface.

4 - Break tang off thread insert with suitable pliers.

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When cylinder head studs are loose or have pulled out of the crankcase it is advisable to install threaded steel inserts (available under Part. No. ZVP 107101).

These inserts have a locking feature on the outside diameter for the crankcase material as well as on the inside diameter for the crankcase stud. Oil leakage is prevented by using closed end inserts for the open stud holes.

A special tool set (US 4415) has been developed to provide the proper interference fit between crankcase and insert.

1 - Place drill and tap jig in cylinder bore. Align the small hole with pilot into the stud hole and lock jig with wingnut.

2 - Drill through ($^{33}/_{64}$" diameter) on open holes, respectively drill blind holes to the depth of former thread. (To assure effective cutting into the magnesium crankcase and to avoid "sudden grabbing", the drill has to be dressed on the cutting lips to 90°, per sketch.)

3 - Repeat the same operation on the 3 remaining holes per cylinder.

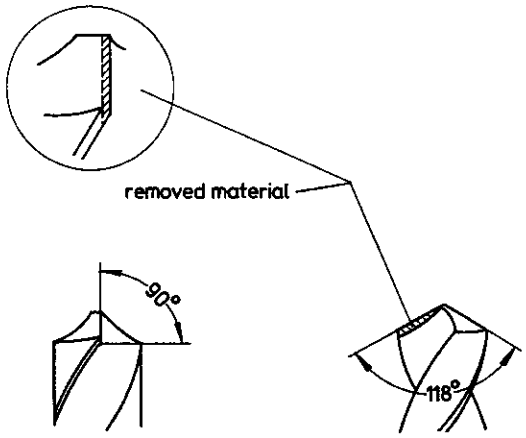
4 - Line up drill and tap jig with large diameter of pilot, lock with wingnut for tapping operation.

5 - Cut $^{9}/_{16}$" thread (modified) with special tap by hand or with a $^{3}/_{8}$" reversible impact wrench.

6 - Remove drill jig and install the appropriate insert with insert tool US 4415-6.

The correct installation depth is achieved when the distance between tool and cylinder sealing surface is 1 mm, i.e. when the upper surface of the insert is slightly below the surface of the cylinder seat.

7 - Lock insert with insert tool by driving the 4 "Kee's" into the crankcase material with hammer.



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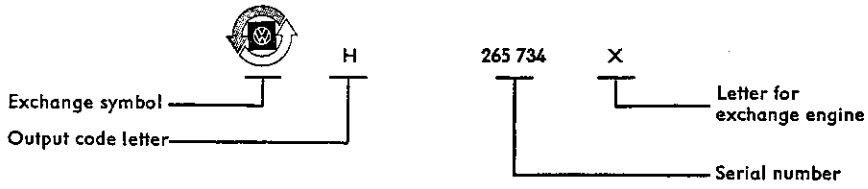
VW exchange engines are stamped with the exchange symbol and an exchange number. The exchange number consists of an output code number, a serial number and the letter X for exchange engine. Before October 1968 the letter X was not stamped on exchange engines.

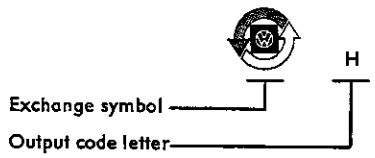
e. g. for VW exchange engines



VW exchange short block engines.

From April 1972 short block engines are only stamped with the exchange symbol and an output code letter. When a short block engine is installed, the number of the old engine must be transferred to the new engine.

e. g. for VW exchange short block engines



Special instructions for short block engines

New and exchange short block engines are protected against corrosion inside and out.

The outside of the engine is sprayed with a wax-based compound. In order to avoid odors and clutch trouble, the engines should be washed with a cold cleaning solution or a depreserving agent before being built up for installation. Seal all openings in crankcase and cylinder heads before washing. All cleaning agent that does not drip off should be blown off with compressed air. Afterward the needle bearing and felt ring in the gland nut must be greased again properly.

The inside treatment is done with anti-corrosion oil that is drained off after use. The residue of about 100 cc that is left in the engine, mixes with the initial filling of engine oil.

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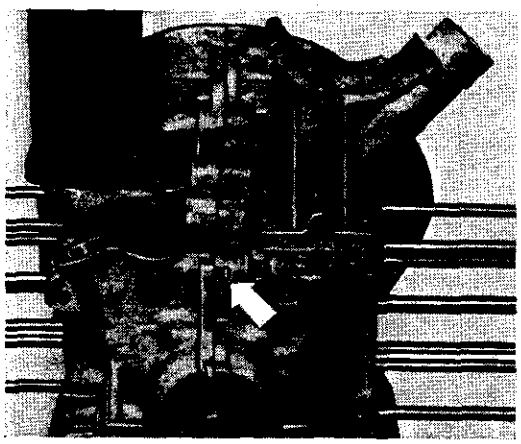

Repair instructions

An exchange engine can differ from a new engine. Because of reworking of various components during reconditioning a number of parts are oversize or undersize.

Note the following when repairing an exchange engine.

1 - **Crankcase**

a - Crankcases on which the joining surfaces have been reworked or the crankshaft bearing seats bored out are marked on the right case half (arrow).

P - Planed (standard dimensions)

O - Crankshaft bores oversize

Caution

Engines marked with an "O" have an oversize crankshaft pulley or fan wheels. Oversize crankshaft pulleys are marked with two circumferential grooves and oversize fan wheels with two 4 mm (0.157 in.) diameter countersink marks on the front.

b - When the cylinder seats on the crankcase have been reworked 0.8 mm (0.031 in.) spacer rings are installed between crankcase and cylinder gaskets.

These rings **must not** be left out because this would alter the compression.

2 - Crankshaft

Crankshafts with worn journals are ground down as follows:

	Main journals 1, 2, 3 and crankpins diameter mm (in.)	Main journal 4 diameter mm (in.)
1st undersize	54.75 (2.1555)	39.75 (1.5650)
2nd undersize	54.50 (2.1457)	39.50 (1.5551)
3rd undersize	54.25 (2.1358)	39.25 (1.5453)
4th undersize	54.00 (2.1259)	39.00 (1.5354)

The following table shows which crankshaft bearings are to be installed with reground shafts and bored out crankcases.

Standard

Crankcase bores	Bearings 1, 2 and 3 = 65 mm (2.5590 in.) Bearing 4 = 50 mm (1.9685 in.)			
Crankshaft	1st undersize mm (in.)	2nd undersize mm (in.)	3rd undersize mm (in.)	4th undersize mm (in.)
Bearings 1, 2 and 3 and crankpins	54.75 (2.1555)	54.50 (2.1457)	54.25 (2.1358)	54.00 (2.1259)
Bearing 4	39.75 (1.5650)	39.50 (1.5551)	39.25 (1.5453)	39.00 (1.5354)
		Spare part No.		
SP Set	111 198 463	111 198 465	111 198 467	111 198 469
consisting of:				
Crankshaft bearings 1	113 105 507 A	113 105 513 A	113 105 519 A	113 105 525 A
2	131 105 537	131 105 543	131 105 549	131 105 555
3	113 105 567	113 105 573	113 105 579	113 105 585
4	021 105 597	021 105 603	021 105 609	113 105 615
Connecting rod bearings	113 105 707	113 105 713	113 105 719	113 105 725

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Oversize

Crankcase bores	Bearings 1, 2 and 3 = 65.50 mm (2.5786 in.) Bearing 4 = 50.50 mm (1.9881 in.)		
Crankshaft	Standard/mm (in.)	1st undersize/mm (in.)	2nd undersize/mm (in.)
Bearings 1, 2, 3 and crankpins	55.00 (2.1653)	54.75 (2.1555)	54.50 (2.1457)
Bearing 4	40.00 (1.5748)	39.75 (1.5650)	39.50 (1.5550)

		Spare part No.	
SP Set	111 198 471	111 198 473	—
consisting of:			
Crankshaft			
bearings 1	113 105 503 D	113 105 509 D	113 105 515 A
2	131 105 533	131 105 539	113 105 545
3	113 105 563	113 105 569	113 105 575
4	113 105 593 A	113 105 599 A	113 105 605
Connecting rod bearings	113 105 701	113 105 707	113 105 713
Crankshaft bearing 1 (with thicker thrust shoulder)	113 105 503 A	113 105 509 A	—

Caution

Up to January 1973 the crankshaft and connecting rod bearings had always been the same undersizes.

From January 1973 the crankshaft and connecting rod bearing undersizes could differ.

e. g. crankshaft bearings = 1st undersize and the connecting rod bearings = 2nd undersize.

3 - **Camshaft**

a - Worn camshaft bearing journals are reground to an undersize of 24.75 mm (0.9744 in.).

b - The camshaft bores in the crankcase are bored out to 28.00 mm (1.1023 in.) if necessary.

The following camshaft bearing shells are used.

	Standard	(oversize)
Crankcase bores	27.5 mm (1.0826 in.)	28.00 mm (1.1023 in.)
	(undersize)	(Standard)
Camshaft journals	24.75 mm (0.9744 in.)	25.00 mm (0.9842 in.)

	Spare part No.	
SP Set	111 198 543	111 198 542
consisting of:		
Camshaft		
bearings 1	113 101 503	113 101 507
2	113 101 513	113 101 517
3 left	113 101 523 A	113 101 527
3 right	113 101 524	113 101 528

4 - Oil pressure valves

The bores in the crankcase for the oil pressure control and pressure relief valves are bored out where necessary and oversize plungers installed.

Standard plunger, diameter = 16.0 mm (0.6299 in.)
Oversize plunger, diameter = 16.5 mm (0.6496 in.)

5 - Cylinder head

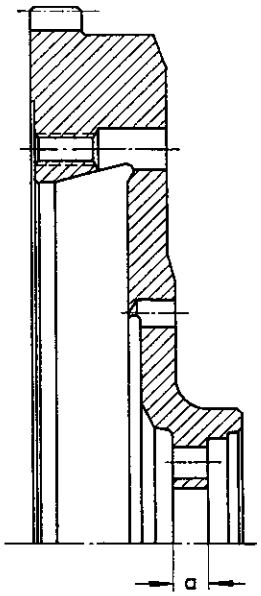
When the cylinder seats in the head have been reworked, a 1 mm (0.0393 in.) thick spacer ring is fitted between cylinder and head with effect from October 1971.

Older engines may have 0.8 mm (0.0314 in.) and 1.5 mm (0.0590 in.) thick spacer rings.

If the rings have to be replaced during a repair, watch the ring thickness as otherwise the compression will be altered.

6 - Gland nut — Flywheel

The various flywheel reworking operations include the machining of the crankshaft seating which reduces the thickness of the flange "a". When installing such flywheels, note the length of the dowels and gland nut.



The following dowels and gland nuts are used with reworked flywheels:

Flywheel flange thickness "a" mm (in.)	Dowel mm (in.)	Shim mm (in.)	Gland nut shaft — length mm (in.)
6.2—6.7 (0.244—0.263)	111 105 277 A 12.5 (0.492)	—	111 105 305 DX*) 24 (0.944)
6.2—6.7 (0.244—0.263)	111 105 277 A 12.5 (0.492)	111 105 297 A 1.4 (0.055)	111 105 305 D 25 (0.984)
6.7—7.2 (0.263—0.283)	113 105 277 14.0 (0.551)	—	111 105 305 D 25 (0.984)
7.2—8.0 (0.283—0.314)	113 105 277 14.0 (0.551)	—	111 105 305 E 27 (1.062)

*) This gland nut is not available as a spare part. Use gland nut with 25 mm (0.984 in.) long threaded portion and shim 111 105 297 A.

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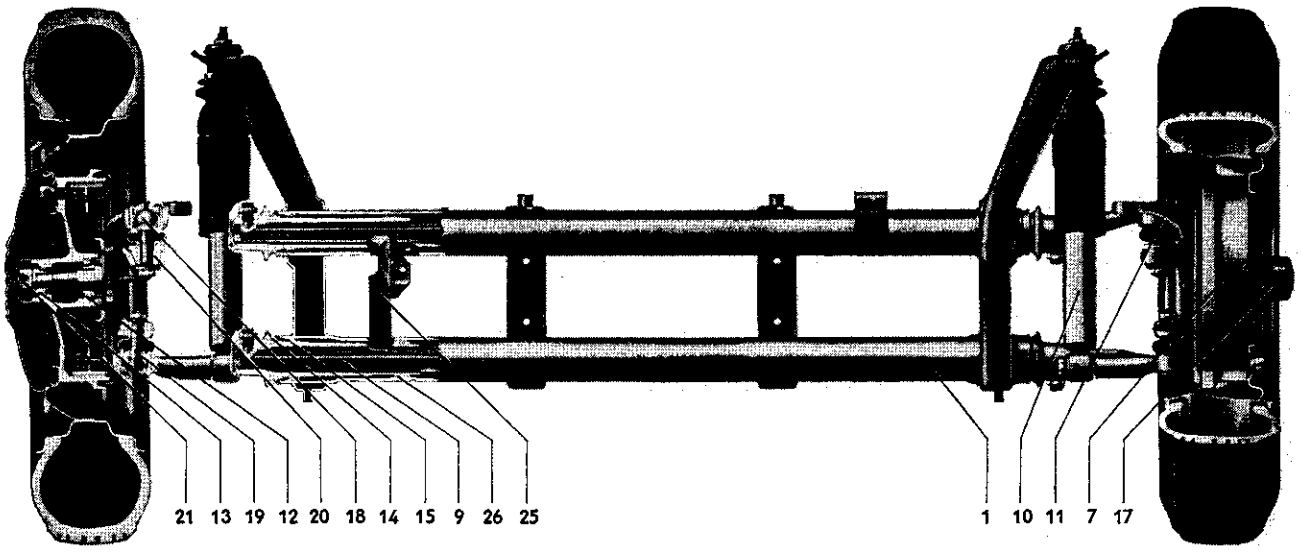
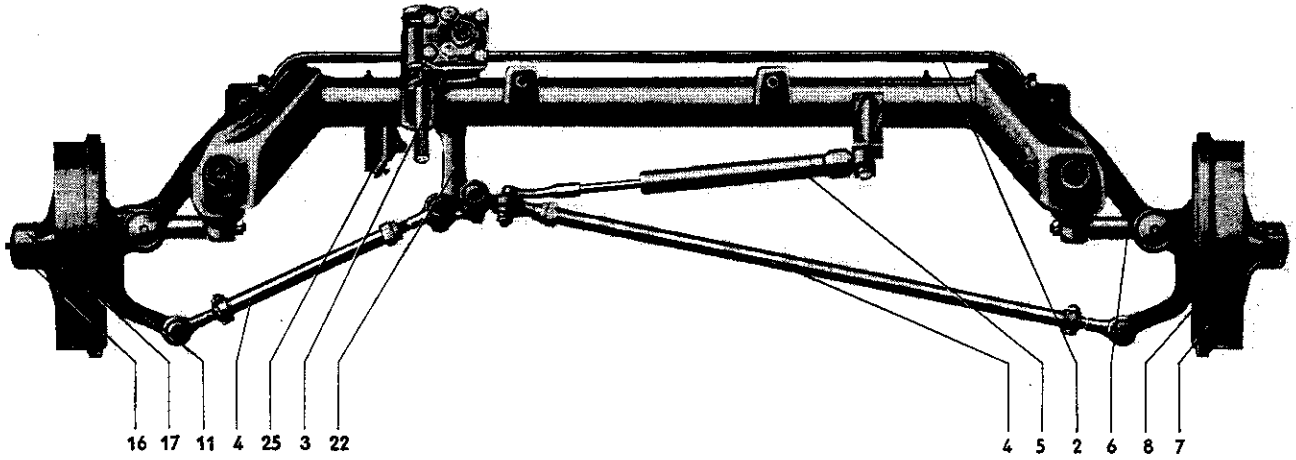
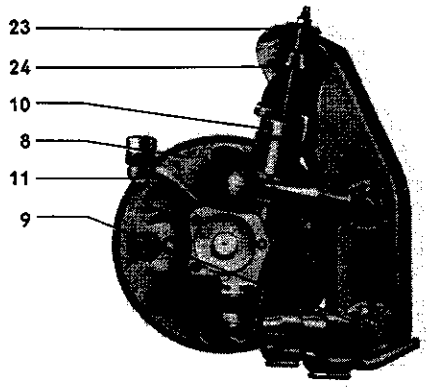
Section V

Front Suspension and Steering





1 - Front axle beam
2 - Stabilizer bar
3 - Steering gear
4 - Tie-rods
5 - Steering damper
6 - Torsion arm
7 - Brake drum
8 - Brake backing plate
9 - Torsion bar
10 - Shock absorber
11 - Steering knuckle
12 - Inner wheel bearing
13 - Outer wheel bearing
14 - Torsion arm seal
15 - Torsion arm needle bearing
16 - Speedometer cable
17 - Dust cap
18 - Upper ball joint
19 - Lower ball joint
20 - Eccentric bush for camber adjustment
21 - Clamp nut for wheel bearing adjustment
22 - Steering drop arm
23 - Damper ring
24 - Rubber stop
25 - Wheel lock stop
26 - Plastic seating and metal bushing



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The main design features of the front axles on Type 1 and 2 vehicles are the same. The basic construction described therefore, is of the Type 1 axle.

Both front axles can be replaced as complete units and are readily detachable from the frame head or side members. The wheels are individually suspended and thus independently sprung.

Front axle beam

The front axle beam consists of two tubes which are rigidly joined together by welded-on end plates and house the torsion bars. When damaged, the axle beam should be replaced complete. Do not attempt to repair any damage by straightening or welding.

Springing and wheel suspension

In each axle tube is a torsion bar consisting of a pack of separate leaves (Type 1: 10 leaves, Type 2: 9 leaves). The torsion bars are located in an anchor bush in the center and secured with a headless setscrew. The torsion arms are pushed onto the ends of the torsion bars and are also secured with headless setscrews.

A stabilizer bar is attached to the lower torsion arms with rubber blocks and clamps.

Progressively acting, hydraulic, telescopic shock absorbers prevent the vehicle from bouncing and pitching when driving over poor roads. The shock absorbers are designed to match the vehicle suspension characteristics so only shock absorbers of the specified type may be installed. They are attached to the axle end plate at the top and to a pin in the torsion arm at the bottom.

Maintenance-free ball joints connect the torsion arms to the steering knuckle. The ball joints are pressed into the torsion arm (additionally peened on Type 2). They are joined to the steering knuckle by a tapered stud and a nut. The stud points upwards on the lower ball joint of the Type 1 and downward on the Type 2. The ball heads of the joints are fitted in wear-resistant plastic shells and lubricated with a special grease to assure ease of movement and long service life. Sturdy rubber boots secured to the joint body or stud with steel clips protect the joints against moisture and dirt.

The brake drums (Types 1 and 2) or the brake discs/wheel hub (Karmann Ghia only) are cast in one piece and the wheel bearings are of the taper roller type.

Front axle with ball joints, Types 1 and 2

The main design features of the front axles on Types 1 and 2 vehicles are the same. The basic construction is therefore described for the Type 1 axle.

Both front axles can be replaced as complete units and are readily detachable from the frame head or side members.

Front axle beam

The front axle beam consists of two tubes which are rigidly joined together by welded end plates and house the torsion bars. When damaged, the axle beam should be replaced complete. Do not attempt to repair any damage by straightening or welding.

Springing and wheel suspension

In each axle tube there is a laminated torsion bar consisting of flat steel leaves (Type 1:10 leaves, Type 2: 9 leaves). The torsion bars are located in an anchor bushing in the center and secured with a setscrew. The torsion arms are pushed on to the ends of the torsion bars and also secured with setscrews.

A torsion bar stabilizer is attached to the lower torsion arm with rubber mounting blocks and retaining clips.

Progressive acting, hydraulic, telescopic shock absorbers prevent the vehicle from bouncing and pitching when driving over uneven road surfaces. The shock absorbers are designed to match the vehicle suspension characteristics so only shock absorbers of the specified type may be installed. They are attached to the axle end plate at the top and to a stud in the torsion arm at the bottom.

Maintenance-free ball joints connect the torsion arms to the steering knuckle. The ball joints are pressed into the torsion arm (peened as well on Type 2) and are joined to the steering knuckle by a tapered stud and a nut. The stud points upward on the lower ball joint of the Type 1 and downward on the Type 2. The ball-shaped heads of the joints are located in wear-resistant plastic shells and lubricated with a special grease to give ease of movement and long service life. Sturdy rubber boots secured to the joint body or stud with steel retaining rings protect the joints against moisture and dirt.

The brake drums or the brake discs and wheel hub on Type 1 vehicles are cast in one piece and the wheel bearings are the tapered roller type.

Front axle with ball joints Type 1, Model 181

The front axle of the Type 1, Model 181 is basically the same as the axle of the Type 1/Sedan 111. The Type 1, Model 181 has modified steering knuckles, a greater ground clearance, lower steering ball joints with studs facing downward, stronger torsion arms and end plates. The front axle of the Type 1, Model 181 is also provided with additional supports attached to the frame.

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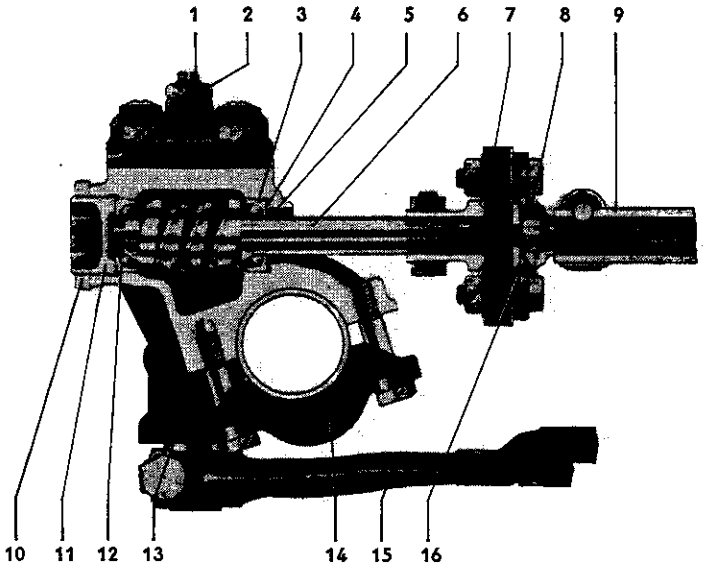
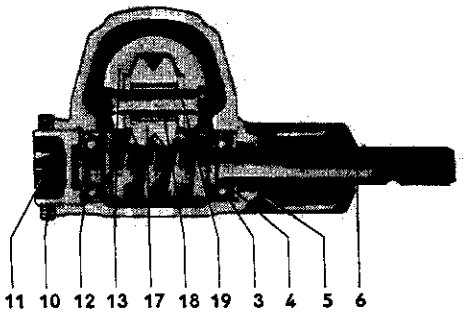
All Type 1 and 3 vehicles are fitted with a roller type steering gear. The steering column is mounted inside a column tube attached to the body. The column is connected to the steering gear by means of coupling with a rubber/fabric disc. The steering case is secured to the axle tube with a mounting clamp. Adjustable, maintenance-free tie-rods located behind the axle beam transmit the steering movements to the road wheels. A hydraulic steering damper helps to reduce road shocks.

The steering housing contains a shaft to which a roller, fitted in a needle bearing, is mounted. This roller engages in an adjustable steering worm spindle. The steering worm spindle is mounted in two thrust ball bearings. The roller is held in bronze bushings in the housing on one side, in the housing cover on the other. The spindle is adjusted axially by a washer fitted under the upper bearing. The steering roller shaft and thus the depth of engagement of the roller in the worm is adjusted with a screw in the housing cover.

Due to a design feature, the roller steering is only free of play in a certain range in the central position. When the steering is moved with the vehicle stationary, the play between spindle and roller increases steadily. The play is not noticed when the vehicle is in motion because of the self-centering action of the wheels.



1 - Roller shaft adjustment screw
2 - Lock nut
3 - Upper worm bearing
4 - Adjusting shim for worm
5 - Oil seal for worm
6 - Steering worm
7 - Coupling disc
8 - Flange for coupling disc
9 - Steering column
10 - Lock nut
11 - Worm adjusting screw
12 - Lower worm bearing
13 - Steering roller shaft
14 - Mounting clamp
15 - Drop arm
16 - Ground connection terminal
17 - Steering roller
18 - Roller needle bearings
19 - Roller support pin



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Steering linkage, Type 1/Sedan 111 and Type 3

Type 1 / Sedan 111 and Type 3 vehicles have two maintenance-free tie rods which are located in a protected area behind the front axle. Both tie rods are adjustable. The movements of the drop arm are transmitted to the wheels by the tie rods. Road shocks are damped by a hydraulic steering damper. The damper is attached to the front axle beam and the tie rod or, on the Type 3, to the drop arm.

Steering linkage, Type 1 / Sedan 113 and Type 4

The Type 1 / Sedan 113 and Type 4 vehicles have three maintenance-free tie rods. The center tie rod is fixed in length and the two outer ones are ajustable.

The movements of the drop arm are transmitted by the center tie rod to the idler arm which is mounted in bonded rubber bushings in the idler arm bracket.

Two adjusting bolts in the bracket limit the movement of the idler arm and thus the wheel lock to left and right. The idler arm bracket is attached to the side member with three bolts.

The hydraulic steering damper is attached to the front axle carrier and the center tie rod.

Steering linkage, Type 2

On the Transporter, the drop arm transmits the movements via an adjustable draglink to the swing lever and two maintenance-free tie rods to the wheels. One tie rod is adjustable and the other is fixed in length. The hydraulic steering damper is attached to the front axle beam and the swing lever.

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Torque specifications for front axle and steering Type 1 / Sedan 111 and Model 181

Location	Description	Thread	Quality grade	Tensile class	mkg	lb ft
Front axle to frame	bolt	M 12×1.5	8 G	8.8	5.0	36
Steering damper to axle	bolt	M 10	8 G	8.8	4.0—4.5	29—32
Steering damper to tie rod	nut	M 10×1	6 G	8	2.5	18
Shock absorber to axle beam side plate	nut	M 10 M 12×1.5	6 G 10 K	6 10.9	2.0 3.0—3.5	14 22—25
Shock absorber to lower torsion arm	nut	M 10	6 G	8	3.0—3.5	22—25
Tie rod to steering knuckle and drop arm	slotted nut	M 12×1.5 M 10×1	8 G	10 8	3.0[1]) 2.5[1])	22[1]) 18[1])
Setscrew for torsion bar	socket hd. screw	M 14×1.5	CK 15 Kv		4.0—5.0	29—36
Locknut for setscrew	nut	M 14×1.5	6 G		4.0—5.0	29—36
Steering ball joint to steering knuckle	self-locking nut	M 12×1.5	6 S	8	5.0—7.0	36—50
Screw for wheel bearing clamp nut	socket hd. screw	M 7	10 K	10.9	1.0—1.3	7—10
Caliper to steering knuckle	bolt	M 10	10 K	10.9	4.0	29
Steering gear to front axle	bolt	M 10	8 G	8.8	2.5—3.0	18—22
Worm shaft to steering coupling	bolt	M 8	10 K	10.9	2.0—2.5	14—18
Steering wheel to column	nut	M 18×1.5	6 G		5.0	36
Drop arm to roller shaft	bolt	M 12×1.5	8 G	8.8	7.0	50
Cancelling ring to steering wheel	fillister hd. screw	AM 3.5	8 G	8.8	0.5	3.5
Lock nut for tapered ring on tie rod	nut	M 14×1.5	6 G		2.5	18
Bolt in clamp for tie rod	bolt	M 8×1	8 G	8.8	1.5	11
Steering column tube mounting plate to instrument panel	bolt with groove	M 8	8 G	8.8	1.5	11
Steering coupling flange to disc	nut	M 8	6 G	8	1.5	11
Cover for steering gear housing	bolt	M 8×1.25	8 G		2.0—2.5	14—18
Locknut for drop arm shaft adjusting screw	nut	M 10×1	5 S		2.5	18
Locknut for worm spindle adjusting screw	nut	M 35×1.5	9 S K 20		5.0—6.0	36—43
Column to coupling flange	bolt	M 8	10 K	10.9	1.5	11
Bracket to front axle (Model 181)	nut	M 12×1.5	10 K	10.9	5.5—6.0	40—43
Front axle bracket to frame (Model 181)	nut	M 10	8 G	8.8	5.5—6.0	40—43

[1]) and turn further to cotter pin hole

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Most front axle repairs can be performed with the axle on the vehicle.

When the axle is taken off, it should be mounted in the repair stand with VW 309 and VW 309c.

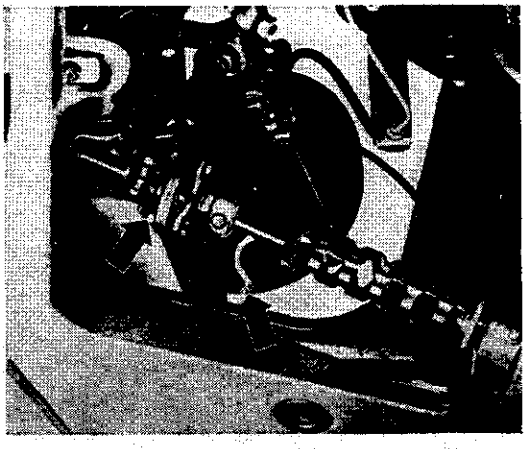
If it is suspected that the axle is bent or distorted due to accident damage, the axle tubes can be checked with a straight edge. Do not attempt to straighten the axle beam.

Removing

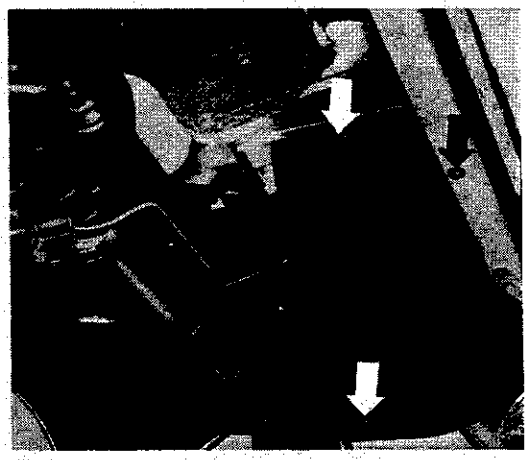
1 - Pull off fuel hose and plug it.

2 - Remove fuel tank.

3 - Disconnect horn ground wire and remove screws holding steering column coupling (arrows).



4 - Remove deflector plate if necessary (arrows).



5 - Remove bolts (arrows) attaching reinforcement plates to axle and frame and take reinforcement plates off.

6 - Take cotter pin out of speedometer cable in left wheel and pull cable out of steering knuckle.

7 - Detach brake hoses at brackets and seal lines with dust caps from bleeder valves.

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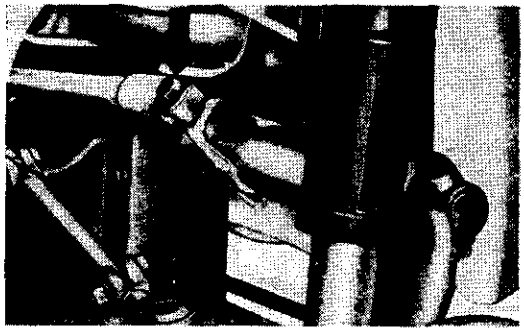
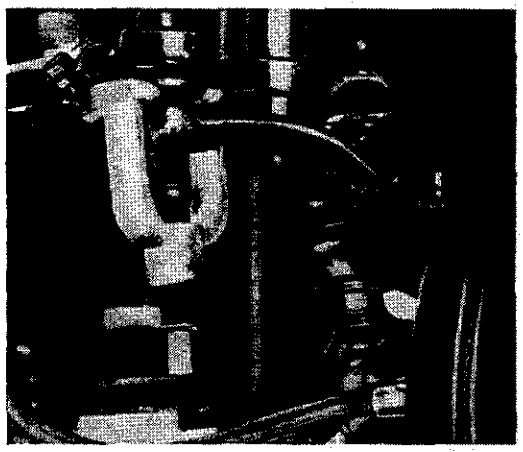
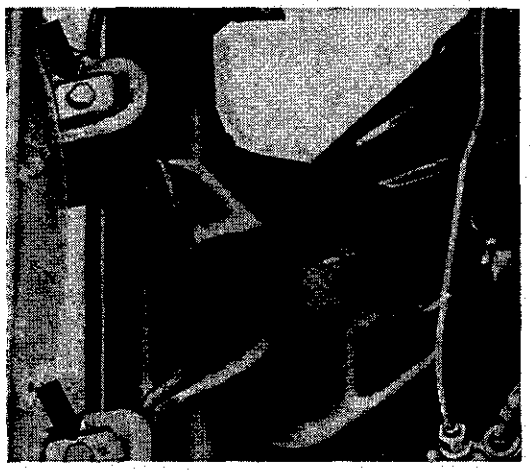


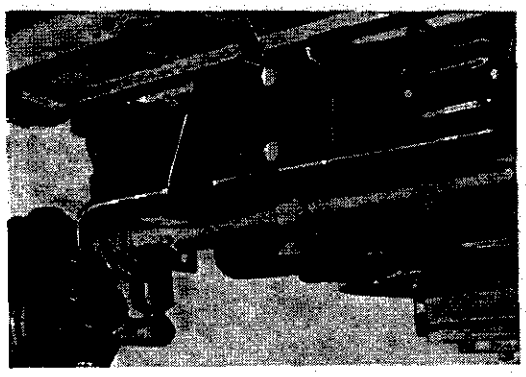
8 - Remove steering damper from bracket on front axle beam (arrow).



9 - Remove cotter pins and nuts holding tierod ends on long tierod and press ends out with VW 266h and remove tierod together with steering damper.



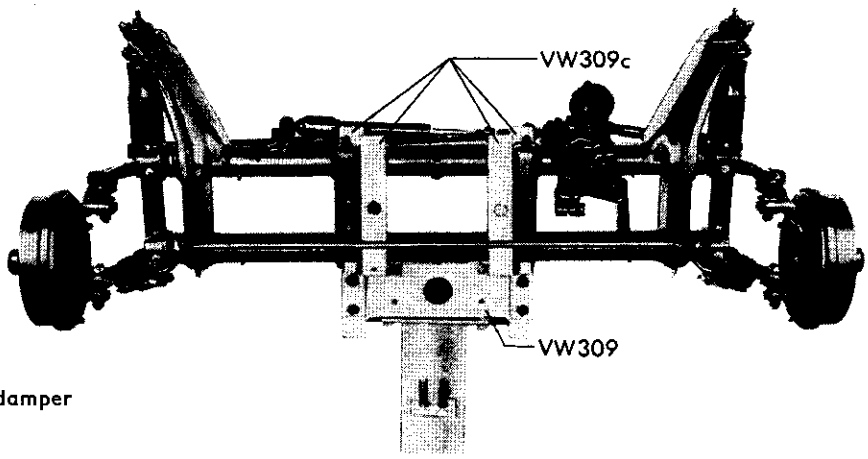
10 - Remove two body mounting bolts (arrows).



11 - Loosen four bolts securing front axle to frame head.

12 - Position floor jack with adaptor, take bolts out and remove axle.

It is advisable to disassemble the axle in the following sequence:



Remove:
1 - tierods and steering damper
2 - steering gear box
3 - brake drums
4 - backing plates
5 - shock absorbers
6 - steering knuckles
7 - stabilizer bar
8 - torsion arms complete with ball joints
9 - torsion bars
10 - needle bearings
11 - metal bushings for torsion arms

Instructions on the assembly of the axle are given in the following sections.

Installing

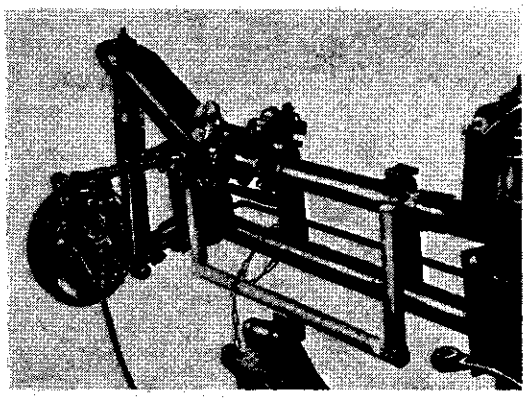
Note the following points:

1 - Place axle in adaptor and position it at the correct angle for installation with the aid of the chain. Place rubber paddings on each of the threaded bushings.

2 - Use new lockwashers on axle bolts.

3 - Tighten axle securing bolts to the correct torque.

Do not forget bracket for deflector plate.



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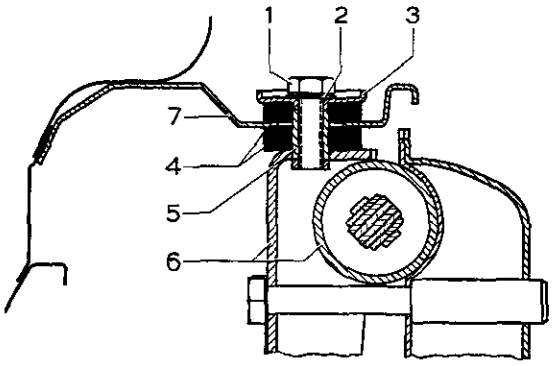
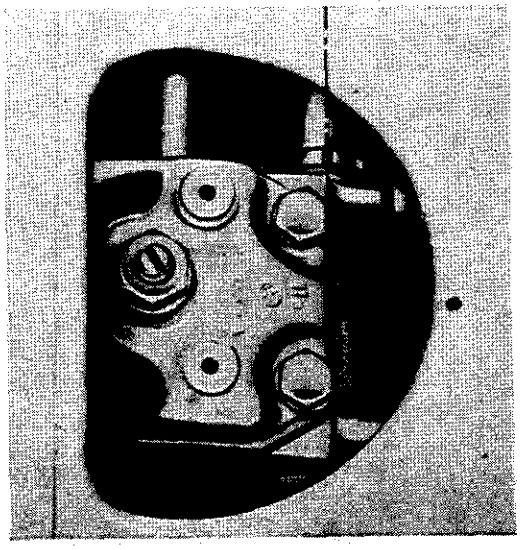


1 - Bolt
2 - Spring washer
3 - Washer
4 - Rubber pad
5 - Threaded bushing
6 - Front axle
7 - Body

4 - Tighten body to axle bolts to correct torque. Do not forget rubber pads, washers and lock-washers.

5 - Tighten tierod end nuts to correct torque and install cotter pins.

6 - Install steering damper bolt in bracket on front axle with a new locking plate, tighten bolt to correct torque and lock it. The locking plate should be fitted so that the open end of the U shaped faces forward and the narrow angled part contacts the bracket.



7 - Set steering to center position with the marking ring and connect column to the steering coupling so that the spokes are horizontal.

8 - Install reinforcement plates and tighten bolts to correct torque.

9 - Install brake hoses. Make sure they hang down and are not twisted.

Check position of hoses over entire steering sweep.

10 - Bleed hydraulic system and adjust brakes.

11 - Check wheel alignment.

12 - Install deflector plate if necessary.

Tools

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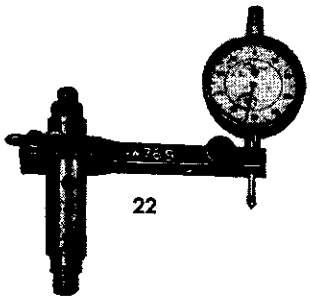
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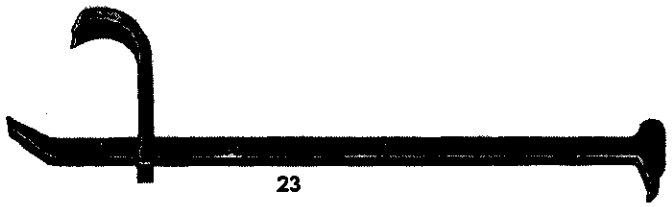
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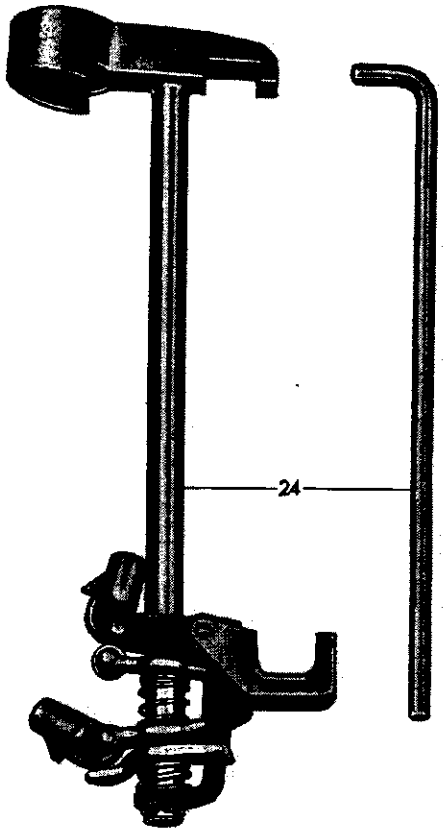
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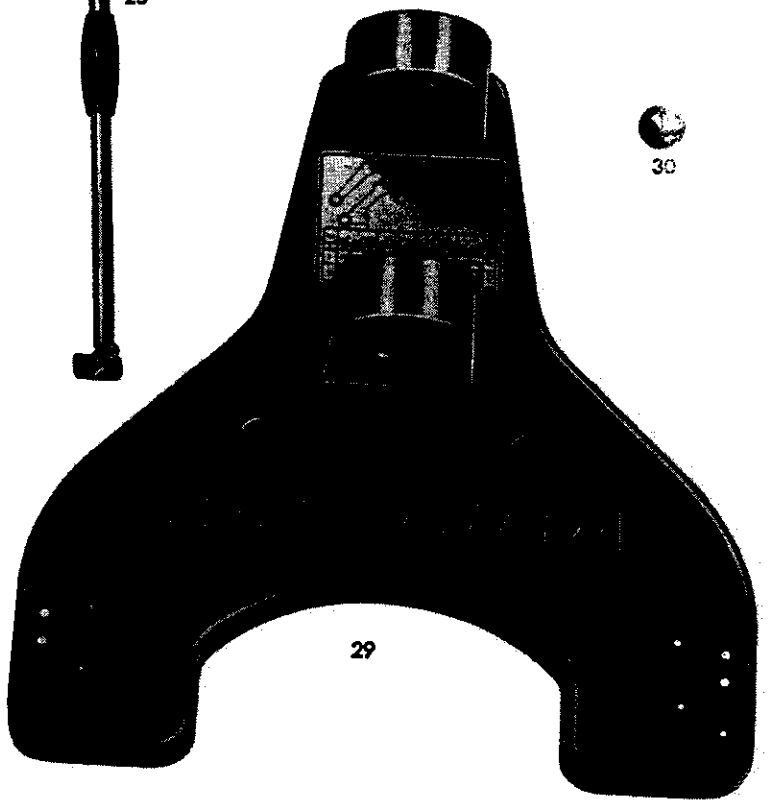
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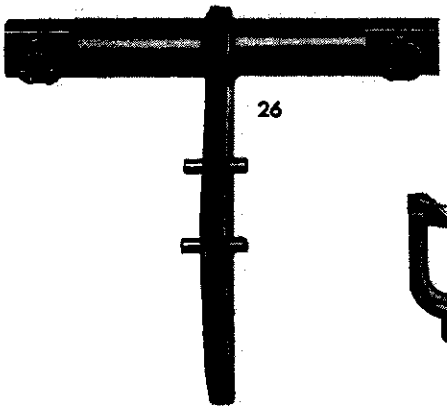
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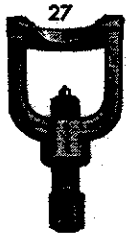
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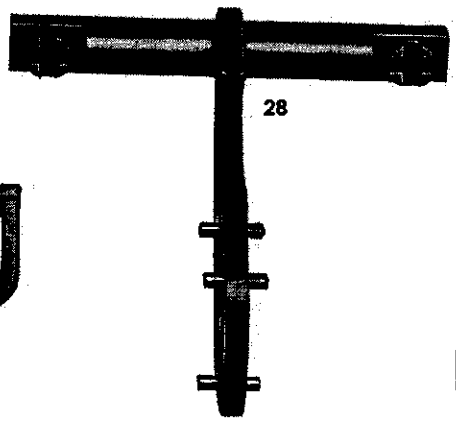
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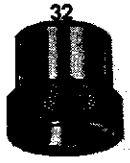
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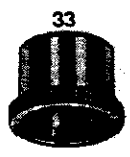
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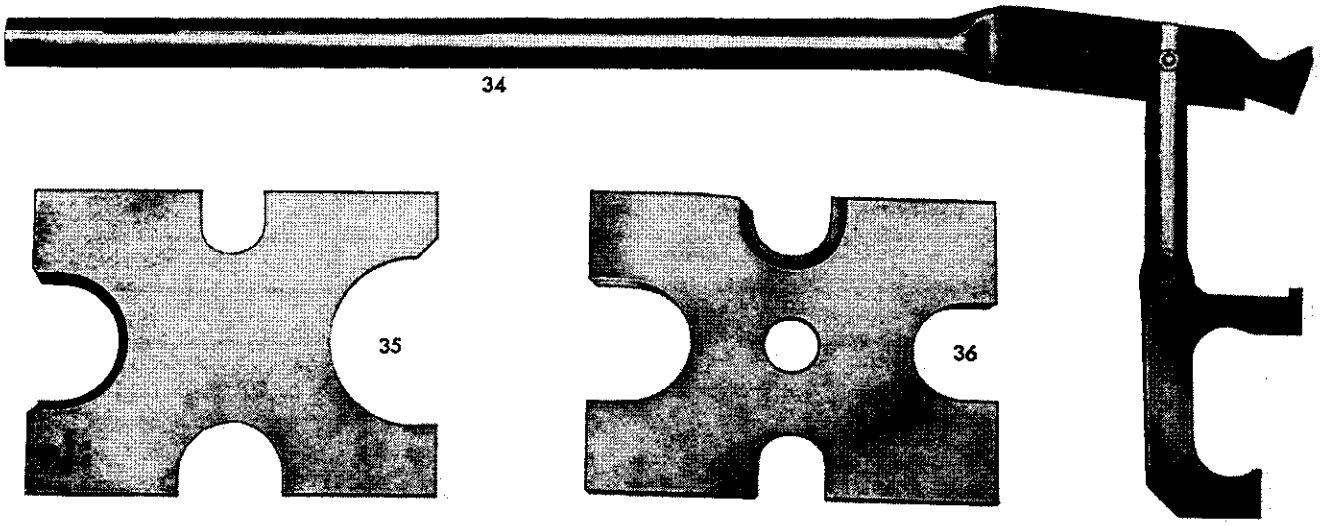

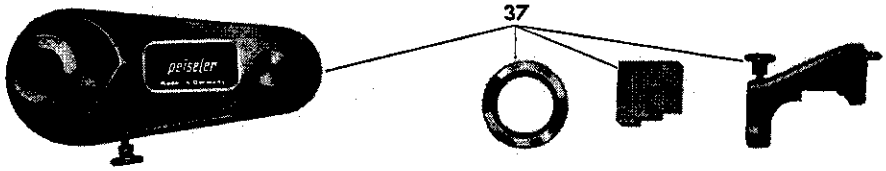

No.	Description	Tool	Explanation
1	Special wrench 36 mm	VW 179	
2	Press tool	VW 432	
3	Ring	VW 440	
4	Ring	VW 429	
5	Multi-purpose tool	VW 771	
6	Washer	VW 771—21/7	for lower needle bearing
7	Washer	VW 771—21/6	for upper and lower metal bushings
8	Washer	VW 771—21/3	for upper needle bearing
9	Press tool	VW 431	
10	Drift	VW 767	
11	Press tool	VW 407	
12	Drift	VW 768	
13	Fitting sleeve	VW 778	

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No.	Description	Tool	Explanation
14	Press tool	VW 408a	
15	Press tool	VW 412	
16	Press tool	VW 433	
17	Tube	VW 418a	
18	Ball joint removing tool	VW 267a	
19	Tube	VW 415a	
20	Fitting sleeve	VW 780-1	for steel retaining ring (lower ball joint)
21	Fitting sleeve	VW 780-2	for steel retaining ring (upper ball joint)
22	Dial gauge bracket and dial gauge	VW 769	for bearing adjustment
23	Hub cap puller	VW 637/2	
24	Clamping device	VW 655/3	
25	Inside measuring gauge		standard type, range 24—60 mm for metal bushings and needle bearing seats
26	Steering knuckle gauge	VW 258 mm	
27	Tie-rod end extractor		commercial type
28	Steering knuckle gauge	VW 258h	
29	Torsion arm test plate	VW 282d	
30	Test point for plate	VW 282d	
31	Bushing	VW 282d/14	
32	Bushing	VW 282d/15	
33	Bushing	VW 282d/13	
34	Lever	VW 281a	for testing ball joint play
35	Plate	VW 402	
36	Plate	VW 401	
37	Measuring bracket	VW 258k or 258p	

No.	Description	Qty.	Note when disassembling	Note when assembling	Special instructions see
72	Metal bushing for torsion arms	4	wear limit 37.38 mm (1.47 in.) knock out with VW 771—21/6	knock new upper bushing in with VW 768 and lower bushing with VW 767	V 4.1/9
73	Grease fitting	4	clean before greasing	turn in, do not knock in	
74	Axle beam	1		replace if bent, do not attempt to straighten	
75	Bolt M 8×25	2		turn in so far that there is a gap of 10±1 mm (0.4±0.004 in.) between upper torsion arm and tire. Steering must be in full lock position and front end fully raised	
76	Nut M 8	2			

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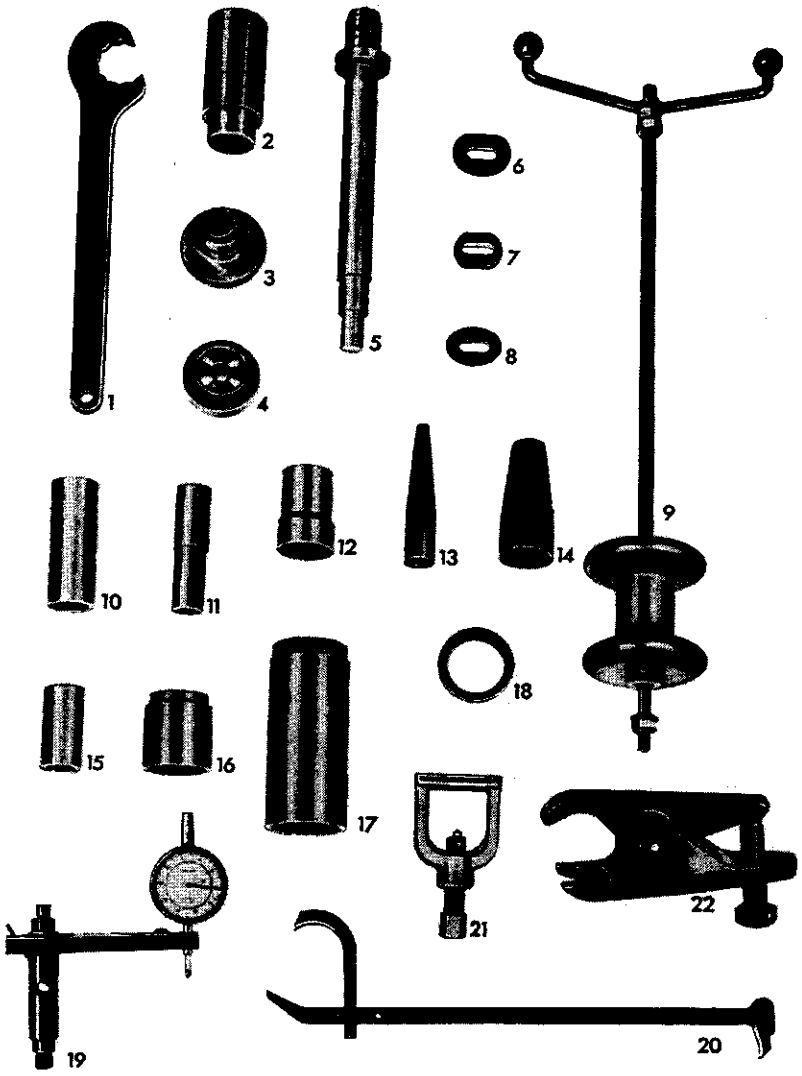
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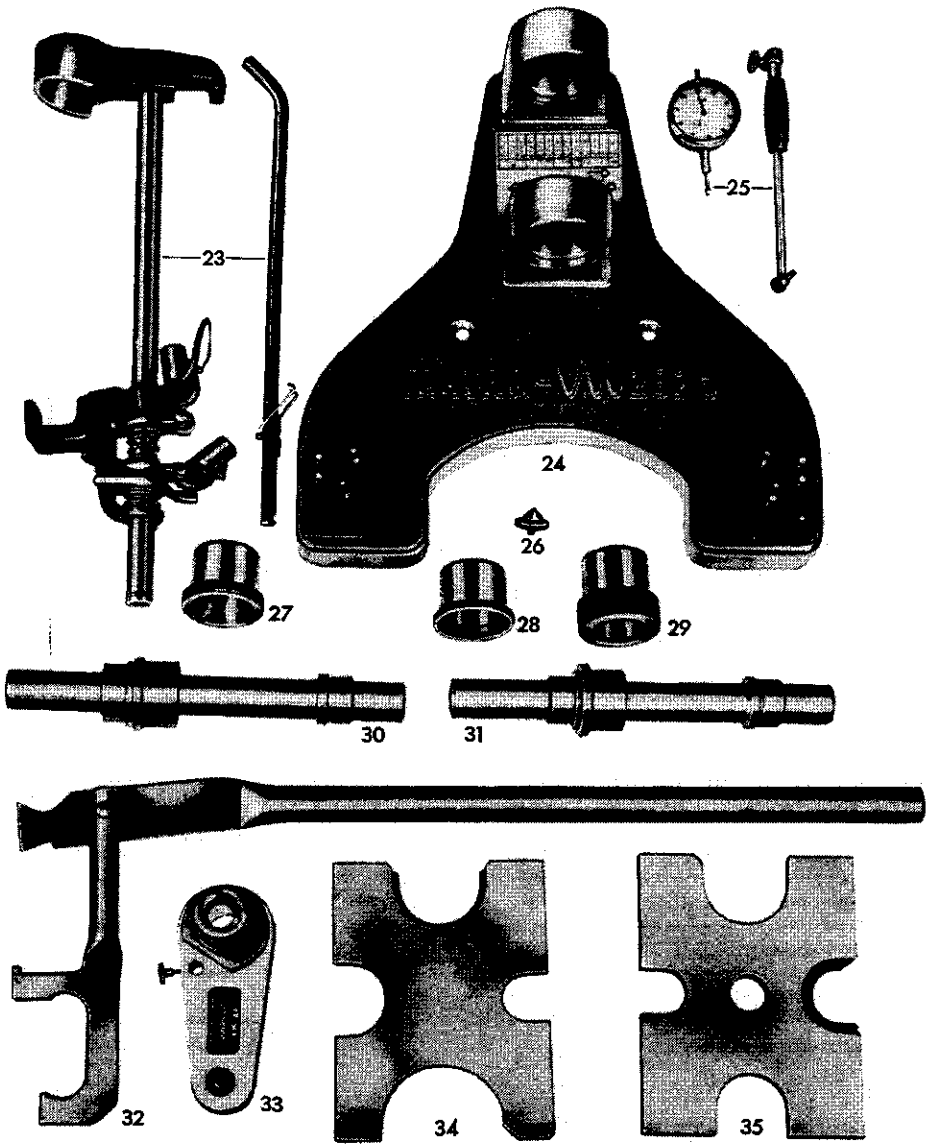

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No.	Description	Tool	Explanation
1	Special wrench 36 mm	VW 179	
2	Press tool	VW 432	
3	Press tool	VW 412	
4	Press tool	VW 433	
5	Press tool	VW 408a	
6	Washer	VW 771—21/7	for lower needle bearing
7	Washer	VW 771—21/6	for upper and lower needle bearings
8	Washer	VW 771—21/3	for upper needle bearing
9	Multi-purpose tool	VW 771	
10	Tube	VW 416b	
11	Tube	VW 421	
12	Press tool	VW 454	
13	Fitting sleeve	VW 778	
14	Fitting sleeve	VW 780	marked "oben"
15	Tube	VW 418a	
16	Fitting sleeve	VW 455	
17	Tube	VW 415a	
18	Ring	VW 429	
19	Dial gauge bracket and dial gauge	VW 769	
20	Dust cap puller	VW 637/2	
21	Tie rod end extractor		local purchase item
22	Ball joint removing tool	VW 267a	
23	Clamping device	VW 655/3	
24	Torsion arm test plate	VW 282d	
25	Inside measuring gauge		local purchase item, range 25—60 mm (0.984—2.362 in.) for metal bushings and needle bearing seats
26	Test point for plate (part of VW 282d)		
27	Bushing	VW 282d/15	
28	Bushing	VW 282d/13	
29	Bushing	VW 282d/12	
30	Drift	VW 767	
31	Drift	VW 768	
32	Lever	VW 281a	for testing ball joint play
33	Measuring bracket	VW 258p	
34	Plate	VW 402	
35	Plate	VW 401	

No.	Description	Qty.	Note when disassembling	assembling	Special instructions see
30	Retainer, large	2	as for point 29	as for point 29	
31	Clip, small	2		hold clip with waterpump pliers to install retainer	V 4.2/5
32	Clip, large	2		as for point 31	V 4.2/5
33	Plate, small	2			
34	Plate, large	2			
35	Rubber mounting, small	2			
36	Rubber mounting, large	2			
37	Stabilizer bar	1			
38	Self-locking nut M 16×1.5	4		always use new nuts tighten to 5—7 mkg (36—50 lb ft)	V 4.1/4
39	Washer, small	2			
40	Washer, large	2			
41	Eccentric bushing for camber adjustment	2	press off upper ball joint with VW 267a	insert in knuckle lightly greased, **no grease in hole for ball joint stud.** In basic position, notch should point forward	V 4.1/4
42	Upper ball joint	2	press out of knuckle with VW 267a, out of torsion arm with VW 412, VW 415a, VW 416b and VW 401	press in with VW 412, VW 432, VW 433, VW 415a, VW 429, VW 402 and VW 401. Notch in joint must be aligned with notch in arm **Note** Check for oversize marking on torsion arm ("B")	V 4.1/4
43	Lower ball joint	2	press out of knuckle with VW 267a, out of torsion arm with VW 412, VW 418a, VW 415a, VW 421 and VW 401	press in with VW 412, VW 454, VW 455, VW 429, VW 415a, VW 402 and VW 401 as for No. 42	V 4.1/6
44	Ring for rubber boot	4		fit with VW 778, do not twist ring	V 4.1/6
45	Boot for lower joint	2		if boot is damaged, clean joint carefully and grease well with multi-purpose grease	V 4.1/6
46	Boot for upper joint	2		as for No. 45	
47	Ring for rubber boot	4		fit with sleeve VW 780 (marked "oben"), ring ends must be offset 60° from ball stud pivot direction	V 4.1/6
48	Plug	4		**always use new plugs,** screw them in, do not knock in	
49	Locknut	4		tighten to 4—5 mkg (28—36 lb ft)	
50	Setscrew for torsion bar	4		tighten to 4—5 mkg (28—36 lb ft)	
51	Torsion arm, upper	2	remove steering knuckle with drum	check for distortion with VW 282d	V 4.1/6
52	Torsion arm, lower	2	remove steering knuckle with drum and stabilizer	as for No. 51	

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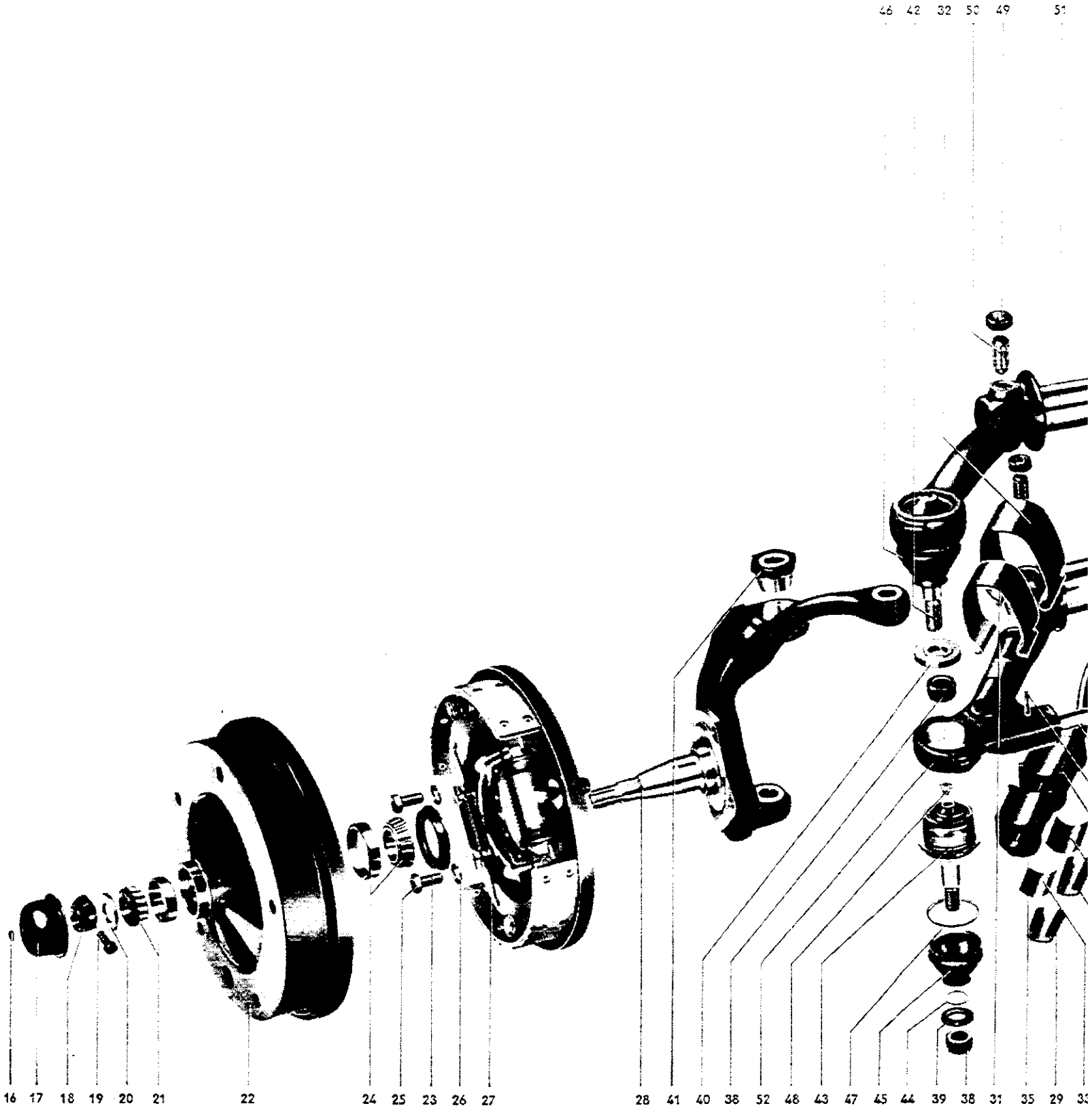
No.	Description	Qty.	Note when disassembling	assembling	Special instructions see
53	Pin	2			
54	Pin for shock absorber	2	drill broken pins out and ream hole	install oversize pin	V 4.2/6
55	Nut M 12×1.5	2		tighten to 4.0 mkg (28 lb ft)	
56	Lock washer 10.5	2			
57	Lock washer 12.5	2			
58	Nut M 10	2	tension upper torsion arm lightly with VW 655/3	tighten as far as possible	V 4.1/10
59	Plate for damper bushing	2			
60	Damper bushing	4			V 4.1/10
61	Pin for buffer	2			
62	Buffer	2			
63	Tube	2			
64	Shock absorber	2	tension upper torsion arm lightly with VW 655/3. Hold lower end of pin (No. 61) with water-pump pliers and remove nut	check shock absorber	V 4.1/10 V 4.2/9
65	Sleeve for rubber bushing	2	press out with VW 408a, VW 402 and VW 401	press in with VW 436a, VW 411, VW 416b, VW 402, VW 401. Coat VW 436a and sleeve lightly with glycerine	V 4.2/9
66	Rubber bushing	2	as for point 65	coat with talcum and press in flush in vise	
67	Torsion bar — 10 leaf	2		check for damage. Note number of leaves and arrangement, bind end with adhesive tape when installing	
68	Seal for upper torsion arm	2		replace if necessary	
69	Seal for lower torsion arm	2		replace if necessary	
70	Needle bearing, upper Standard size: 46.0 mm (1.574 in.) outside diameter Oversize: 46.2 mm (1.819 in.) outside diameter	2	knock out with VW 771 and washer VW 771—21/3	knock in with drift VW 768 until shoulder of drift makes contact. Note bearing dia., oversize is 0.2 mm (0.0078 in.) larger	V 4.1/9
71	Needle bearing, lower Standard size: 50.0 mm (1.968 in.) outside diameter Oversize: 50.2 mm (1.976 in.) outside diameter	2	knock out with VW 771 and washer VW 771—21/7	knock in with drift VW 767 until shoulder of drift makes contact. Note bearing dia., oversize is 0.2 mm (0.0078 in.) larger	V 4.1/9
72	Metal bushing for torsion arms	4	wear limit 37.38 mm (1.47 in.), knock out with VW 771 and washer VW 771—21/6	knock new upper bushing in with VW 768 and lower bushing with VW 767	V 4.1/9
73	Grea e fitting	4	clean before greasing	turn in, do not knock in	
74	Axle beam	1			
75	Bolt M 8×25	2		turn in so far that there is a gap of 10±1 mm (0.393± 0.039 in.) between upper torsion arm and tire when wheel is locked hard over and on full rebound	V 8.1/6
76	Nut M 8	2		tighten so 1.5 mkg (11 lb ft)	



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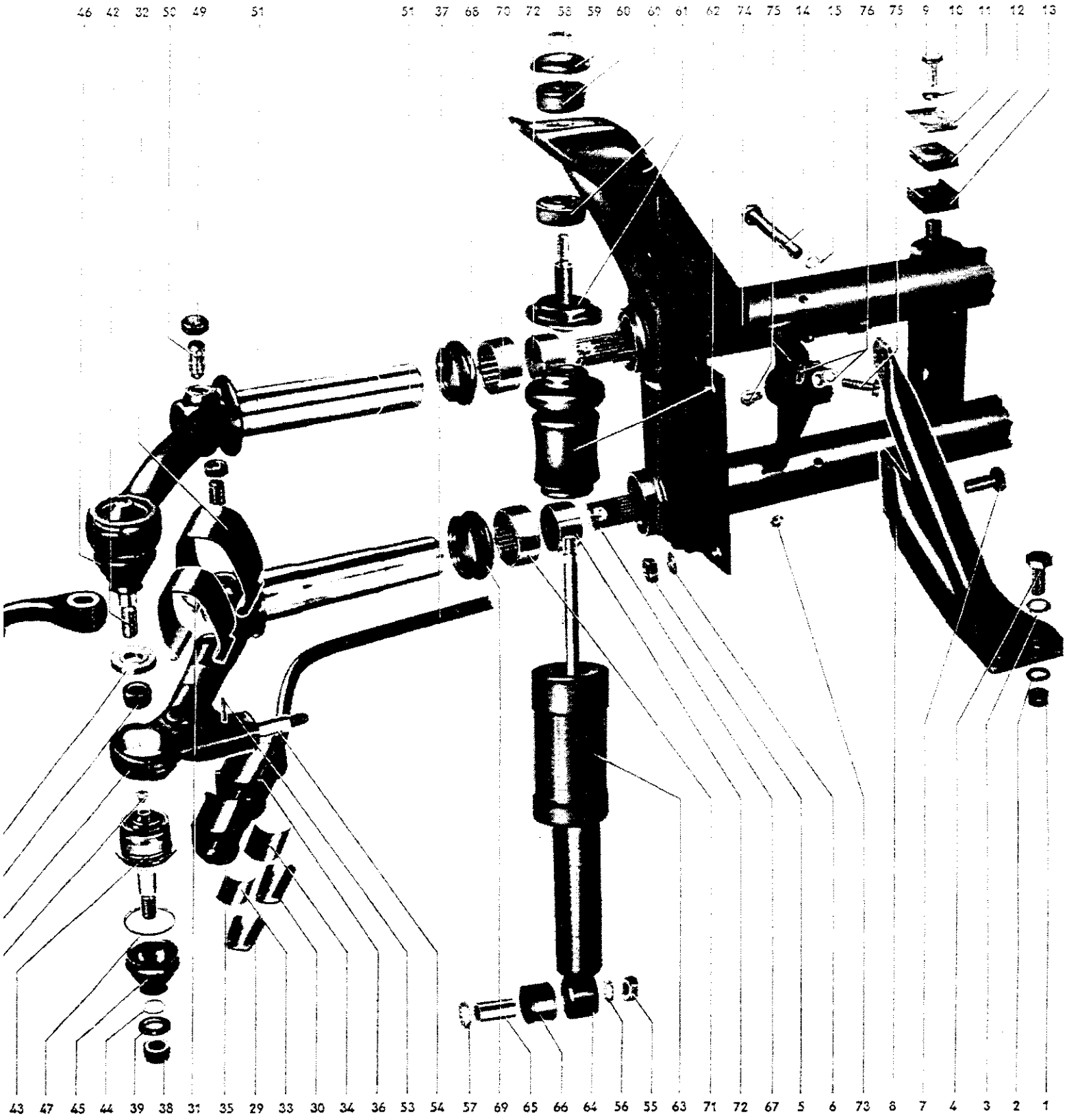
V4.1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51 37 68 70 72 58 59 60 60 61 62 74 75 14 15 76 75 9 10 11 12 13
43 47 45 44 39 38 31 35 29 33 30 34 36 53 54 57 69 65 66 64 56 55 63 71 72 67 5 6 73 8 7 4 3 2 1

V 4.1 Front Axle with Ball Joints

No.	Description	Qty.	Note when disassembling	Note when assembling	Special instructions see
1	Nut M 10	4		tighten to 5.5—6.0 mkg (40—43 lb ft)	
2	Spring washer	4			
3	Washer	4			
4	Bolt M 10 × 25	4			
5	Nut M 12 × 1.5	2		tighten to 5.5—6.0 mkg (40—43 lb ft)	
6	Spring washer	2			
7	Bolt M 12 × 1.5 × 25	2			
8	Support for axle	2			
9	Bolt M 10 × 25	2		tighten to 2.0 mkg (14 lb ft)	
10	Spring washer	2			
11	Plate	2			
12	Rubber packing, upper	2			
13	Rubber packing, lower	2			
14	Bolt M 12 × 1.5 × 90	2		tighten to 5.0 mkg (36 lb ft)	
15	Spring washer	2			
16	Lock washer	1			
17	Dust cap	2	pull off with VW 637/2	must be free of grease, seal speedo cable hole	V 4.2/3
18	Clamp nut for wheel bearing	2	lefthand thread on left steering knuckle	adjust as specified	V 4.2/3
19	Socket hd. screw for clamp nut M 7 × 18	2		after adjusting wheel bearing play to 0.03—0.12 mm (0.001—0.004 in.) with VW 769, tighten screw to 1.0—1.3 mkg (7—9 lb ft)	V 4.2/3
20	Thrust washer	2		do not tilt as this will affect adjustment	
21	Outer tapered roller bearing Outside dia. 40 mm (1.574 in.)	2	knock outer race out with brass drift	lubricate with multi-purpose grease of correct specification. Press grease into cage	
22	Brake drum	2		clean carefully, check dimensions, damaged threads for wheel bolts, friction surface condition. Amount of grease per side approx. 50 grams	
23	Oil seal	2		knock in carefully with a rubber hammer	
24	Inner tapered roller bearing Outside dia. 50 mm (1.968 in.)	2	as for point 21	as for point 21	
25	Bolt M 10 × 18	3		tighten to 5.0 mkg (36 lb ft)	
26	Spring washer	3			
27	Front wheel brake and backing plate	2	detach brake hose at bracket	bleed brakes	
28	Steering knuckle	2	press off ball joints with VW 267a	check bearing seats for wear, check for distortion with VW 258p	V 4.1/4
29	Retainer, small	2	knock off	bend lugs down after installing stabilizer	V 4.2/5

When removing a steering knuckle, the brake parts need only be taken off if the steering knuckle itself has to be replaced.

Removing

1 - Detach brake hose at bracket and seal brake seal with dust cap from bleeder valve.

2 - Press outer tie rod end out.

3 - Remove brake drum and backing plate.

4 - Take self-locking nut off lower ball joint and press ball joint out of steering knuckle with VW 267a. Screw cap nut (M 12×1.5) from VW 267a on to ball joint stud to prevent damage to the thread.

Caution

The upper edges of the fork on the appliance which contact the rubber boot when pressing the joint out must be free of burrs to avoid damaging the boot. Position the appliance carefully.

The nut should be screwed on as far as it will go to ensure that the thrust is taken mainly at the base of the nut as well as on the thread flanks. The nut must not be screwed on too tightly otherwise the stud will turn as well and make the nut difficult to remove after the joint has been pressed out.

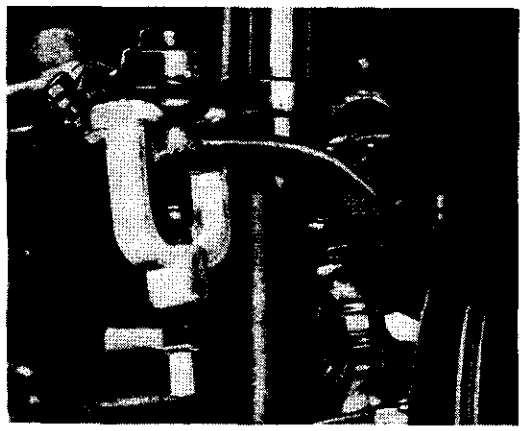
Very tight ball joints can be loosened by tapping the steering knuckle eye with the appliance tensioned.

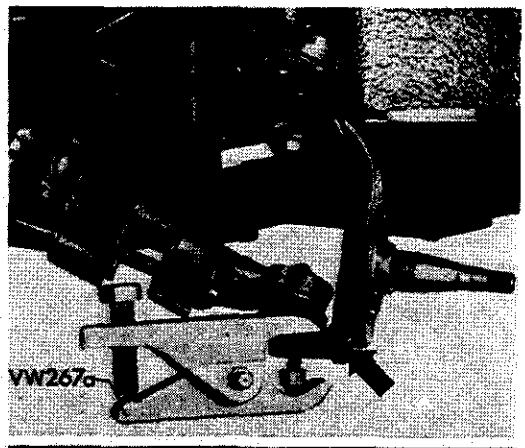
5 - Remove self-locking nut from upper ball joint and loosen eccentric bushing for camber adjustment with VW 179.

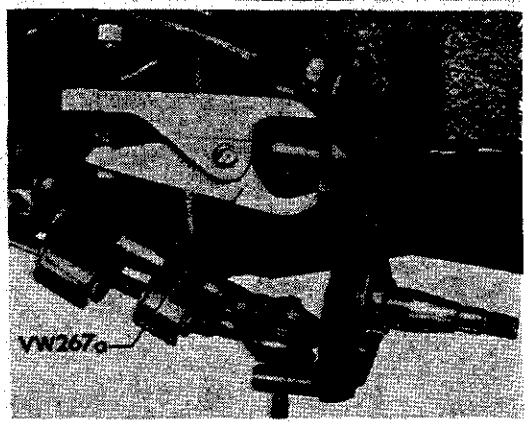
Note

If the upper ball joint is to be repaired or replaced it should be pressed out of eccentric bushing with VW 267a. If the steering knuckle is to be removed, the bushing should be loosened with VW 179 and the bushing left on the ball joint stud.

6 - Take steering knuckle off.







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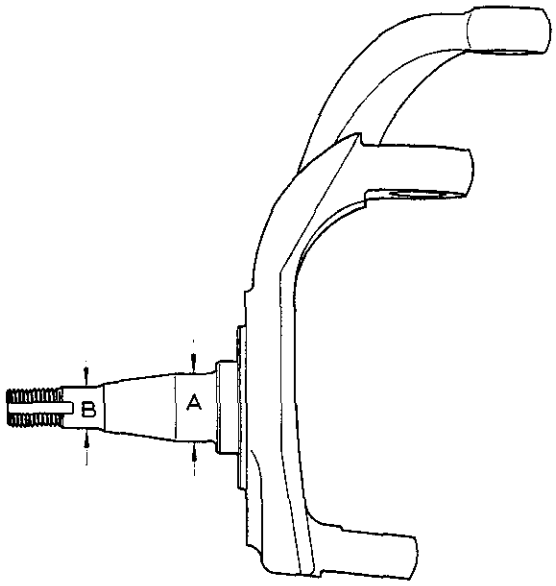


Checking steering knuckle

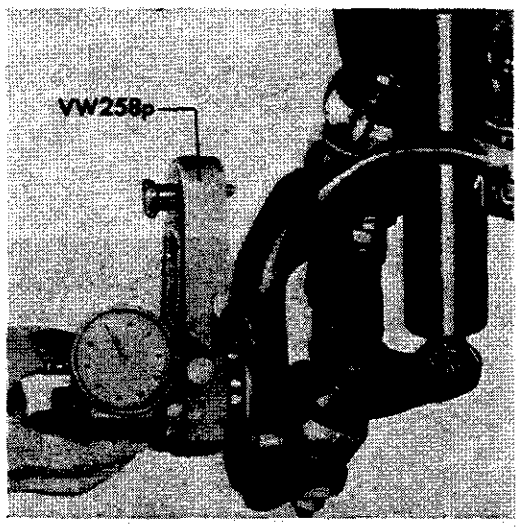
The steering knuckle can be checked on or off the vehicle.

a - On vehicle

1 - Checking bearing seats for wear and size.

Inner bearing seat A =
28.98—29.0 mm dia. (1.1409—1.1417 in.)

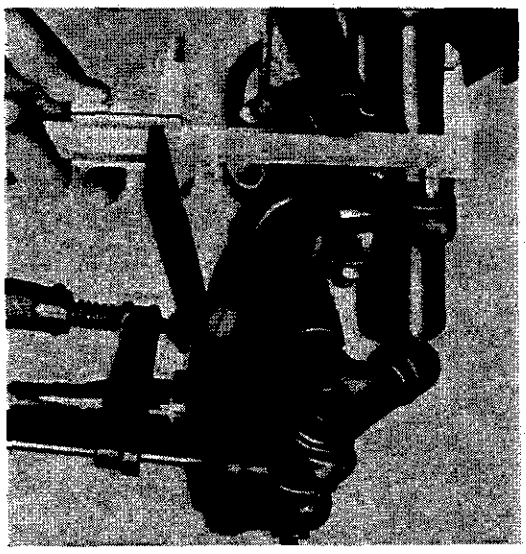
Outer bearing seat B =
17.45—17.46 mm dia. (0.6869—0.6874 in.)



2 - Checking stub axle for bend

Place measuring appliance VW 258p on the stub axle and press it firmly against shoulder for inner bearing. Set dial gauge to zero and check stub axle by turning appliance one complete turn.

The deflection on the dial gauge needle must not exceed 0.15 mm (0.0059 in.).



3 - Checking steering arm for bend

The steering arm on the steering knuckle can be checked for bend with a straight edge and a vernier caliper. The dimension from backing plate flange to the outer edge of the tie rod hole should be 117.75 to 118.25 mm (4.6357 to 4.6554 in.).

Warning

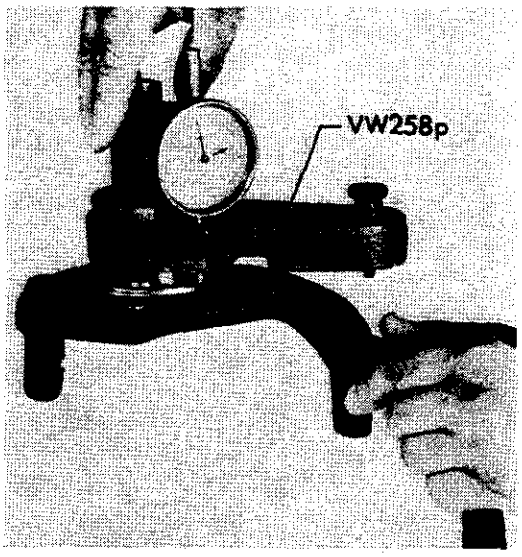
Do not attempt to straighten bent steering knuckles. Install new parts.

b - Removed

1 - Checking stub axle for bend

Place appliance VW 258p on the stub axle and press it firmly against the shoulder for inner bearing. Set dial gauge to zero and check stub axle by turning appliance one complete turn.

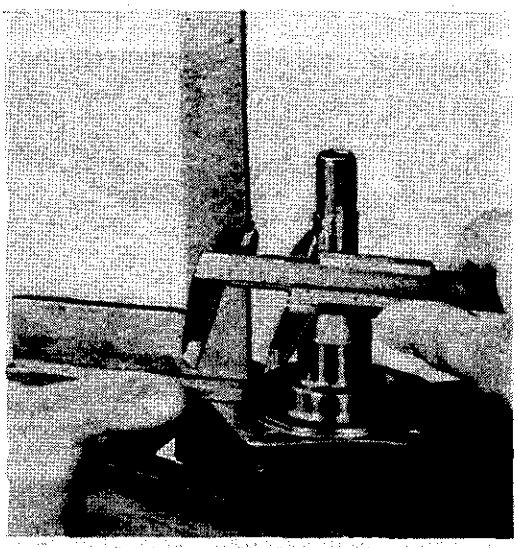
The deflection of the gauge needle must not exceed 0.15 mm (0.0059 in.).



2 - Checking stub axle with square and vernier caliper

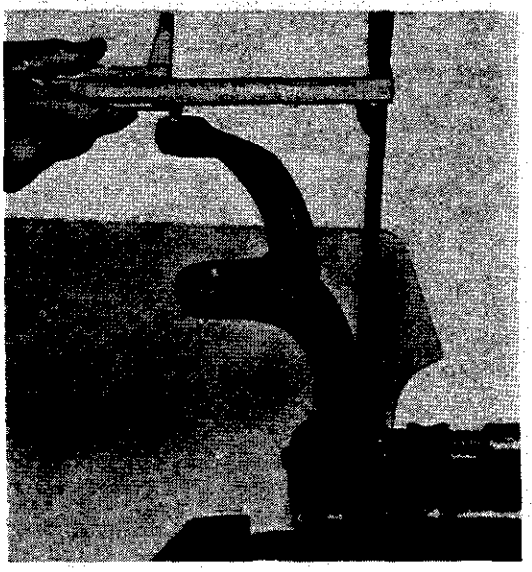
Measure as shown in illustration at least three points around the stub axle.

The difference between the measurements must not exceed 0.25 mm (0.0098 in.).



3 - Checking steering arm for bend

The steering arm on the steering knuckle can be checked with a straight edge and a vernier caliper. The dimension from the backing plate flange to the outer edge of the tie rod hole should be 117.75 to 118.25 mm (4.6357 to 4.6554 in.).



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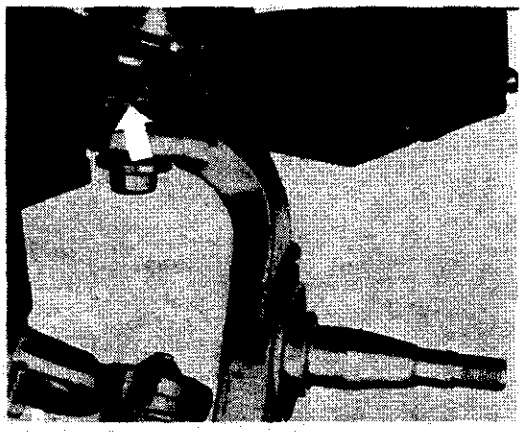
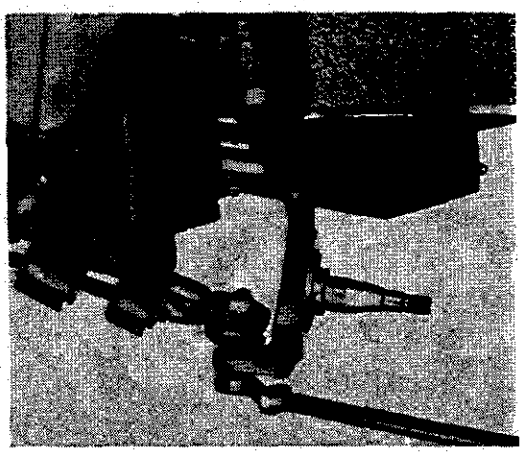




Installing

1 - Install steering knuckle on lower ball joint but do not fully tighten the nut. **Always use new self-locking nuts.**

2 - Lift upper torsion arm with the tensioner VW 655/3 until the steering knuckle can be attached to the upper ball joint.

3 - Set the camber adjusting bushing so that the notch is pointing forward (arrow).

4 - Tighten the self-locking nuts on the ball joints to the correct torque.

Caution

Use only self-locking nuts.

5 - Tighten tie rod end nuts to the correct torque, turn on to align cotter pin holes and fit cotter pins.

6 - Install backing plates and brake drums and tighten backing plate bolts to correct torque.

7 - Adjust wheel bearings correctly. See the instructions on "Checking and adjusting wheel bearings" on page V 4.2/3.

8 - Install brake hoses without twist so that they hang down. Check position of brake hose over full range of steering movement.

9 - Bleed brake system and adjust brakes.

10 - Adjust wheel alignment.

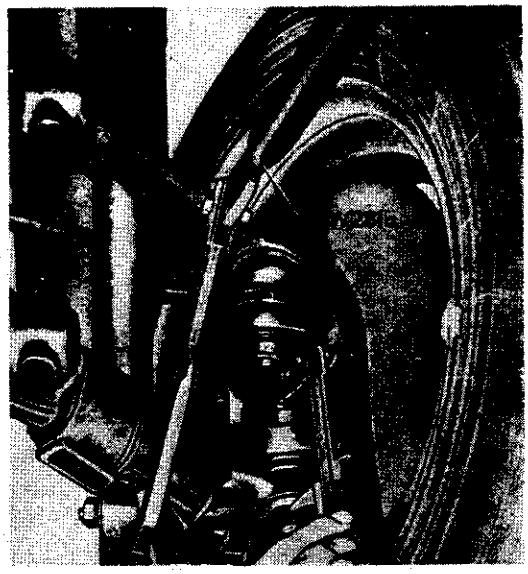
Checking ball joints (installed)

The axial play of the ball joint can be checked with special tool VW 281 a.

1 - Raise vehicle and turn wheels to one side.

2 - Position tool VW 281 a between upper and lower torsion arms as shown in illustration.

3 - Place vernier caliper on the ball joint with one jaw on the torsion arm and the other jaw on the steering knuckle and read the measurement. Without removing the vernier caliper, pull down checking lever to expand torsion arms and obtain second reading. Subtract first reading from second reading to obtain play of ball joint.



All Type 1 / Sedan 111

	Type 1, except 181	Model 181
Maximum play, new	0.5 mm (0.019 in.)	0.3 mm (0.011 in.)
Wear limit:		
Upper ball joint	2.0 mm (0.08 in.)	2.0 mm (0.08 in.)
Lower ball joint	1.0 mm (0.04 in.)	2.0 mm (0.08 in.)

Worn ball joints must be replaced with new ones.

Model 181

Removing torsion arms

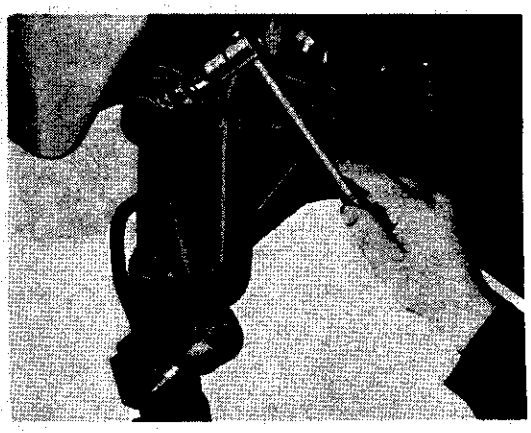
1 - Remove steering knuckle complete with brake drum.

2 - If the lower torsion arm is to be removed, disconnect stabilizer.

3 - Loosen lock nuts on torsion arm securing pins and remove pins.

4 - Remove torsion arms from axle tubes.

5 - If necessary, remove seals from axle tubes.



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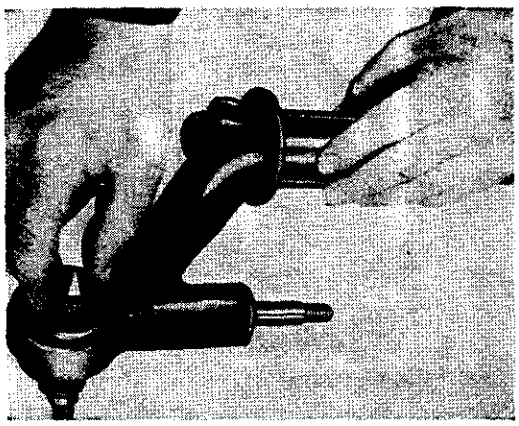
Checking torsion arms

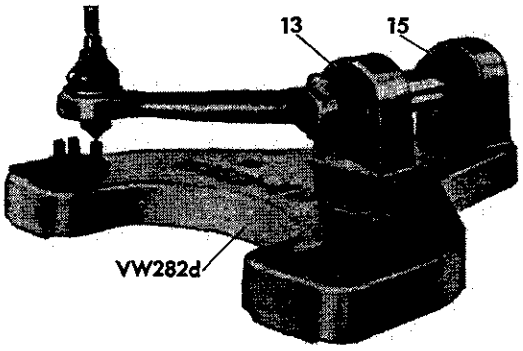
1 - Carefully clean torsion arms and ball joints.

2 - Check bearing seats on torsion arms for wear.

3 - Remove plastic plugs from bottom of ball joint and insert tip of test appliance VW 282d.



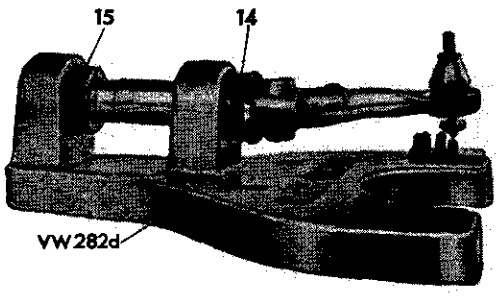
Torsion arm upper



4 - Locate torsion arm bushings in test plate VW 282d.

	Sedan 111		Model 181	
	Bushing No.		Bushing No.	
	inner	outer	inner	outer
Upper arm	15	13	15	13
Lower arm	15	14	13	12

Torsion arm lower



5 - Place torsion arm in test plate.

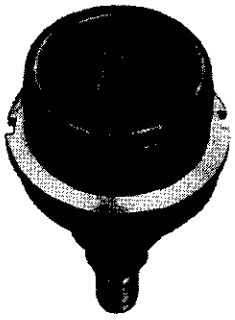
The tip must contact the small boss on the plate. If it does not do so, the torsion arm is bent.

Replacing

For manufacturing reasons standard size ball joints as well as oversize ball joints (0.4 mm = 0.016 in.) are installed in corresponding torsion arms.

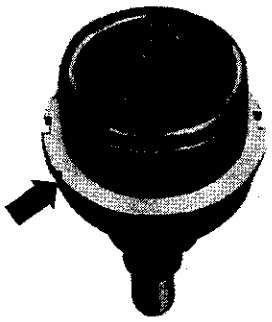
Standard size

Two grooves 180° apart to show fitting position.



Oversize

Two notches (arrow) 45° from the grooves showing fitting position.



Caution

When replacing the ball joints, it is essential to check these marks so that the proper ball joint is pressed in. The torsion arm itself has no marks to show which ball joint is to be used.

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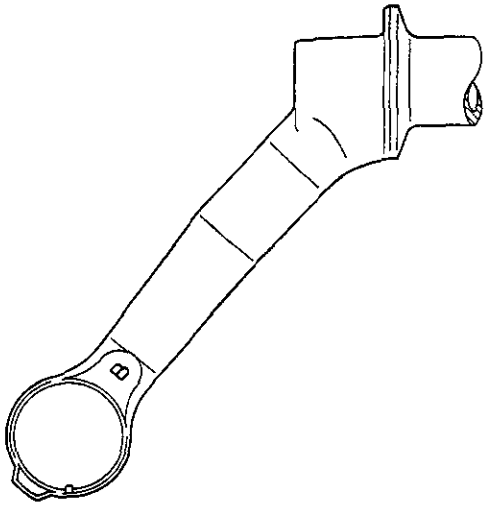
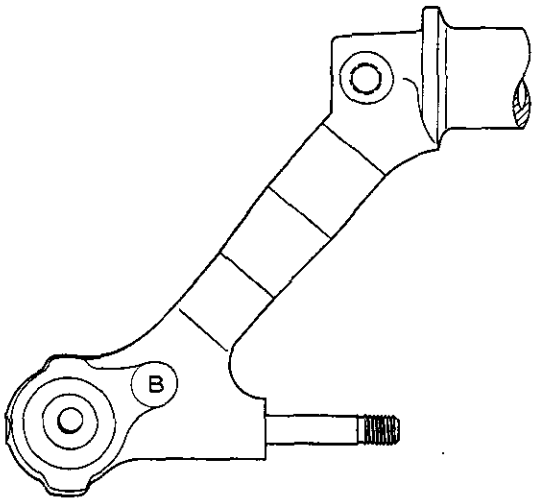


Model 181

The torsion arms with oversize holes for the ball joints (also 0.4 mm = 0.016 in. larger) are marked with a "B" as shown.

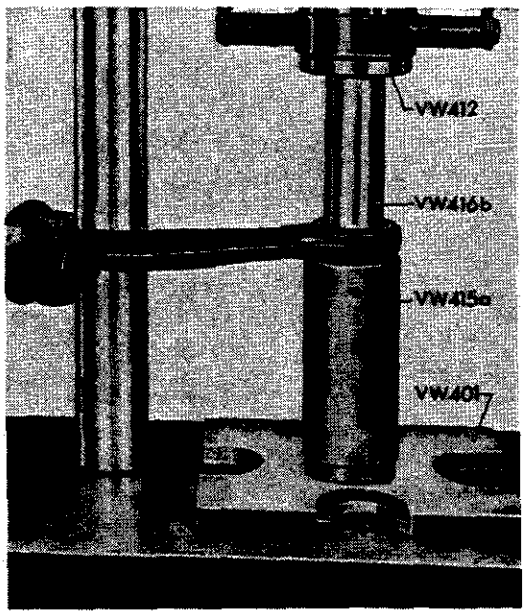
When replacing the ball joints, it is essential to check the marks on the ball joint or torsion arm in order to ensure that the correct joint is pressed in.



Note

The upper ball joint spigot has been increased in diameter from 16 to 18 mm (0.629 to 0.708 in.), and the ball joint spigot thread has been increased in length by 2 mm (0.078 in.). In connection with this, the tapered drilling in the eccentric bushing for camber adjustment has also been increased to 18 mm (0.708 in.) dia., the washer between the steering knuckle and the self-locking nut has been increased in thickness from 5 to 7 mm (0.196 to 0.275 in.), and in diameter from 34 to 38 mm (1.338 to 1.496 in.).

The new ball joints can be service installed without difficulty, but the other new parts, i.e. eccentric bushing and washer, must however also be installed.



Upper ball joint

1 - Press joint out with press tools VW 412, VW 416b, VW 415a and VW 401.

Installing torsion arms

Note the following points:

1 - Check condition of torsion arm sealing rings and install new parts where necessary.

2 - Install torsion arm on torsion bar. Install retaining screws and tighten to correct torque.

3 - Install all other parts. Grease front axle thoroughly with multi-purpose grease.

4 - Check wheel alignment.

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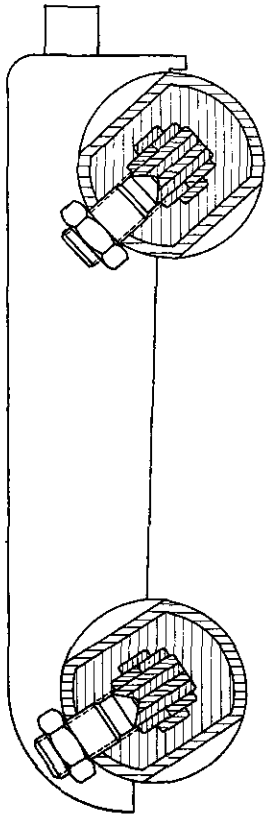
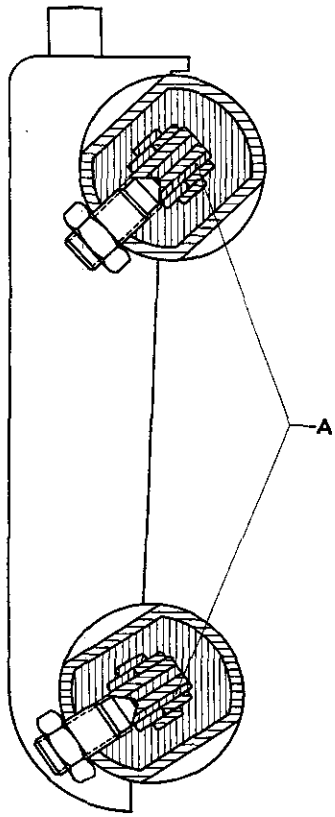
The front axle torsion bars are made up of 10 spring steel leaves. There are two versions which differ as follows:

Type 1 all (except Model 181)



Model 181

A = thinner leaf must be at bottom



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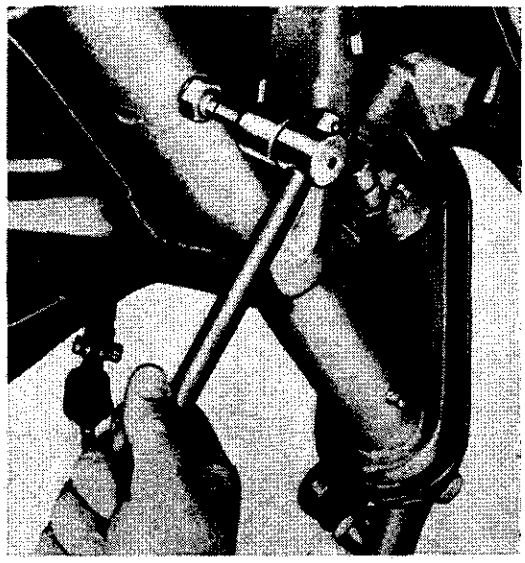
Removing

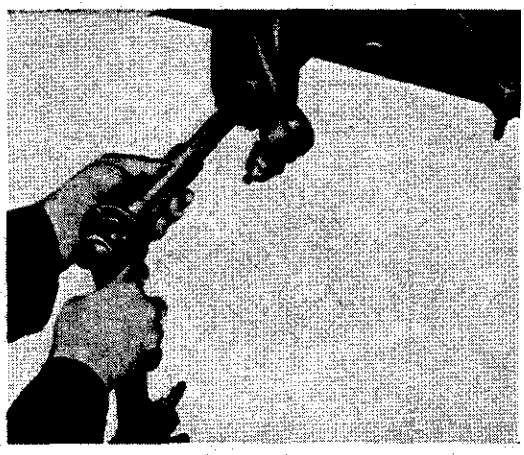
1 - Remove both steering knuckles.

2 - Remove torsion arms on one side.

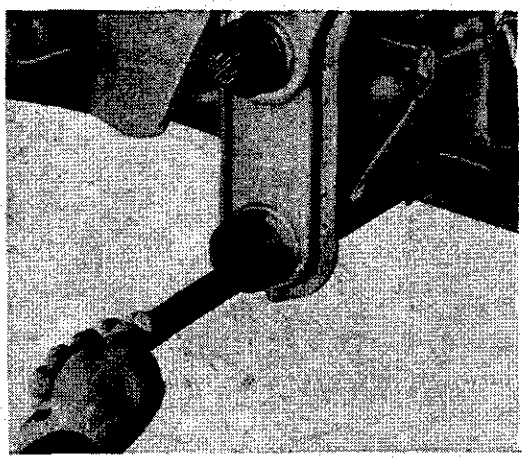
3 - Loosen the locknut on the headless setscrew.

4 - Remove the setscrew.





5 - Pull torsion arm and bar out.



Installing

Note the following points:

1 - Clean the torsion bars and examine them for cracks and breakage. Install new bars if necessary.

2 - Check torsion arms, needle bearing and bushings and replace as necessary.

3 - Coat bars liberally with multi-purpose grease before installing.

4 - When inserting the torsion bars, note the number of leaves and the position of the countersunk marks for the torsion arm attaching pins.

5 - Align the countersunk mark in the center of the bar with the hole for the setscrew. Tighten center setscrew to correct torque and secure with the locknut.

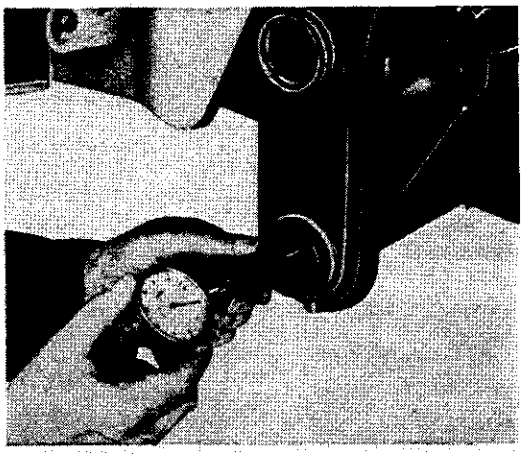
6 - Reinstall all removed parts and lubricate front axle with multi-purpose grease.

The metal bushes are subject to very little wear and do not usually need replacement. However, if wear is noted on the torsion arm bearing surface, the metal bush should be replaced as well as the torsion arm.

Removing

1 - Remove both steering knuckles complete with drums, take out torsion arms and torsion bars.

2 - Measure metal bush wear with an internal measuring gauge. The wear limit for upper and lower bushes is 37.38 mm (1.47 in.).

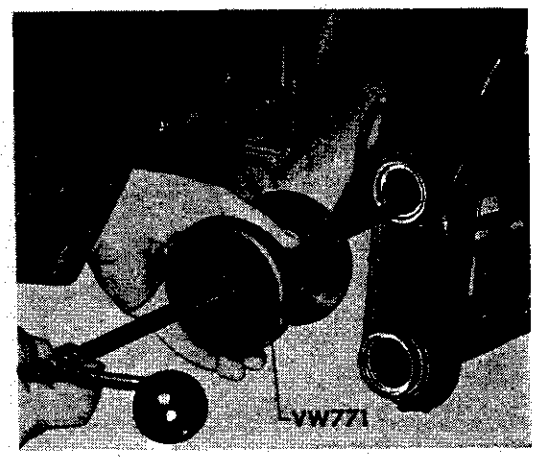


Removing needle bearings and metal bushes

Upper and lower needle bearings

a - Attach washers VW 771—21/3 for **upper needle bearing** or washer VW 771—21/7 for **lower needle bearing** to extractor VW 771. Insert tool into axle tube and locate washer against shoulder of needle bearing.

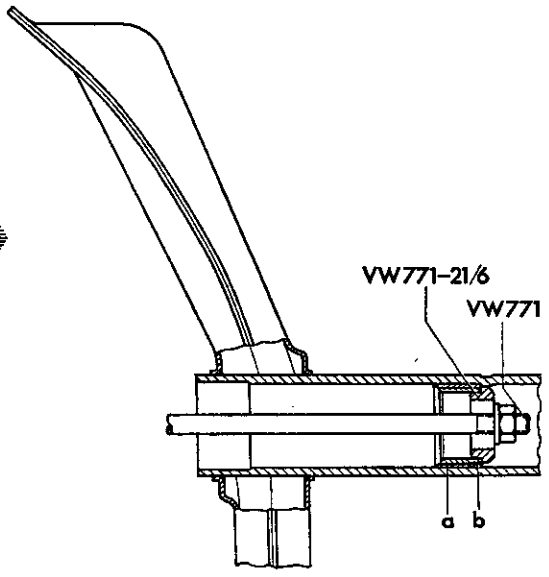
b - Pull bearing out.



Upper and lower metal bushings

a - Insert extractor VW 771 into axle tube with washer VW 771—21/6 attached and locate washer against bushing.

b - Pull metal bushing out.



a - Plastic sleeve
b - Metal bushing

Important

The plastic sleeves for the bushings do not wear and remain in the axle tube. Exercise extreme care when driving out bushings to avoid damaging plastic sleeves.

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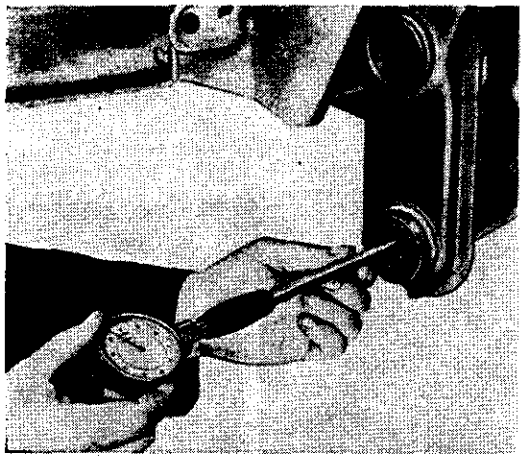


Installing

1 - Clean axle tubes particularly at the needle bearing and bushing seats.

2 - Check condition and dimensions of needle bearing seats in axle tube.

Note:

Since oversize needle bearings are also used, it is essential to check the size of the axle tubes when fitting a new needle bearing. The inside diameters of the bores are:

	Standard	Oversize
Upper:	45.99—45.97 mm 1.81— 1.80 in.	46.19—46.17 mm 1.82— 1.81 in.
Lower:	49.99—49.97 mm 1.97— 1.96 in.	50.19—50.17 mm 1.96— 1.95 in.

The bearings to match are:

	Standard	Oversize
Upper needle bearing:	46 mm 1.811 in.	46.2 mm 1.818 in.
Lower needle bearing:	50 mm 1.969 in.	50.2 mm 1.976 in.

If the seats in the axle tubes are no longer within tolerance, a new axle beam must be fitted as it is not possible to machine the seats.

3 - Drive in new upper metal bushing and upper needle bearing with VW 768. The bushings should be driven in until the shoulder on the drift contacts the axle tube.

Important

When installing the metal bushings be careful not to damage the plastic sleeves. Damaged plastic sleeves cannot be replaced. Clean needle bearings carefully, check for diameter of bearings and bushings.

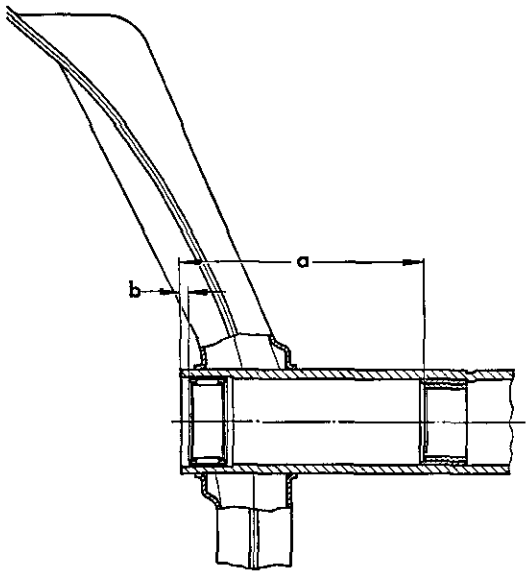
Lubricate needle bearing seats lightly with universal grease. The needle bearings should be installed so that the marking on the shoulder is facing outward.

4 - Drive new lower metal bushing and lower needle bearing in with VW 767 until shoulder on drift contacts the axle tube.

5 - Install all parts removed and lubricate axle thoroughly with multi-purpose grease.

Note:

In cases where the drifts 767 and 768 are not available, drive metal bushings and needle bearings into axle beam to the dimensions given in sketch.



a - metal bushings:

upper 122+2 mm
4.80+.08 in.

lower 132+2 mm
5.20+.08 in.

b - needle bearings:

upper 3.5+0.2 mm
.0137+.008 in.

lower 5.0+0.2 mm
.0197+.008 in.

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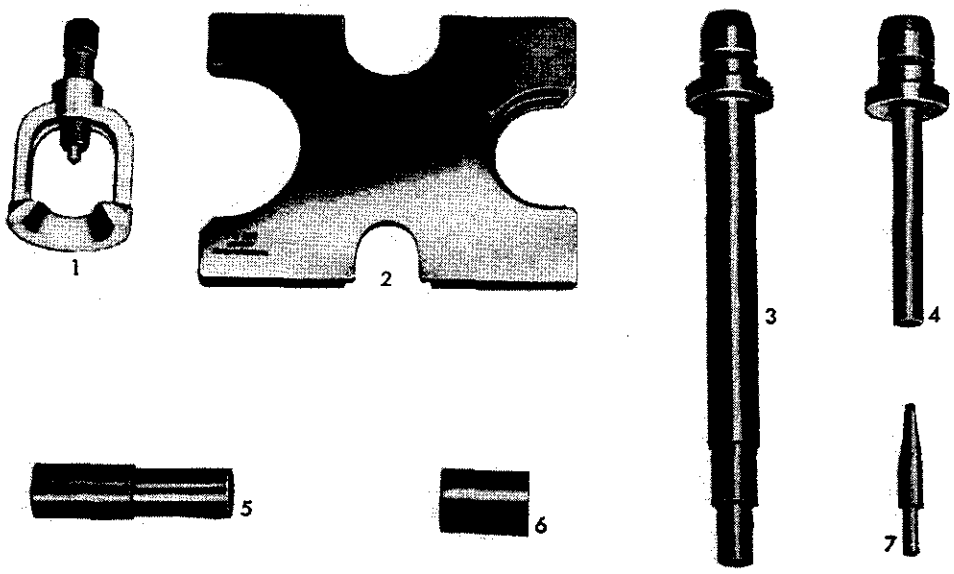
Tools



No.	Description	Special Tool	Remarks
1	Tie-rod end extractor	VW 266h	
2	Plate	VW 402	
3	Press tool	VW 408	
4	Press tool	VW 411	
5	Tube	VW 421	
6	Tube	VW 426	
7	Tapered pilot	VW 437a	

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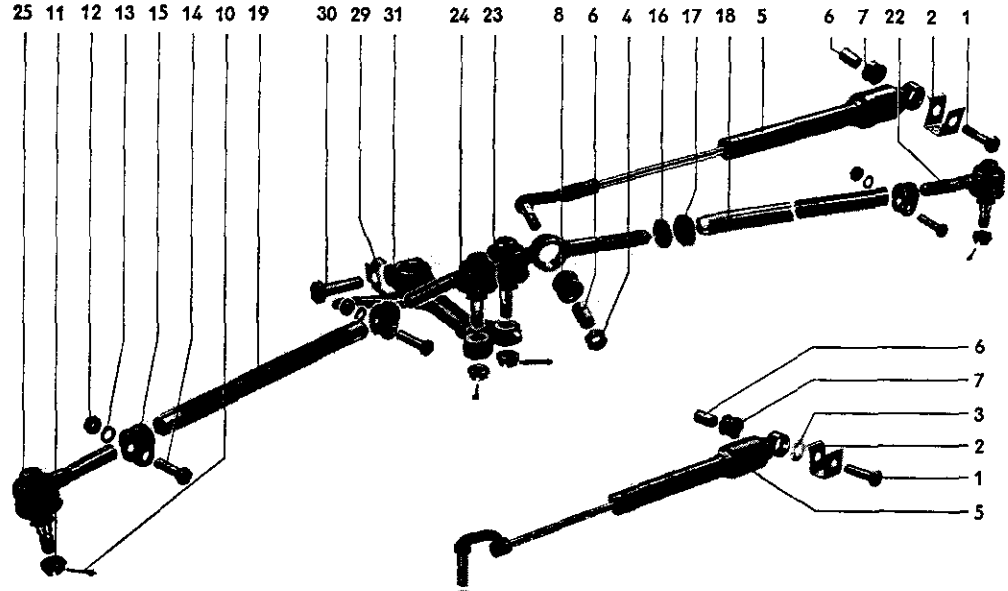
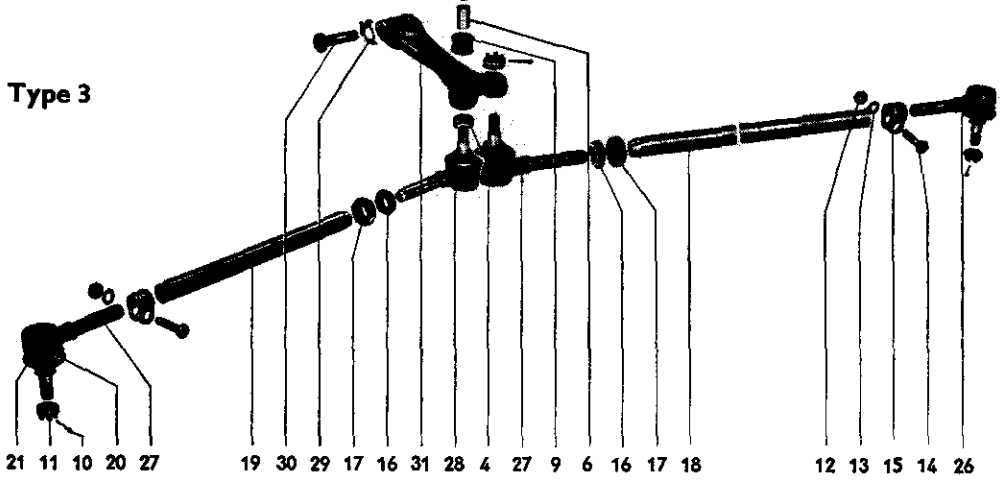
Type 1



Type 3



No.	Description	Qty.	Note when removing	Note when installing	Remarks
1	Bolt M 10×40	1		tighten to 4.0 to 4.5 mkg (29—32 lbs. ft.)	
2	Lockplate	1		use new plate	
3	Washer	1		only on Type 3	
4	Self-locking nut M 10×1	1		always use new nut	
5	Steering damper	1		check by extending and compressing	V 6.1/2-1

No.	Description	Qty.	Note when removing	Note when installing	Remarks
6	Sleeve for rubber bushing	2		coat with glycerine, when pressing into bushing	V 6.1/2
7	Bushing for steering damper	1		coat with talcum and press in flush	V 6.1/2
8	Bushing for tie rod end	1		as No. 7	
9	Bushing for drop arm	1		as No. 7	
10	Cotter pin	4		always use new pins, note size of hole in tie rod end	
11	Slotted nut	4		tighten to 3.0 mkg (22 lb. ft.) then turn on until cotter hole is aligned	
12	Nut M 8 on Type 1 on Type 3	3 2		tighten to 1.5 mkg (11 lb. ft.) after adjusting wheel toe	
13	Spring washer on Type 1 on Type 3	3 2			
14	Bolt M 8×1×30 on Tyep 1 on Type 3	3 2			
15	Clamp on Type 1 on Type 3	3 2			
16	Nut for tapered ring M 14×1.5 on Type 1 on Type 3	1 2		tighten to 2—2.5 mkg (14—18 lb. ft.) after adjusting wheel toe	
17	Tapered ring on Type 1 on Type 3	1 2			
18	Tie rod (long)	1			
19	Tie rod (short)	1			
20	Retaining ring for dust seal	4			
21	Dust seal	4		check for damage	

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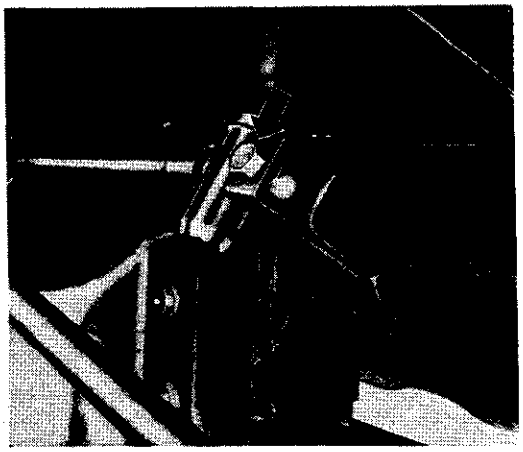
No.	Description	Qty.	Note when removing	Note when installing	Remarks
22	Tie rod end, straight, RH thread	1		**Do not use** the tie rod ends of the Sedan 113	V 6.1/3 V 6.1/6
23	Tie rod end, for steering damper	1			
24	Tie rod end, offset RH thread	1			
25	Tie rod end, straight, LH thread	1		as No. 22	
26	Tie rod end, straight, RH thread	1		as No. 22	
27	Tie rod end, straight, LH thread	2		as No. 22	
28	Tie rod, offset	1		as No. 22	
29	Lockplate	1		use new plate	
30	Bolt M 12×1.5	1		tighten tp 5.0—7.0 mkg (36—50 lb. ft.) and lock with lock plate	
31	Drop arm	1			

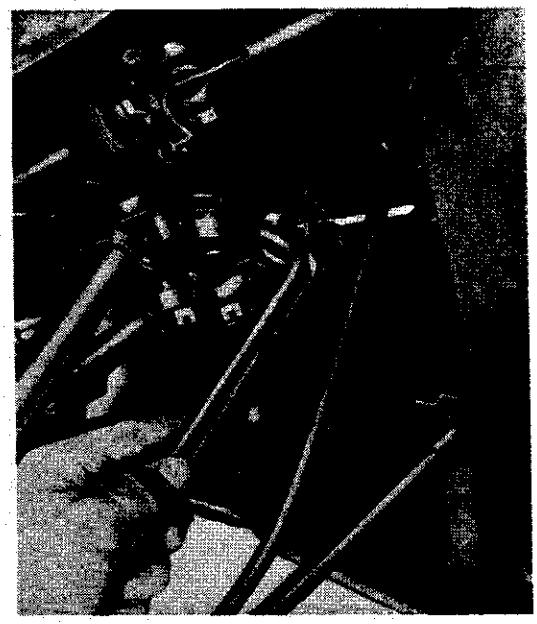
Removing and checking steering damper

Removing

1 - Release lockplate and remove bolt from bracket on axle beam.



2 - Remove nut at tie-rod eye (at drop arm on Type 3) and take damper out.



Checking

Check damper by extending and compressing it. The damper resistance must be uniformly firm and free of jerks over the complete stroke. When in doubt compare with a new damper.

The damping action in both directions must be clearly felt to the end of the stroke.

Two steering dampers which differ in length and stroke are available as replacement parts for type 1 vehicles.

To avoid trouble with the steering due to premature failure of the steering damper ensure, when replacing a damper, that the one installed is the correct type for the vehicle concerned.

Check the rubber bushings and sleeves in damper for wear and damage and replace it necessary.

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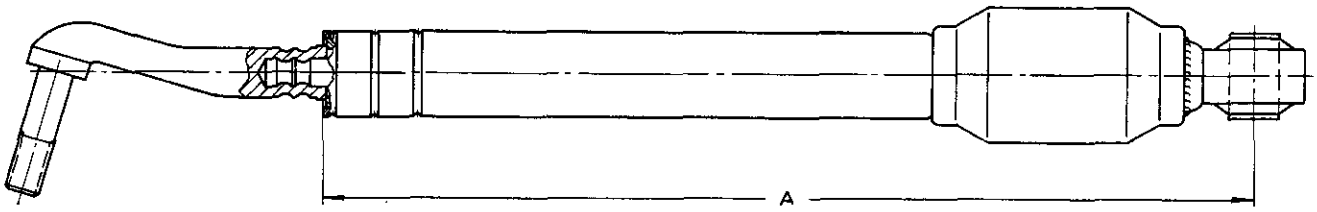
Replacing

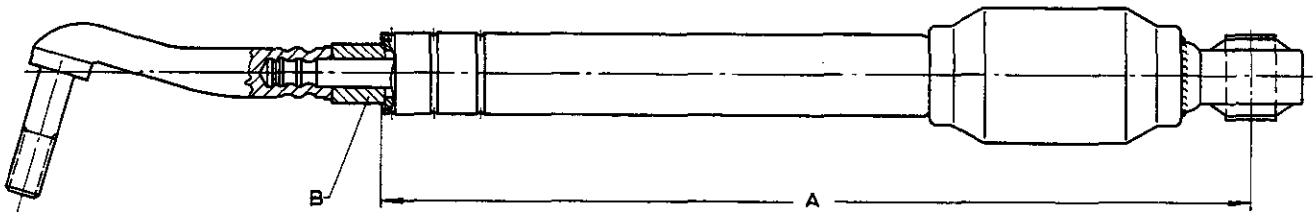
Steering damper without spacer



A = appr. 260 mm (10 1/4")

Model	Chassis No.
113, 117, 141, 143, 151	from 116 000 001
141, 143	from 2 921 252 to 115 999 000

Steering damper with spacer



A = approx. 243 mm (9 9/16")

B = Plastic spacer

Model	Chassis No.
113, 117, 151	from 2 921 252 to 115 999 000

Installing

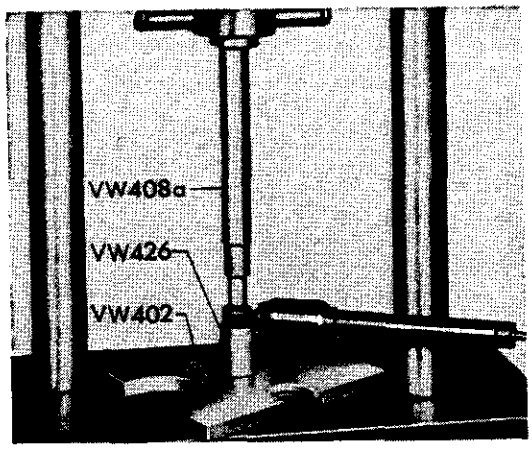
1 - Attach steering damper to tie-rod or the drop arm on Type 3 vehicles. Tighten the **new self-locking nut** to correct torque.

2 - Attach steering damper to bracket on axle tube, using a **new lockplate.** Tighten bolt to correct torque and lock.

Replacing steering damper bushing and sleeve

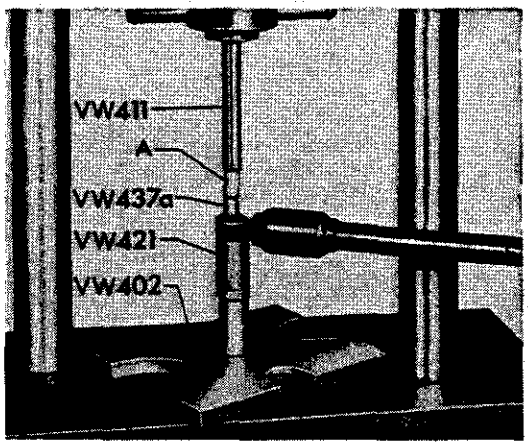
1 - Press bushing and sleeve out with VW 408a, 426 and 402.

2 - Press new bushing into damper eye.



3 - Press sleeve into bushing using VW 411, 437a, 421 and 402.

A = Sleeve for bushing



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Removing

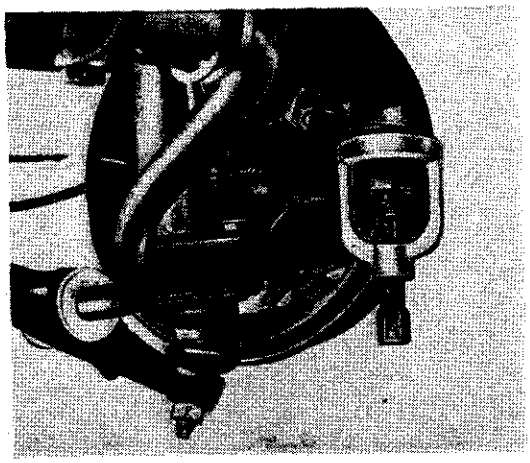
1 - Remove cotter pins and nuts from tie rod ends.

2 - Detach steering damper from tie rod end.

3 - Press tie rod ends out, using VW 266h.

Caution

Do not damage the rubber seals when removing tie rod ends. Take care not to squeeze grease out of the seals when working on the steering linkage. The service life of the joints is satisfactory only when they are packed with the correct amount of grease. Damaged rubber seals must be replaced.



Installing

1 - Check tie rods for damage.

Important

Bent tie rods must be replaced, not straightened.

2 - Check tie rod ends for wear and tighten. If there is any play or if the stud cannot be moved by hand, the tie rod end must be replaced. The thread on the stud must be undamaged.

3 - Check dust seals for damage. The seals may be replaced only if it is known that no dirt has entered the joint. If in doubt, replace the joint.

4 - On Type 1 vehicles, check the steering damper bushing for wear and replace if necessary.

5 - Install both tie rods so that the left-hand thread is on the left.

Caution

Do not confuse the tie rod ends of the link pin or ball joint type axles with those of the suspension strut type axle. Tie rod ends of the suspension strut axle have a greater movement. Under no circumstances are they to be installed on a vehicle with either ball joint or link pin axles. Otherwise the driving and steering characteristics of the vehicle will be seriously impaired.

The tie rod ends of the suspension strut type axle are identified by either a protusion or indentation on the housing as shown at point "A".

6 - Tighten slotted nuts on tie rod ends to correct torque and lock.

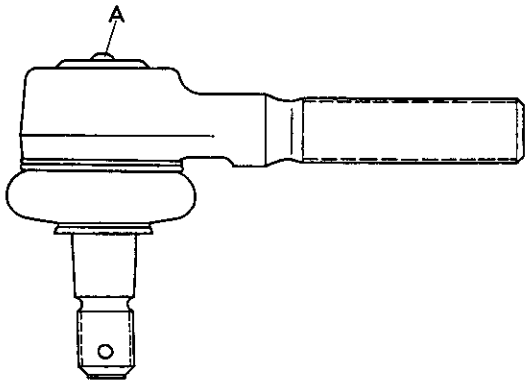
7 - Loosen nuts for tapered rings or clamps.

8 - Turn both ends on each rod in one direction to front or rear as far as possible so that the ends are properly aligned with one another.

9 - In this position tighten nuts for tapered rings or clamps to correct torque.

10 - On Type 1 vehicles, attach steering damper to tie rod.

11 - Adjust wheel toe.



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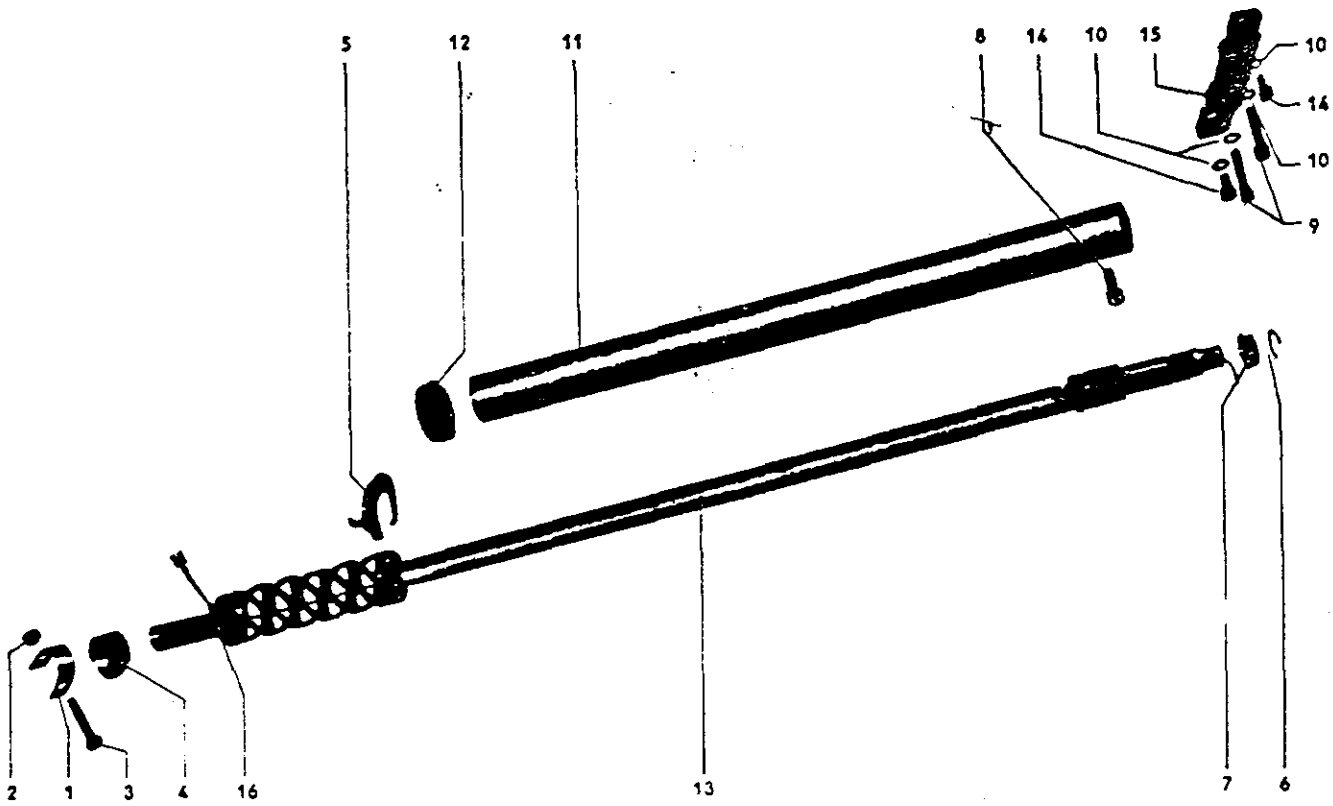

No.	Description	Qty.	Note when removing	Note when installing	Remarks
1	Lockplate	1	bend up	use new plate, lock nut and bolt by bending plate	V 7.1 2-1
2	Hex nut	1		tighten to 2—2.5 mkg (14—18 lb. ft.) and lock	
3	Bolt	1		lock	
4	Clamp for column	1			
5	Support for column	1	bend tabs up	bend tabs down	V 7.1 2-1
6	Circlip for column	1	pry off with two screwdrivers		
7	Contact ring	1		place in bearing in column switch from underneath	
8	Allen head bolt (M 8 x 22, secures column switch to column tube)	1		tighten to 0.5—1.0 mkg (4—7 lb. ft.)	

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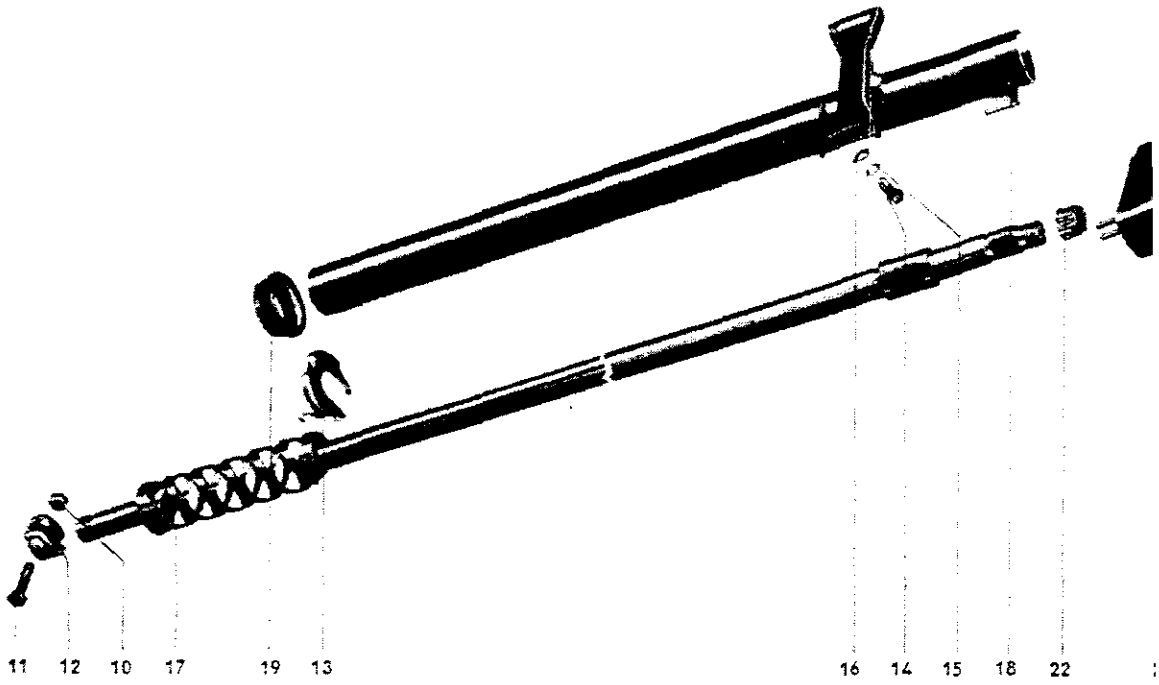
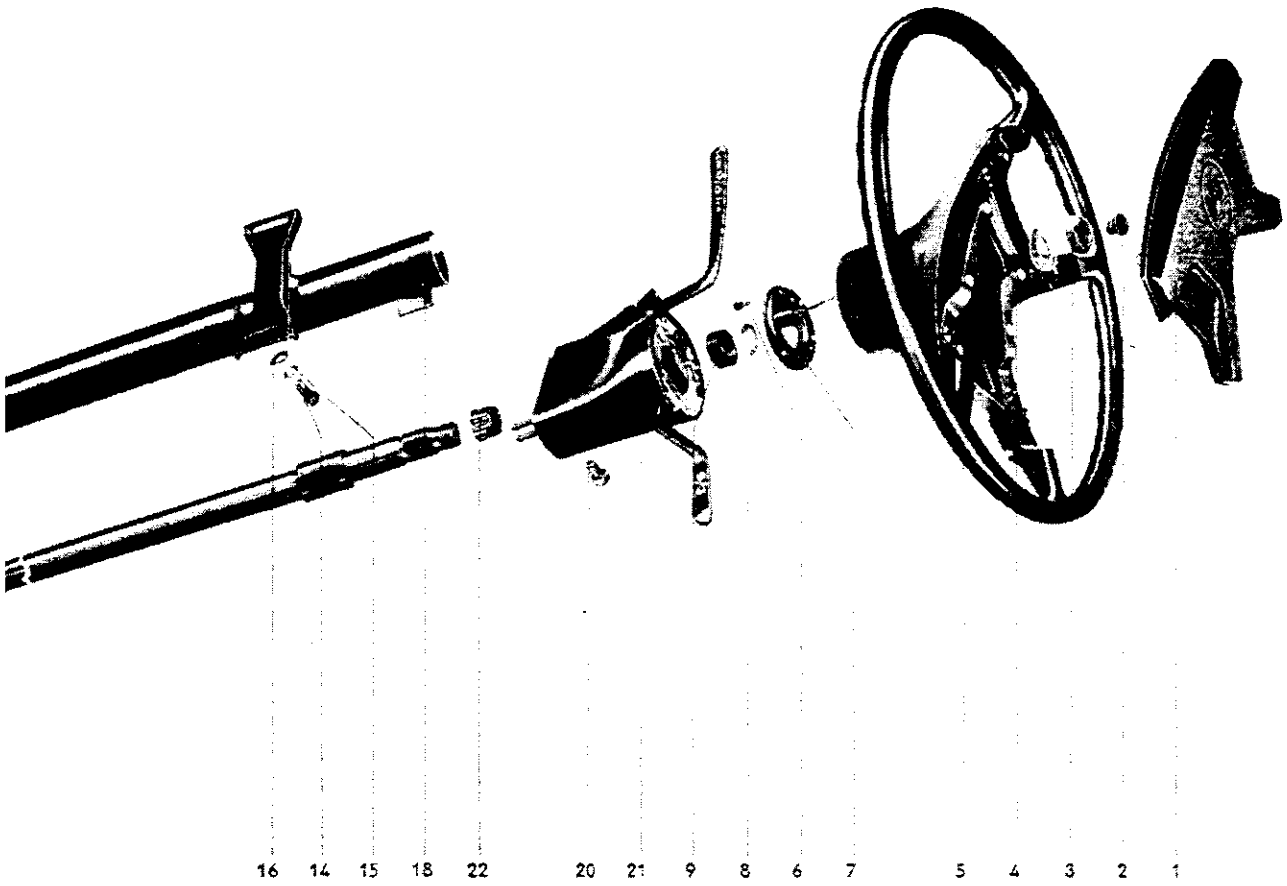
No.	Description	Qty.	Note when disassembling	assembling	Special instructions see
1	Padded cap	1	remove from steering wheel		
2	Plug	1			
3	Nut M 18x1.5	1		tighten to 5 mkg (36 lb ft)	
4	Circlip				
5	Steering wheel	1		install with wheels in straight-ahead position	
6	Screw with lock washer	3			
7	Cancelling ring	1		the cancelling lug points to the right	
8	Circlip for column	1			
9	Sealing ring	1			
10	Nut M 8 self locking	1		tighten to 2.5 mkg (18 lb ft)	
11	Bolt M 6x40	1			
12	Clamp	1			
13	Support ring for column tube	1	open tabs	close tabs	
14	Bolt with groove M 8x18	2		tighten to 2 mkg (14 lb ft)	
15	Spring washer	2			
16	Washer	2			
17	Steering column	1			
18	Column tube	1			
19	Sealing ring	1			
20	Screw M 8x16	1		tighten to 0.5—1 mkg (3.5—7 lb ft)	
21	Steering column switch	1			
22	Contact ring	1			



Disassembling and assembling steering Type 1 / Model 181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No.	Description	Qty.	Note when disassembling	assembling	Special instructions see
1	Padded cap	1	remove from steering wheel		
2	Plug	1			
3	Nut M 18×1.5	1		tighten to 5 mkg (36 lb ft)	
4	Circlip				
5	Steering wheel	1		install with wheels in straight-ahead position	
6	Screw with lock washer	3			
7	Cancelling ring	1		the cancelling lug points to the right	
8	Circlip for column	1			
9	Sealing ring	1			
10	Nut M 8 self locking	1		tighten to 2.5 mkg (18 lb ft)	
11	Bolt M 8×40	1			
12	Clamp	1			
13	Support ring for column tube	1	open tabs	close tabs	
14	Bolt with groove M 8×18	2		tighten to 2 mkg (14 lb ft)	
15	Spring washer	2			
16	Washer	2			
17	Steering column	1			
18	Column tube	1			
19	Sealing ring	1			
20	Screw M 8×16	1		tighten to 0.5—1 mkg (3.5—7 lb ft)	
21	Steering column switch	1			
22	Contact ring	1			

Removing

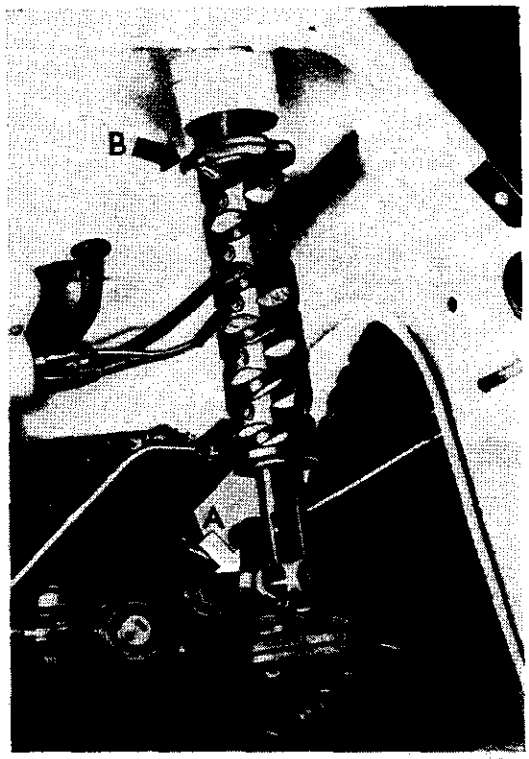
1 - Disconnect battery ground strap.

2 - Remove fuel tank.

3 - Remove nut from bolt in column securing clamp (arrow A). Bend up tab on column support ring and take ring off (arrow B).

4 - Remove steering wheel and column circlip. Turn ignition key to "on" position.

5 - Disconnect all wiring from column switch. Release pressure before disconnecting hoses for windshield washers from the steering column switch.

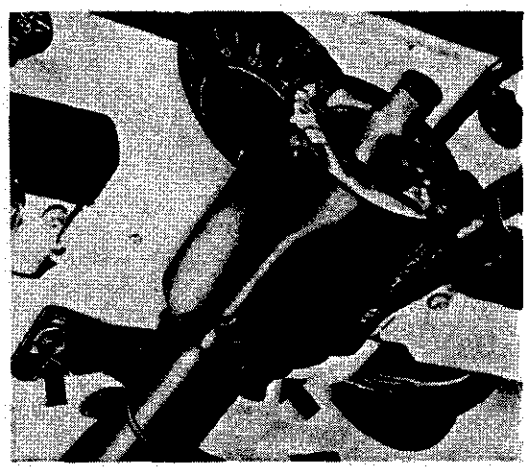


6 - Remove two bolts (arrows) attaching column tube to mounting plate.

7 - Pull column tube back into passenger compartment complete with column and switch.

8 - Remove bolt holding switch to column tube and take switch off.

9 - Pull column tube off column.



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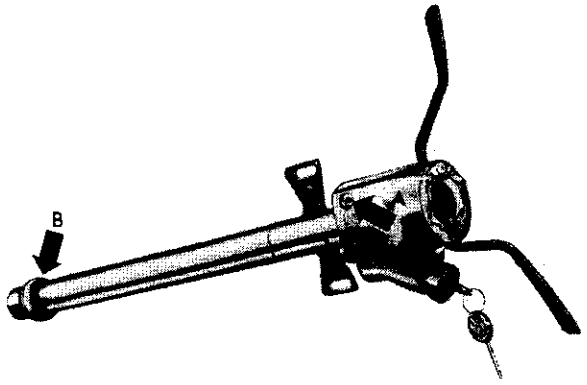
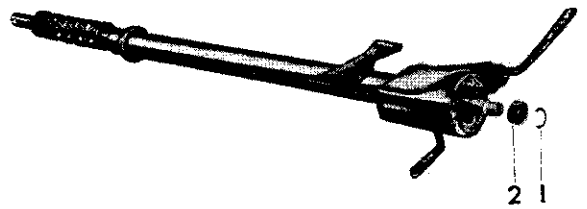




1 = Circlip

2 = Sealing ring

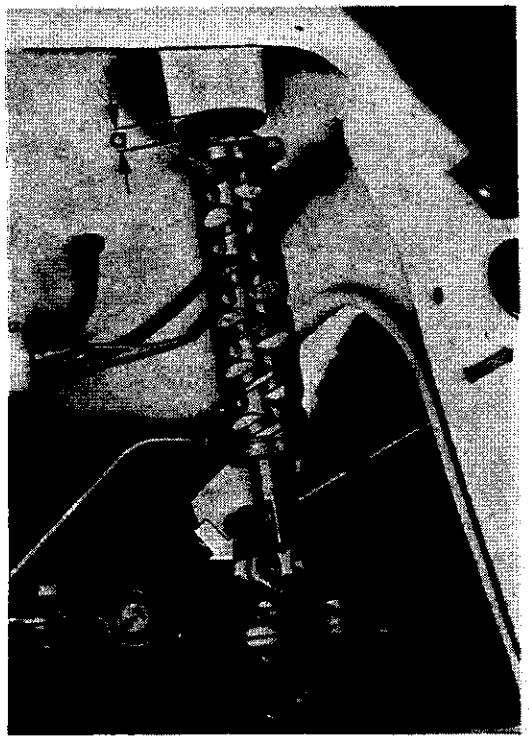
Installing

1 - Install switch on column tube and tighten socket head bolt (arrow A) to correct torque. Fit sealing ring on column tube (arrow B).

2 - Place contact ring and seat on the column, insert column into column tube and secure with circlip.

3 - Install the assembly in the vehicle and push column on to column coupling after installing the clamp. Insert bolt through clamp and tighten new self-locking nut lightly.

4 - Install column support ring and secure by bending down the tab.

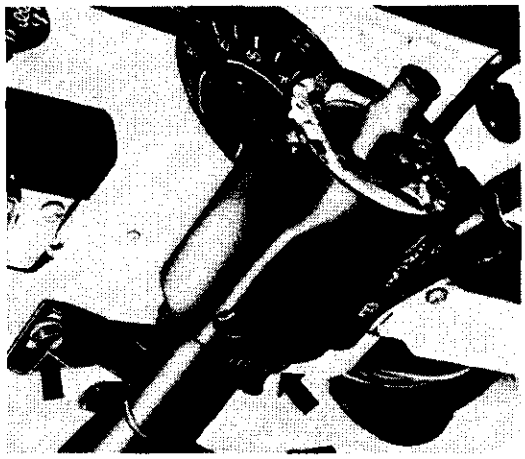


5 - Move steering column far enough that the distance between the support ring and tube in the cross panel is (a) 6—8 mm (0.24—0.31 in.) Then tighten self-locking nut (arrow) to correct torque.

6 - Tighten bolts (arrows) for column tube lightly.

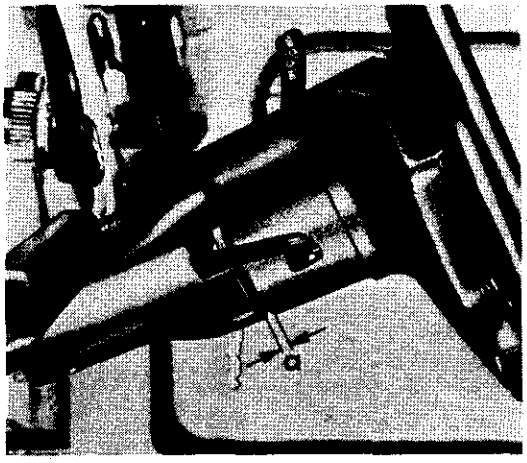
7 - Install steering wheel on column with wheels in straight-ahead position (marking ring on worm spindle in line with casting seam in housing, steering wheel spokes horizontal). Make sure that turn signal lever is in the central position as otherwise the canceling cams will be damaged by the lug on the canceling ring when the steering wheel is installed.

8 - Tighten steering wheel nut to correct torque.



9 - Adjust gap between steering wheel hub and column switch to 2—4 mm (0.08—0.16 in.) (a) by moving the column tube. Tighten bolts to correct torque.

10 - Connect all wires and water hoses for windshield washer to column switch.



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Troubleshooting Chart

Symptom	Cause	Remedy
Hard Steering		
Steering is equally stiff from lock to lock, jams or does not automatically self center	a - Front axle inadequately lubricated	a - Jack up front end af car thoroughly lubricate front axle
	b - Steering gear not properly adjusted	b ; Check steering gear adjustment
Front wheel do not self center although there is no tightness in the steering system	a - Front wheel alignment improperly adjusted	a - Check and adjust front wheel alignment (caster, camber and toe-in)
Play in Steering		
Play in steering gear	a - Steering gear not properly adjusted	a - Sheck steering gear adjustments
	b - Steering gear set worn	b - Install new steering gear set
Excessive play in tie rod ends	Tie rod ends aorn	Install new tie rod ends
Excessive play in front wheel suspension	Worn bearing points (torsion arms stub axle, and front wheel bearings)	Check adjustment of torsion arms and front wheel bearings. Adjust parts with excessive play or replace if necessary
Vehicle pulls to one side	a - Tire pressures uneven. The vehicle pulls to the side with low pressure	a - Check pressures and rectify
	b - Tires unevenly worn. The vehicle pulls to the side on which the tires are most worn	b - Rotate or install new tires
	c - Toe-in out of adjustment	c - Adjust toe-in
	d - Steering damper defective	d - Install new damper
	e - Difference between front wheel camber excessive. The vehicle pulls to one side if the camber differs more than 20′ between sides	e - Check camber
Front wheel wobble	a - Wheels are not balanced	a - Balance wheels (see section B)
	b - Steering out of adjustment	b - Adjust steering
	c - Steering damper defective	c - Install new damper
	d - Shock absorber defective	d - Install new shock absorber
	e - Front axle worn	e - Overhaul axle
	f - Wheel alignment out of adjustment	f - Correct wheel alignment

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Checking the steering gear of accident vehicles

Whenever repairs are performed to the front end of a vehicle that has been involved in an accident the steering must be very carefully checked as follows:

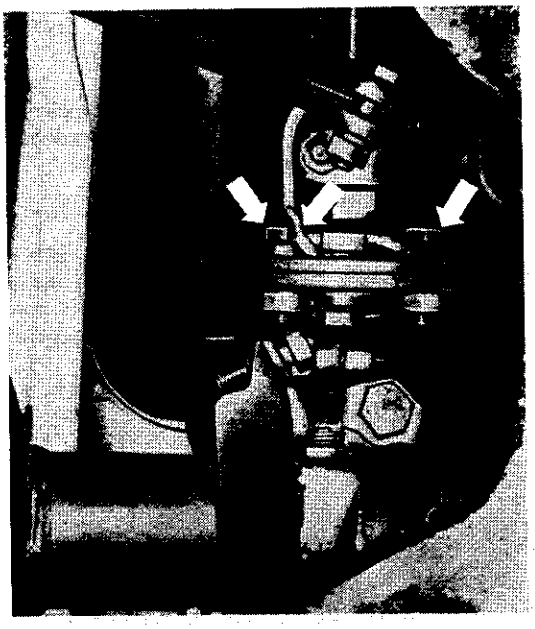
1 - The steering gear and all component parts must be checked for fractures, cracks, distortion and also for security of mountings etc.

2 - In addition the steering must be checked, both with the vehicle standing on its wheels and with the front end jacked up, by turning the steering wheel repeatedly to both full lock positions and checking for excessive play, noises, jamming, sticking, grinding and uneven movement.

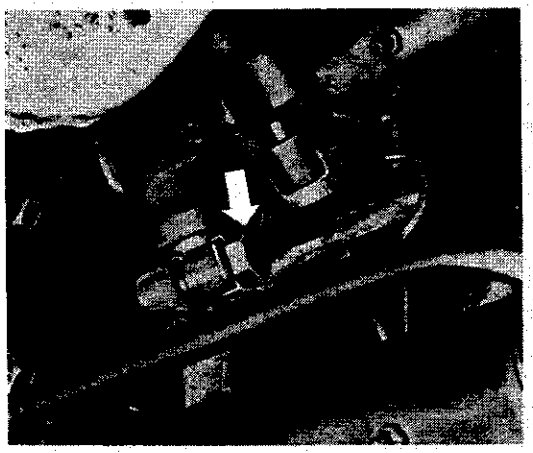
Where such defects are noted, the steering gear must either be repaired or replaced.

Removing

When removing the steering gear, it is advisable to pull the drop arm off the shaft. The tie-rods need not be taken off the drop arm. The arm remains on the vehicle.

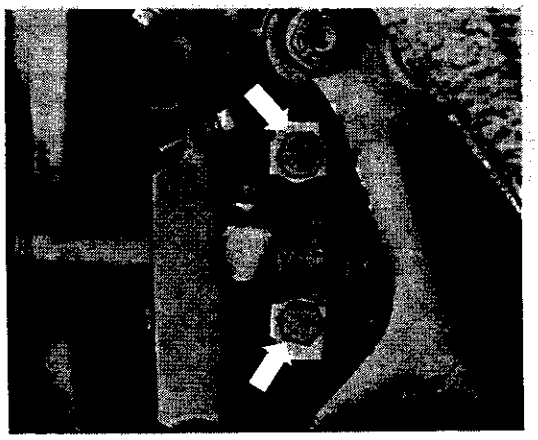


1 - Pull horn ground cable off. Remove bolts from upper flange of column coupling.



2 - Bend lock plate for the drop arm securing bolt and remove bolt.

3 - Pull drop arm off shaft. Turn wheels to a suitable angle.



4 - Bend lock plate for steering gear mounting clamp bolt. Remove bolts.

5 - Remove steering gear.

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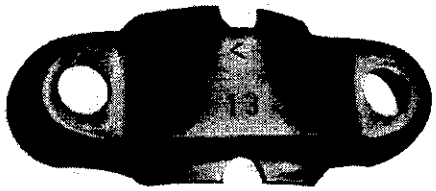
Installing

The position of the steering gear on the upper tube is controlled by two stops welded to the tube as well as cutouts in the mounting clamp.

1 - Install steering gear on the axle tube with the appropriate cutout in the clamp on the left and the arrow pointing forward. Install a new lock plate, tighten bolts to correct torque and lock.



13 = for 113 and 151

14 = for Karmann Ghia

2 - Place drop arm on shaft, install bolt with new lock plate, tighten to correct torque and lock.

3 - Attach upper flange on column to coupling and tighten nuts to correct torque. **Use new self-locking nuts.**

4 - Connect horn ground cable.

5 - Check toe-in and adjust if necessary.

Tightening torques

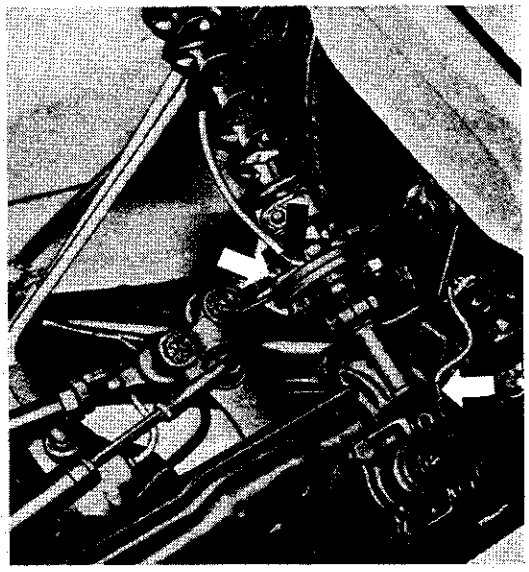
Location	Description	Thread	Quality grade	Tensile class	mkg	lb. ft.
Steering gear to front axle	bolt	M 10	8 G	8.8	2.5—3	18—22
Drop arm to shaft	nut	M 12×1.5	8 G	8.8	7.0	51
Coupling flange to disc	nut	M 8	6 G	8	1.5	11

Removing

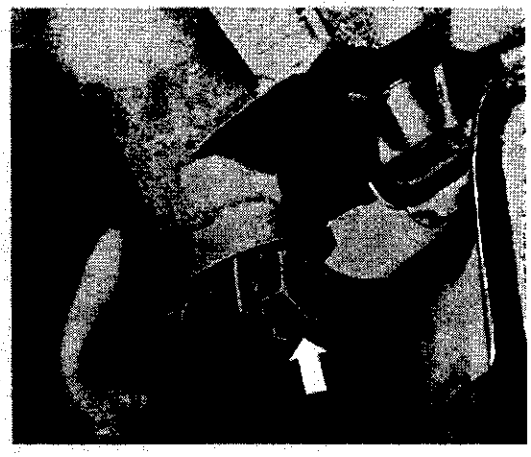
To remove the steering gear, it is necessary to remove the spare wheel well and the fuel tank. The drop arm can now be pulled off the shaft.

1 - Take spare wheel well and fuel tank out.

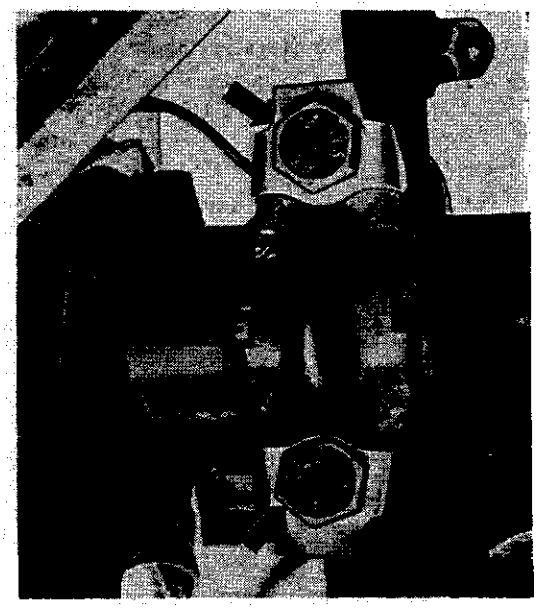
2 - Pull horn ground cable off the connector on the steering column coupling (arrow A), remove bolts holding upper part of flange (arrow B) and bolt holding the ground connection from steering gear to axle retainer (arrow C).



3 - Bend lock plate for drop arm securing bolt and remove bolt.



4 - Bend lock plate for the bolts holding the steering gear clamp. Remove bolts.



5 - Take steering gear.

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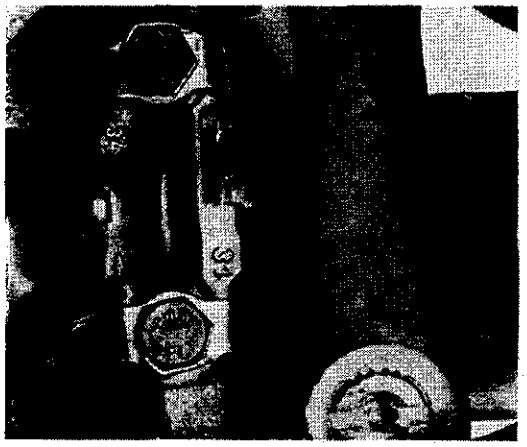
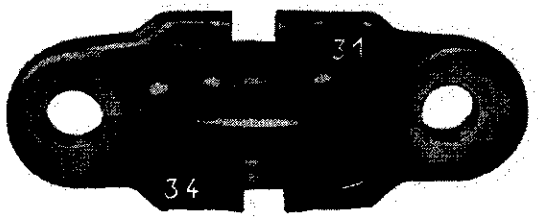




LHD:

Cutout "31" for Sedan and Squareback
Cutout "34" for Karmann Ghia, Type 3

Installing

The position of the steering gear on the axle tube is controlled by a stop.

1 - Install steering gear and fit drop arm on shaft.

2 - Install retaining clamp with new lockplates. The clamp should be placed on the axle tube with the appropriate cutout engaged in the stop on the axle.

3 - Tighten clamp securing bolt to correct torque and lock.

4 - Tighten drop arm securing bolt to correct torque and lock. Always use a new locking plate.

5 - Insert bolts for upper column flange, install **new self-locking nuts** and tighten to correct torque.

6 - Connect horn ground cable to the column coupling and attach steering gear ground cable.

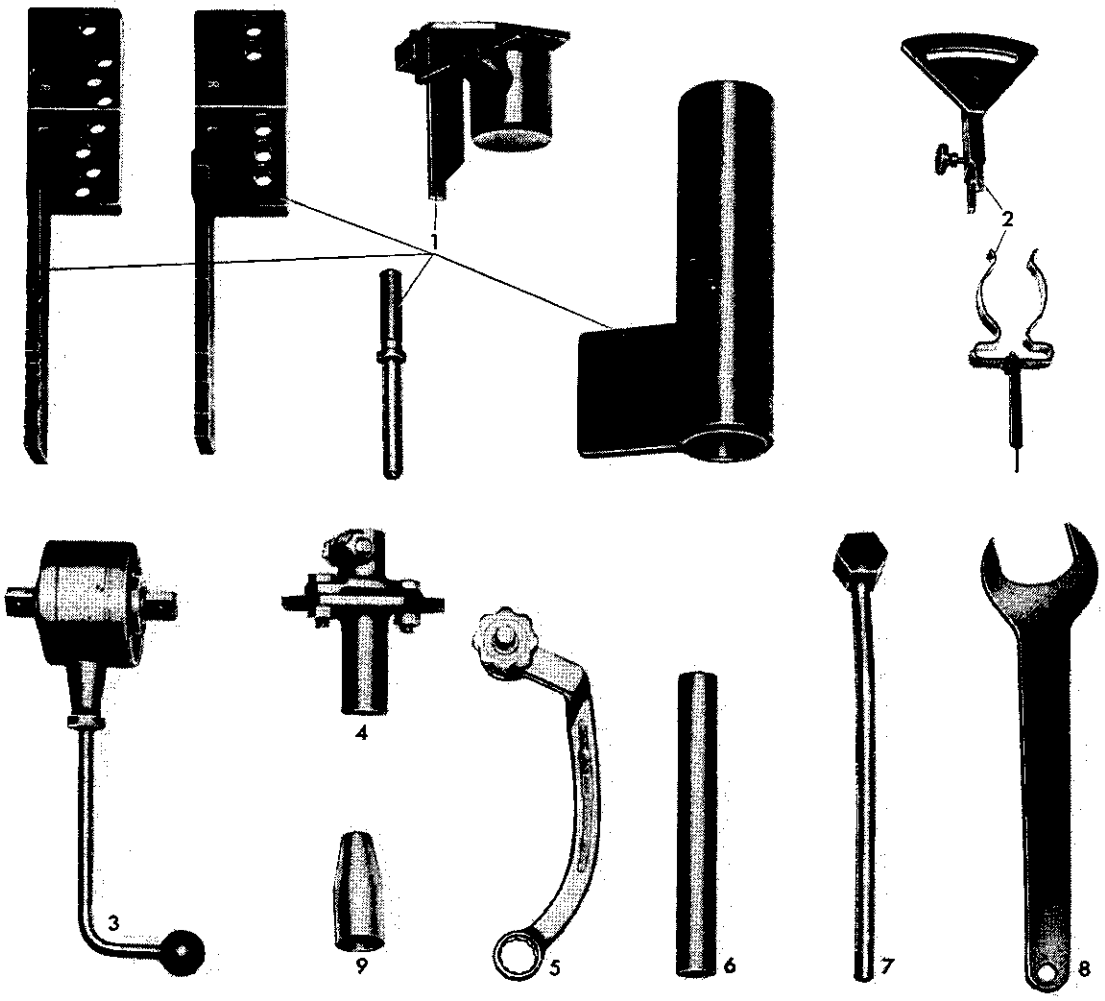
7 - Install fuel tank and spare wheel well.

8 - Check toe-in and adjust if necessary.

Tightening torques

Location	Description	Thread	Quality grade	Tensile class	mkg	lb. ft.
Steering gear to front axle	Bolt	M 10	8 G	8.8	2.5—3.0	18—22
Drop arm to shaft	Bolt	M 12×1.5	8 G	8.8	7.0	51
Coupling flange to disc	nut	M 8	6 G	8	1.5	11

Tools



No.	Description	Tool No.	Explanation
1	Repair and checking tools	VW 280	
2	Setting devices	VW 279	
3	Torque gauge		standard type, from 0—30 cmkg
4	Adaptor	VW 758/1	
5	Special wrench	2569	17 mm
6	Tube	VW 423	
7	Spindle adjusting wrench	VW 278a	
8	Open-end wrench	VW 277	

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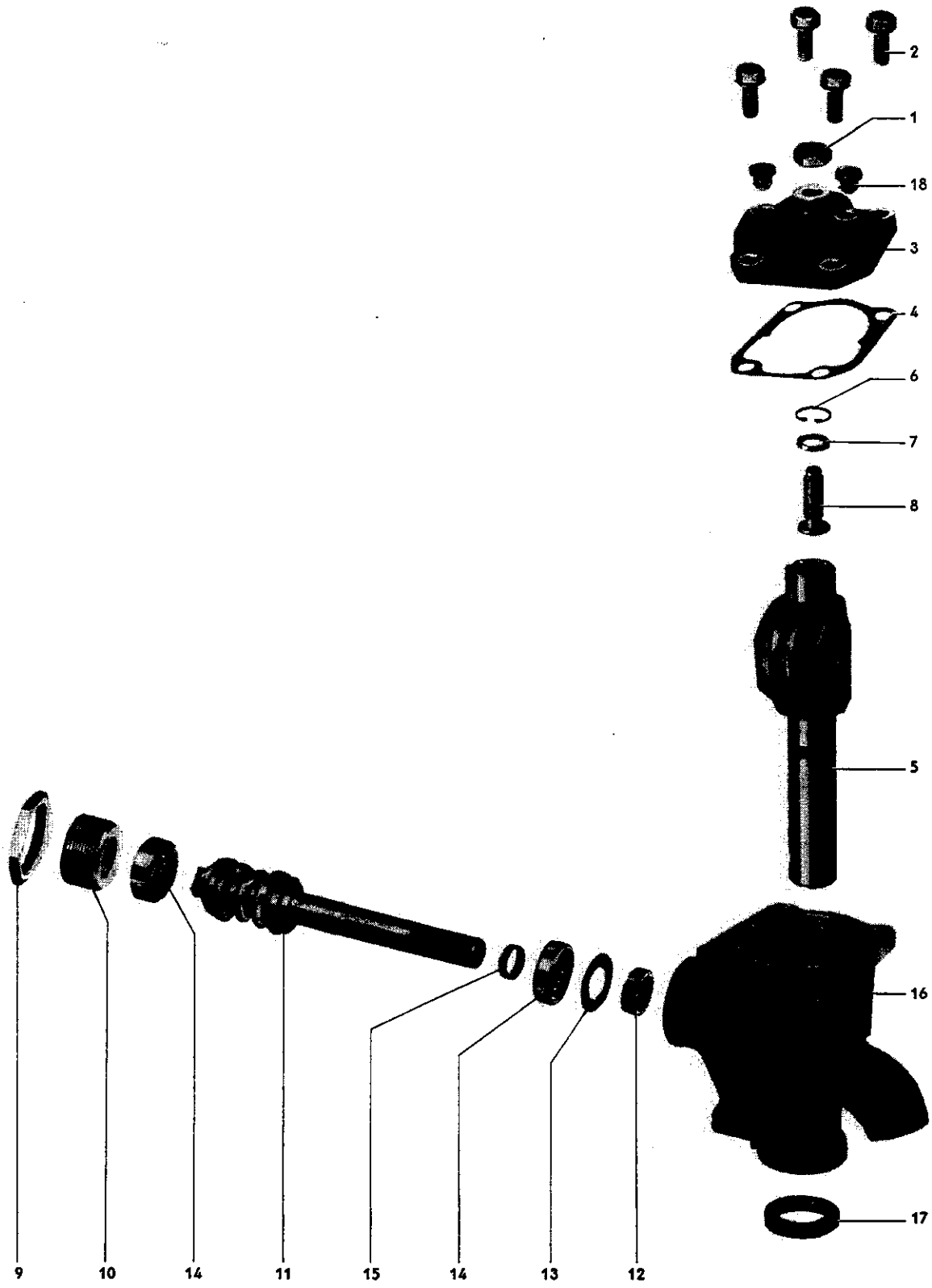
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No.	Description	Qty.	Note when disassembling	assembling	Special instructions see
1	Locknut for adjusting bolt	1			V 8.1/4
2	Bolt M 8×20 and spring washer M 8×15	4 of each		tighten to correct torque	V 8.1/4
3	Housing cover	1	detach by turning adjusting screw (No. 8) and remove	fill housing with liquid transmission grease. Install cover. Before tightening bolts, move cover to side opposite that of spindle if the modified cover marked "KD" is installed use longer bolts.	V 8.1/4
4	Gasket for cover	1		always install new gasket	
5	Drop arm shaft	1	turn spindle to center position, push oil seal protection sleeve VW 649 over splines, press shaft out upward with a punch	check shaft and adjusting screw for damage. Turn screw through the cover	V 8.1/4
6	Circlip 17×1	1		must fit properly in groove in shaft all around	
7	Adjusting washer	x		select as detailed	V 8.1/4
8	Adjusting screw	1		if washer has been selected properly, it should just be possible to turn screw in shaft with thumb and fore-finger, without lateral play	V 8.1/4
9	Lock nut for adjuster	1	loosen with wrench VW 277	tighten to correct torque after adjusting spindle axial play	V 8.1/4
10	Adjuster	1	screw out with VW 278	use sealing compound when installing, tighten, back off and tighten again until spindle turning torque is obtained: 1.5—2.5 cmkg (1.3—2.2 in. lb) 2.0—3.0 cmkg (1.7—2.6 in. lb) with seal installed (No. 12)	V 8.1/4 V 8.1/5
11	Worm spindle	1	knock out with rubber hammer	install with upper bearing and medium thickness washer 0.35 mm (1.378 in.) No 13. Adjust axial play, see turning torque under No. 10	V 8.1/4
12	Seal for spindle	1	knock inward together with washer and upper bearing, using tube VW 423	after adjusting, press seal in with VW 423	V 8.1/4
13	Adjusting washer	x		when installing spindle, use a medium washer 0.35 mm (1.378 in.). If free-of-play movement to left is larger than 11°±2°, use thicker washer; if free-of-play movement to left is less than 11°±2°, use thinner washer	V 8.1/4
14	Ball thrust bearing	2			
15	Marking ring	1		mark center position with ring and secure with paint	
16	Housing	1		fill with 160 cc (5.4 oz.) of transmission grease	
17	Oil seal for shaft	1			
18	Plug for cover	2			

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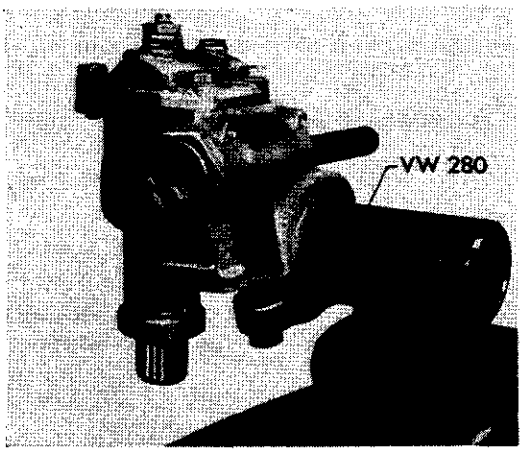
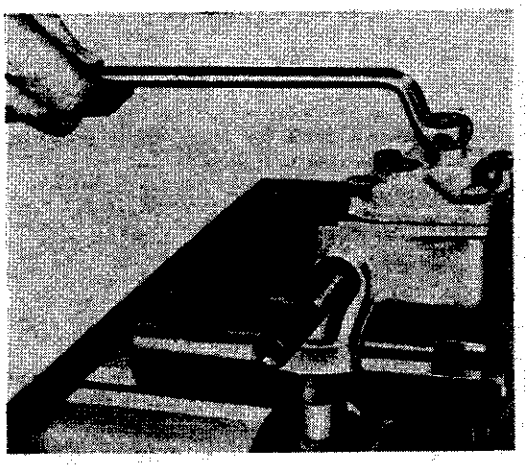
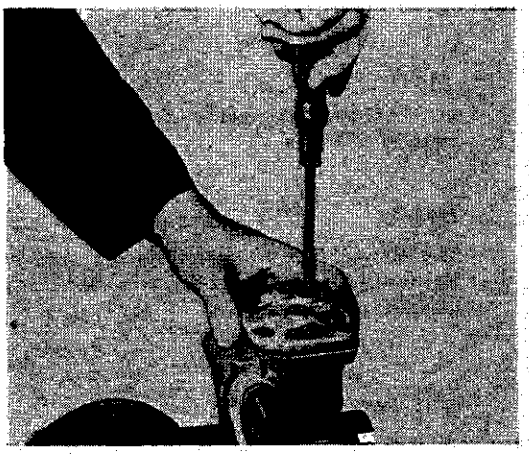
1 - Bolt steering gear onto mounting tube VW 280. The exact position is controlled by a stop on the tube.



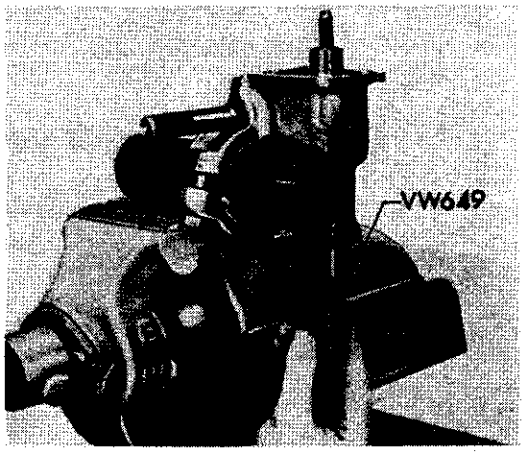
2 - Remove lock nut on drop arm shaft adjusting screw. Remove four cover securing bolts.



3 - Detach cover from shaft by turning the adjusting screw and take cover off.



4 - Slide oil seal protective sleeve VW 649 over splines on drop arm shaft as far as it will go.



5 - Turn steering worm to center position: push drop arm out upwards with a drift.

6 - Remove grease from housing.

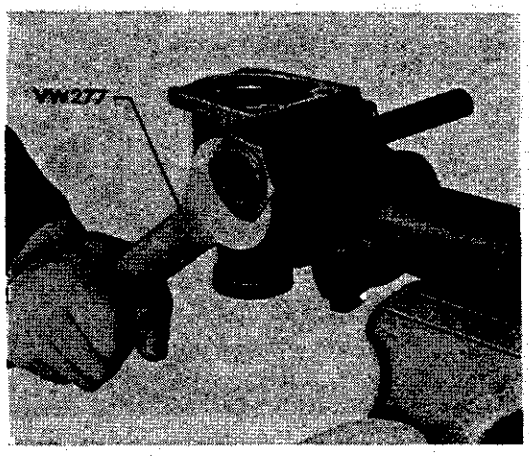
7 - Take circlip for drop arm shaft adjustment out.

8 - Take adjusting screw and shim out of the drop arm shaft.

Note:

The drop arm shaft cannot be dismantled any further.

9 - Loosen the lock nut on the worm spindle adjuster with open-end wrench VW 277.



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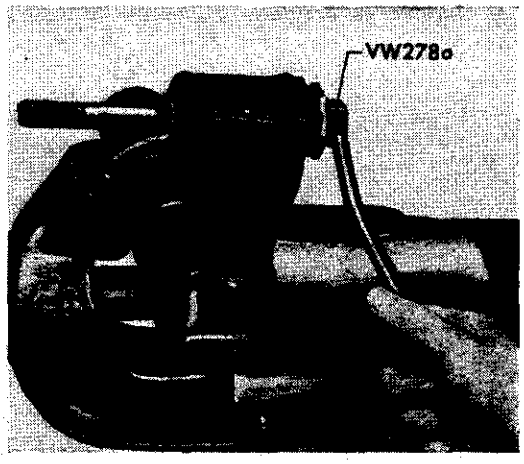
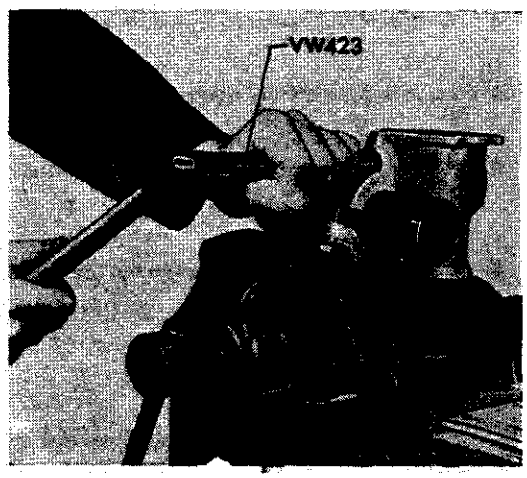


10 - Screw adjuster out with wrench VW 278a.

11 - Take marking ring off.

12 - Remove worm spindle and lower ball bearing by tapping lightly with a rubber hammer.



13 - Drive oil seal, shim and upper bearing inwards with tube VW 423.

14 - Check all parts for wear and damage and replace where necessary.

Assembling

When assembling the steering gear, the worm and roller must be adjusted in a way that the free-of-play movement is approximately the same in both directions by selecting a shim of the correct thickness. It is advisable to install a shim of medium thickness (0.35 mm/.0138 in.) first.

The correct shim is then determined with the appliances VW 279 and VW 280.

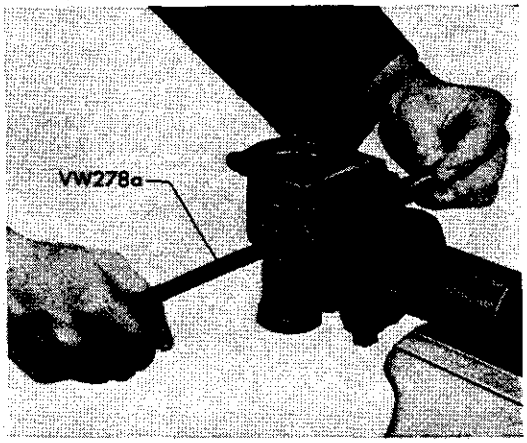
1 - Insert worm spindle into housing with the upper bearing and shim.

Note:

The oil seal for the worm spindle must not be installed until the steering has been assembled and adjusted.

2 - Install lower bearing.

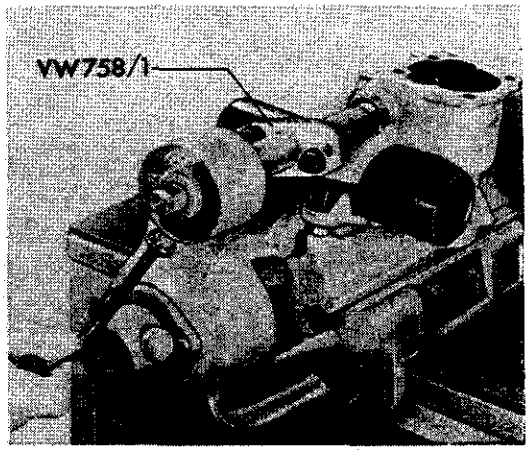
3 - Install worm adjuster with sealing compound and tighten lightly with VW 278a to press the bearings onto their seats.



4 - Loosen adjuster and tighten again until the worm feels rough when turned.

The torque required to turn the worm spindle should be 1.5 to 2.6 cmkg (1.3 to 2.2 in. lb). 2.0 to 3 cmkg (1.7 to 2.5 in. lb) with oil seal installed. A special torque wrench is required for this purpose.

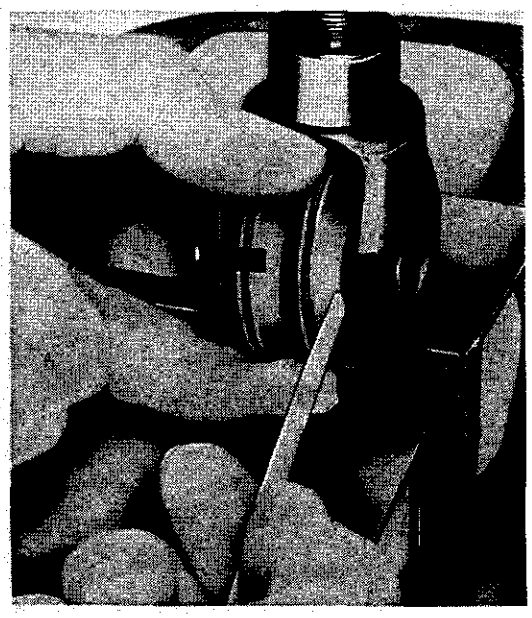
5 - Tighten the adjuster locknut and check the spindle adjustment again.



6 - Assemble drop arm shaft:

a - Check axial play of roller. The play must not exceed 0.04 mm (0.001 in.). It is checked between roller and washer with a 0.05 mm (0.002 in.) feeler blade. If the blade can be pushed between roller and washer, a new shaft must be installed.

b - Check adjusting screw. If the threads or the thrust surface are damaged, a new screw must be used.



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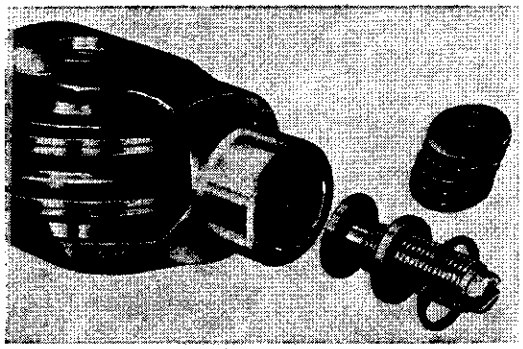
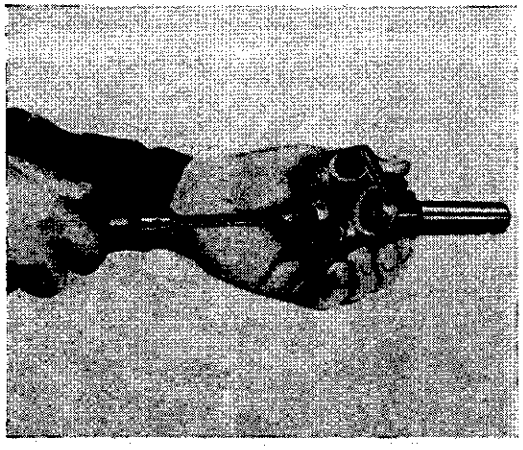


c - Place adjusting screw and shim in the end of the shaft and secure with circlip. The thickness of the shim should be selected so that the screw can just be turned with thumb and forefinger without lateral play. The shims are available in thicknesses from 2.0 mm (0.08 in.) to 2.5 mm (0.098 in.) in 0.05 mm (0.002 in.) steps.

Caution

The circlip must seat properly in the groove all the way around.



7 - Attach drop arm shaft to housing cover by inserting the adjusting screw through the cover as far as it will go.

Modification
Type 1 from Chassis No. 111 2517 788, Jan. 71
Type 3 from Chassis No. 311 2131 806, Febr. 1971

The material for the steering gear cover has been changed to an aluminium alloy (previously magnesium alloy).

Also a new gasket between the housing and cover as well as longer bolts (M 8×25) are installed.

To identify this modified cover the letters "KD" are stamped on it in addition to the Part Number. When this cover is used as a spare part make sure that the longer bolts (M 8×25) are also used.

8 - Insert oil seal protection sleeve VW 649 into housing.

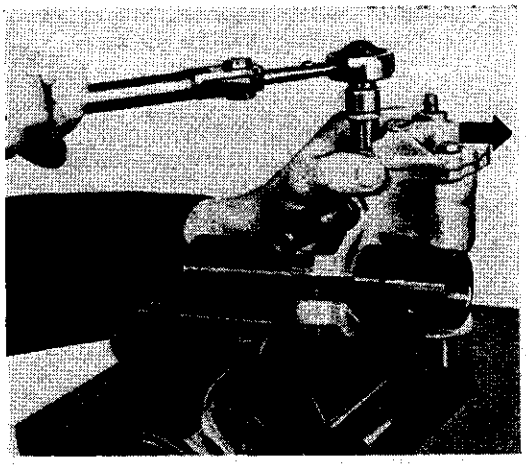
9 - Install drop arm shaft in housing with the roller at right angle to the worm.

Note

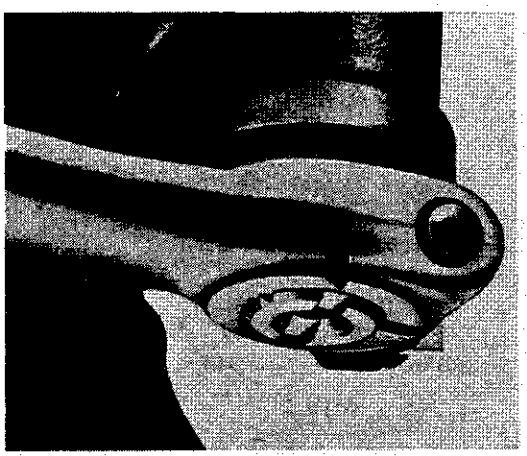
Do not put grease into housing until steering gear has been adjusted.

10 - Tighten cover bolts to 2.0—2.5 mkg (15—18 lb. ft.). While doing this, press the cover against the housing on side opposite to worm as shown by arrow. This will prevent the cover from moving and causing premature play in the steering.

To adjust the steering gear, fit the appropriate drop arm on the shaft.



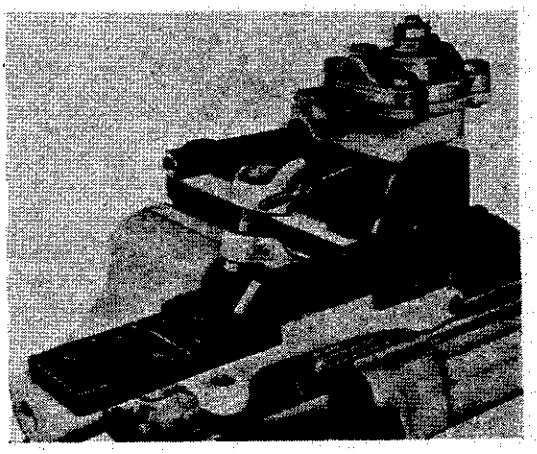
11 - Push drop arm on until upper edge is level with the chamfer on shaft. Tighten securing bolt to 7.0 mkg (51 lb. ft.) and lock.



12 - Check operation of steering by moving drop arm back and forth several times.

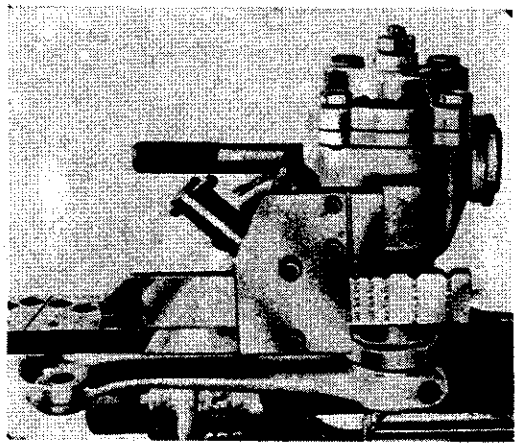
Adjusting

1 - Place measuring head of appliance VW 280 in the mounting tube and clamp in position. Ensure that the feeler plate on the head contacts the worm spindle.



539.301.23 Printed in Germany 4. 69

2 - Move the setting plate until the appropriate drop arm number is under the mark:



Typ 1

L = Left hand drive
up to August 1965

113 415 371 — 113 - 117 - 151
141 415 371 a — 141 - 143

from August 1965

131 415 371 — 113 - 117 - 151
141 415 371 B — 141 - 143

Type 3

L = Left hand drive

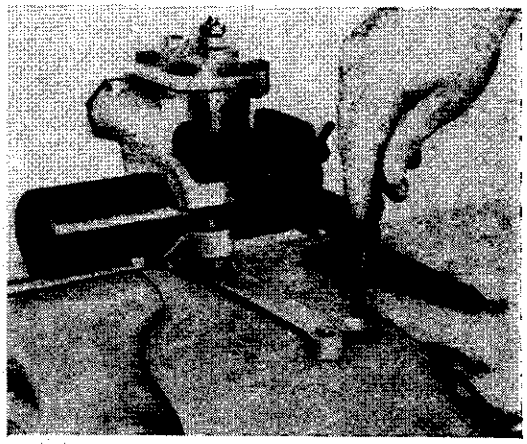
311 415 371 — 311 - 361

3 - Move drop arm to center position:

a - Align right hand hole in drop arm roughly under the appropriate hole in plate.

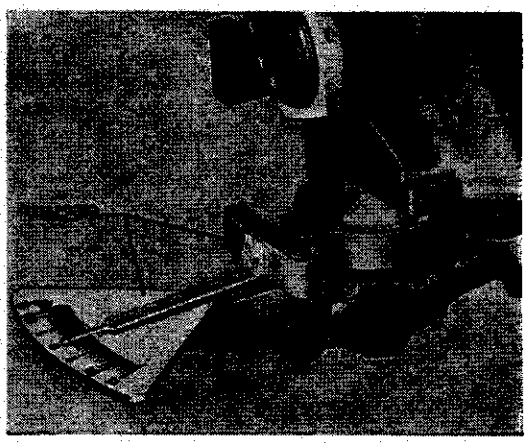
b - Insert pilot into correct hole in plate.

c - Move drop arm and plate slightly until the pilot fits the hole in the drop arm.



4 - Insert scale of setting device VW 279 into slot in drop arm and clamp in position.

5 - Install finger of VW 279 on housing and set to zero.



6 - Pull pilot out.

7 - Turn drop arm 11° to left or right.

Important

The angle of 11°±2° is only applicable when drop arm shaft and worm spindle or one of these parts has been replaced. Otherwise the steering should be set to 5°.

8 - Turn drop arm shaft adjusting screw in until no further play can be felt. While doing this, move the drop arm slightly and hold the worm spindle with other hand. The column coupling flange should be fitted on the worm spindle to enable it to be held properly.

9 - Tighten the lock nut of adjusting screw to correct torque.

10 - Check the no-play range on the other lock. It should be possible to turn the worm through the center position with a torque of 9—12 cmkg.

At 11°±2° there should be no detectable play at the drop arm. If play can be felt at this angle, dismantle the steering gear again and correct the setting of the worm to the roller by installing a different shim:

a - No-play angle to left side of scale is larger than 11°±2°.

Fit a thicker shim.

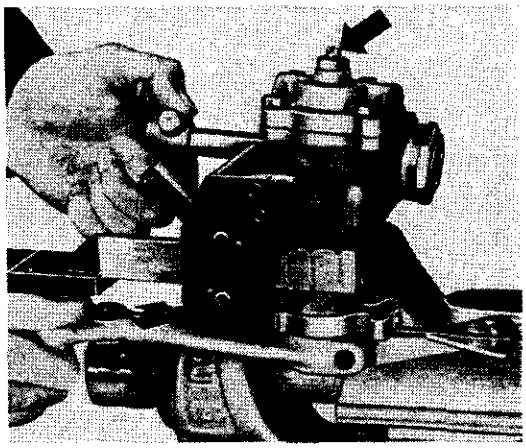
b - No-play angle to left side of scale is smaller than 11°±2°.

Fit a thinner shim.

The adjustment should be repeated until the necessary degree of accuracy is obtained. Shims are available in thickness from 0.20 mm (.008 in.) to 0.50 mm (.02 in.) in 0.05 mm (.002 in.) steps.

11 - When adjustment is completed, press the worm spindle oil seal in with 21.5 mm (.846 in.) diameter tube VW 423.

12 - Take lock nut off drop arm shaft adjusting screw.



13 - Remove four cover securing bolts.

14 - Loosen cover by turning adjusting screw and take cover off.

15 - Fill housing with transmission grease (approx. 160 cc/5.4 oz.). Move the drop arm shaft about slightly while putting the grease in so that all air escapes and the proper quantity can be put in.

16 - Fill the adjusting screw hole in the drop arm shaft with transmission grease.

17 - Install new plastic plugs in housing cover.

18 - Install cover with a new gasket and insert bolts. Press the cover away from the steering worm and tighten the screws to the correct torque (see V 8.1/4-9).

19 - Adjust drop arm shaft again as described at points 7 to 9.

20 - Mark center position with a new marking ring and secure with paint.

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Checking and Adjusting Steering Gear (Installed)

A - **Checking** (steering gear installed)

The vehicle must not be lifted when checking the roller steering.

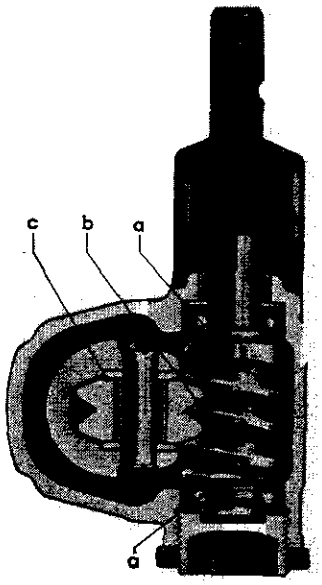
1 - Set the front wheels to straightahead position.

2 - Move the steering wheel lightly, holding outer end of spoke, until resistance is felt in both directions. This movement at the center position is determined by the steering adjustment and by the linkage (tie rods and coupling disc). It must not exceed max. 25 mm (1.0 in.), measured on the circumference of the steering wheel.

B - **Adjusting**

Excessive play at the center position can be caused by three things. These points should be checked in the following order:

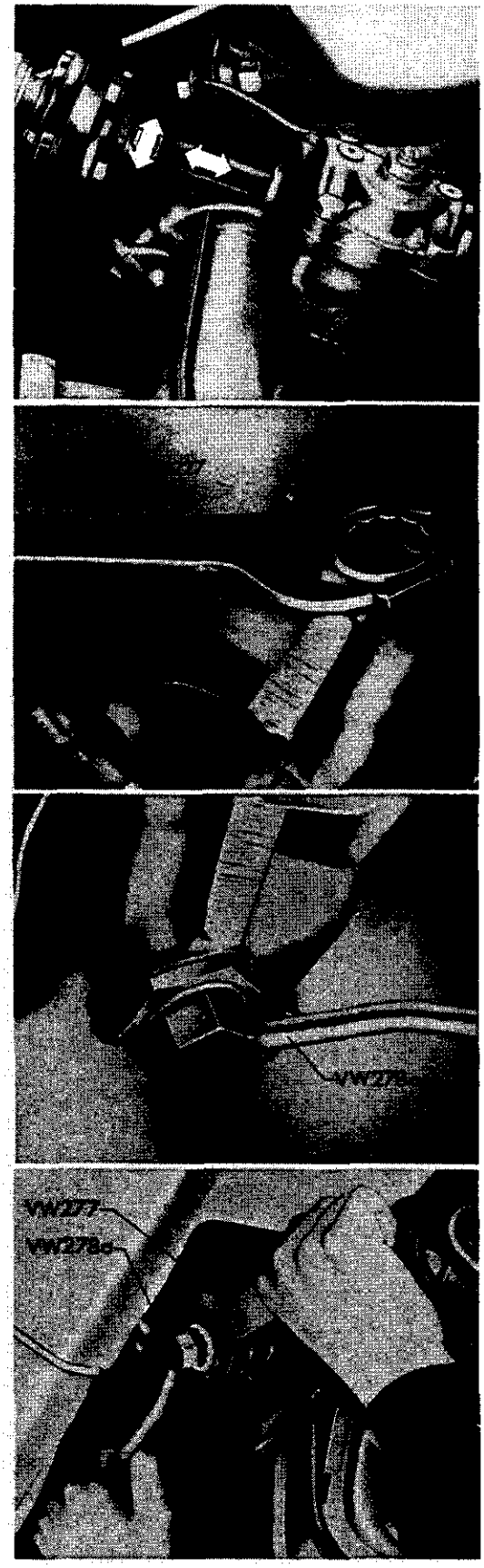
a = Axial play of worm spindle
b = Play between roller and worm
c = Axial play of roller



Note

Before adjusting the steering gear, the cesurity of the steering gear housing cover bolts and the steering gear mounting bolts must be checked. Loose bolts must be tightened to the specified torque.

539.307.23 V 7th Supplement Printed in Germany 5.71



a - Axial play of worm spindle

The worm spindle axial play is determined by turning the spindle at the steering coupling with the vehicle lifted. If there is play it can be eliminated as follows:

1 - Turn steering fully to left ro right.

2 - Loosen locknut on worm spindle adjuster with special wrench VW 277.

3 - Turn worm spindle and tighten the adjuster with special wrench VW 278a at the same time until play can no longer be felt.

4 - Hold adjuster and tighten lock nut with special wrench VW 277.

5 - Turn worm spindle from lock to lock. There should be no tight spots. Should there be any, the adjuster has been moved in too far and the adjustment has to be rectified.

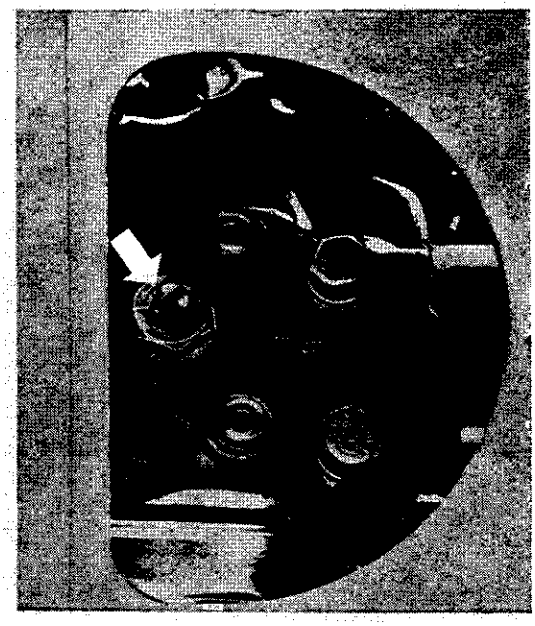
b - Play between roller and worm

If play in the steering gear cannot be eliminated by adjusting the worm spindle, the roller to worm setting must be adjusted. There should be no play between roller and worm with the steering gear in the center position. The roller to worm adjustment can be made with the vehicle lifted. To check the adjustment, however, the vehicle must be standing on the ground.

1 - Turn steering wheel 90° to left or right.

2 - Loosen locknut on drop arm shaft adjusting screw and turn adjusting screw out about one turn.

3 - On **Type 1** / Sedan 111 vehicles, the adjusting screw (arrow) is accessible through the hole in the luggage pan.



On **Type 3** vehicles, the spare wheel well must be taken out. The steering gear is then adjusted with the special roller steering wrench.

4 - Turn adjusting screw in until roller can be felt contacting the worm.

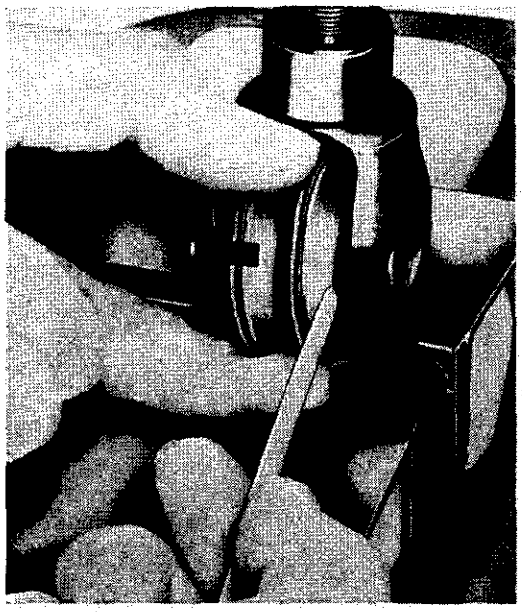
5 - Hold screw and tighten lock nut.

6 - With vehicle standing on wheels, turn steering wheel 90° to each side and check adjustment. The play at this point must not exceed 25 mm (1 in.), measured at the circumference of the steering wheel. If there is more play on one side, the adjustment of the roller to worm must be repeated on this side at 90°.

7 - Check toe-in and rectify if necessary.

8 - Road test the vehicle. If the steering does not return to about 45° from the center position after taking a corner at 10—12 mph, the roller setting is too tight. The adjustment should then be repeated, otherwise the worm and roller will be damaged.

539.307.23 V 7th Supplement Printed in Germany 5.71



c - Axial play of roller

If the steering cannot be adjusted properly by carrying out the adjustments described so far, the steering gear must be removed, disassembled and the axial play of the roller checked.

1 - Check roller axial play. The play must not exceed 0.04 mm (.0016 in.).

Measure the clearance between roller and washer (arrow) with a 0.05 mm (.002 in.) feeler gauge. If the feeler blade can be pushed between roller and washer, the complete drop arm shaft must be replaced.

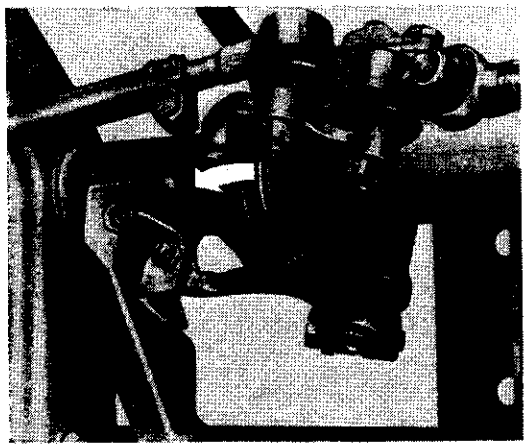
2 - Assemble steering gear, adjust and install

3 - Check toe-in, rectify if necessary.

4 - Road test vehicle.

Type 1

The wheel lock to left and right is limited by two adjustable stops on the axle beam which contact the drop arm.



When correcting the wheel lock, the bolts in the steering stops on the axle beam must be set so that there is always a gap of 10 mm ± 1 mm (.4 ± .04 in.) between upper torsion arm and tire. This dimension, which is measured with the vehicle lifted with the wheels fully extended and on full lock, ensures that there is adequate clearance between wheel housing and wheels under all load conditions.

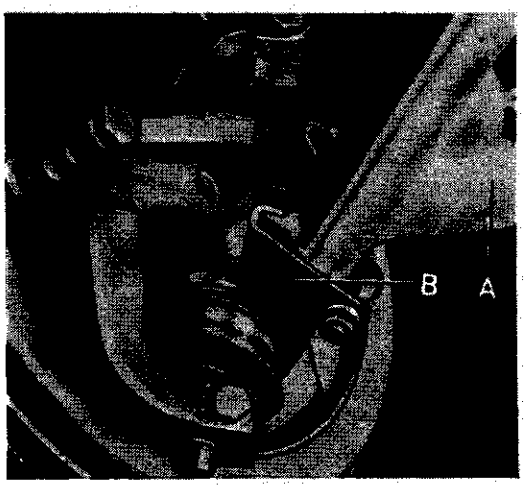
Type 3

If the steering lock on a vehicle is too great the front tires will tend to rub on the wheel housings.

This can be eliminated by installing clips on the torsion arms.

The clip is pushed over the torsion arm and secured with a bolt M 8 × 35, a washer 8.1, a spring washer B 8 and a nut M 8.

If this makes the diameter of the turning circle too large, the clips should be removed again and the lugs on the torsion arms ground down slightly. When grinding the lugs, however, take care not to reduce the clearance between tire and wheel housing to less than 35 mm (1.37 in.) with the clip installed. The vehicle must be empty and should not be lifted or supported when measuring.



a = Lower torsion arm
b = Clip

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Workshop Bulletin

No. F

(Supersedes W. B. F of 15 February 1973) of 4 June 1974

Subject:	Type/Model:
Adjusting overheating switch on BN 4 heater in Type 1/Model 181 and Type 2	1 / Model 181 2

see workshop manual

The overheating switch can be adjusted only when installed. Adjustment is necessary when a new switch is installed or when the setting is not correct. The switch cannot be set to temperature readings but to the upper cut-off value of the temperature regulating switch.

These instructions do not apply to the BN 2 heater.

Printed in Germany 0.00.578.024.21

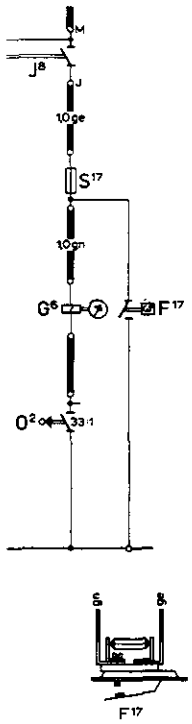
see workshop manual

Adjusting instructions

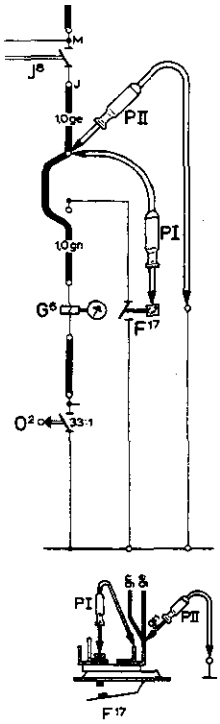
When adjusting the switch on Type 1 Model 181, use a new temperature regulating switch.

1 - Connect wires and test lights to overheating switch as shown in wiring diagram and illustrations. Take overheating fuse out.

Standard wiring layout



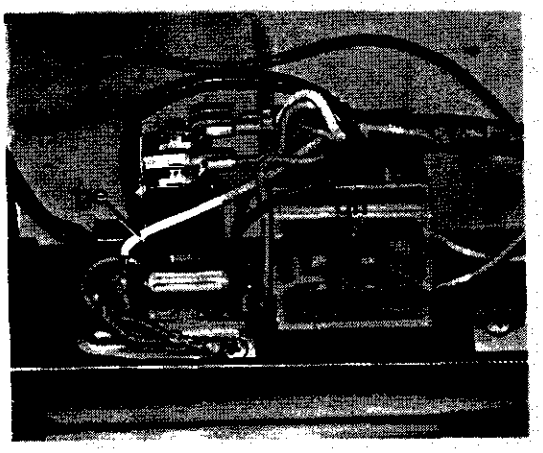
Test wiring layout

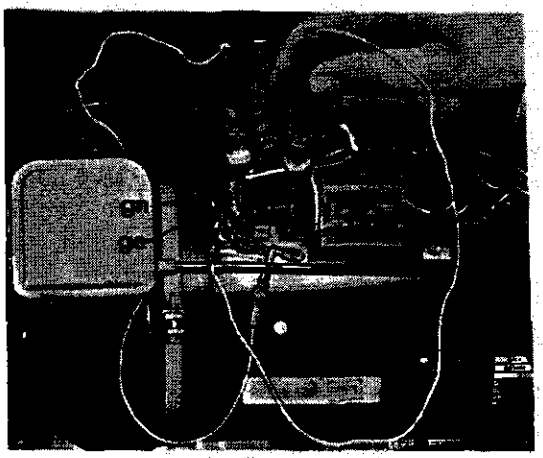


gn = green

ge = yellow

J 8 = Relay (controlled by temperature regulating switch)
S 17 = Overheating fuse
G 6 = Metering pump
F 17 = Overheating switch
P = Test light
O 2 = Breaker contacts in combustion air blower





see workshop manual

2 - Start engine.

3 - Switch heater on.

4 - Set to maximum output: Pull Bowden cable out all the way. Type 1/Model 181: Move lever on warm air outlet up so that warm air is directed to the windshield.

5 - Close vehicle doors.

6 - Wait until heater has regulated four times (Heater goes out, test light II goes out).

7 - Remove green paint from adjusting screw of overheating switch and turn adjusting screw in as far as it will go.

8 - When heater starts again (test light I and II light up) turn adjusting screw out slowly until test light I just goes out.

C a u t i o n

If the test light II goes out, do not turn adjusting screw further. Continue adjustment after test light II has come on again.

9 - Switch heater off.

10 - Take test lights off.

11 - Turn adjusting screw of overheating switch out as follows:

Type 1/Model 181	- 1 turn
Type 2 Delivery Van, Combi, Station wagon	- 3 turns
Type 2 Pick-up	- 2 turns

12 - Seal adjusting screw with a different colored paint.

13 - Connect green wire to the appropriate connector on the overheating switch.

14 - Install overheating fuse (8 amp.).

15 - Type 1/Model 181: Install old temperature regulating switch.

(If the overheating switch fuse blows during the test run, the temperature regulating switch should be replaced. Before doing this, however, check that the air circulation duct is not blocked).

Workshop Bulletin

No. H

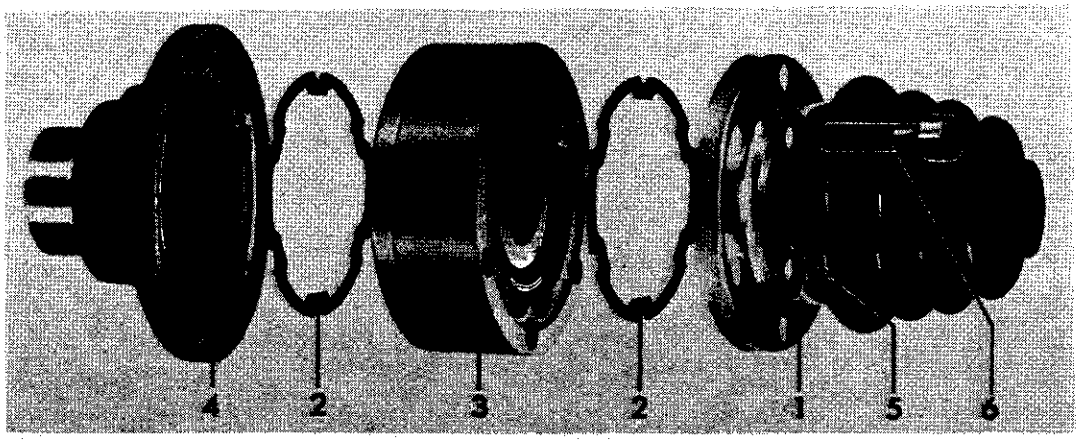
(Supersedes W.B. H of 15 February 1974)

of 5 June 1974

Subject:	Type/Model:
Constant Velocity Joints	1/Model 181 4

see workshop manual

To improve sealing of C.V. joints, a gasket was installed on both sides of the joint. Both drive flange and joint have a recess for the gasket.



1 - Gap and boot
2 - Gasket
3 - Joint
4 - Flange
5 - Plate
6 - Socket head screw

Repair instructions

During repairs, joints and flanges should be checked whether they have a recess for the gaskets.

Parts with recess - Install gasket

Parts without recess - Do not install gasket

When installing shafts, be sure to position gasket in recess. If necessary hold them in place with some grease when assembling joints. Gaskets which are not properly positioned will cause socket head bolts to become loose. The tightening torque for socket head bolts remains unchanged (4.5 mkg / 32 ft lb). If gaskets are not available, drive flanges and joints without recess for gasket (Type 181) should be installed as otherwise grease will leak from joints.

Printed in Germany 0.00.574.126.21

SERVICE

Workshop Bulletin

No. V

(Supersedes Workshop Bulletin V of 16 June 1972) of 29 Sept. 1973

Subject:	Type/Model:
Values for wheel alignment checks	1, 2, 3 and 4

see workshop manual

This bulletin contains the current alignment specifications for front and rear axle of all models. Previous bulletins pertaining to alignment are herewith superseded.

Workshop Bulletin "Torsion bar adjustment" contains all the necessary dimensions and specifications for their adjustment.

Make adjustments as close as possible to values given. Avoid using the tolerances to their fullest extent.

All measurements are made with vehicle unladen, fuel tank full, tires inflated to pressures for maximum vehicle weight, with vehicle properly aligned and suspension bounced.

Printed in Germany 3.48.5 73.064.21

see workshop manual

Type 1

Link pin and ball joint front axles

Total toe, wheels not pressed		+30' ± 15'
Total toe, wheels pressed		+5' ± 15'
Applied pressure		22 ± 4 lbs. (10 ± 2 kg)
Maximum permissible difference between total toe with wheels pressed and not pressed		25'
Camber in straight-ahead position		
from Chassis No. 116 000 001		30' ± 20'
up to Chassis No. 115 979 202		40' ± 30'
Maximum permissible difference between sides		30'
Toe angle difference at 20° lock to left and right (not pressed)		
a - from Chassis No. 116 000 001	to left	-1°20' ± 30'
	to right	-2°10' ± 30'
b - up to Chassis No. 115 979 202		-2° ± 30'
c - De Luxe Sedan and Convertible up to Chassis No. 1 430 497	to left	-1°40' ± 30'
	to right	-2°30' ± 30'
Maximum permissible difference between sides		1°
d - Karmann Ghia up to Chassis No. 1 644 421		-2° ± 1°
Offset between stub-axles in direction of motion		max. 8 mm
Caster angle of a wheel		3°20' ± 1°
Corresponds to camber difference of a wheel on a lock from 20° left 20° right		2°15' ± 40'

Strut front axle

Total toe, wheels not pressed		+30' ± 15'
Total toe, wheels pressed		+10' ± 15'
Applied pressure		22 ± 4 lbs. (10 ± 2 kg)
Maximum permissible difference between total toe with wheels pressed and not pressed		max. 25'
Camber in straight-ahead position		1° + 20' ± 40'
Maximum permissible difference between sides		30'

see workshop manual

Toe angle difference at 20° lock to left and right (not pressed) all models	-30' ± 30'
Offset between stub axles in direction of motion	max. 11 mm
Caster angle of a wheel (measured with the vehicle standing horizontally)	2° ± 35'
Corresponds to camber difference of a wheel on a lock from 20° left to 20° right	1°20' ± 25'

Rear axle

Camber with spring plates correctly set (after at least 300 miles in use)	
a - All models with double joint rear axle *)	-1° ± 40'
Model 181	+20' ± 40'
b - Vehicles with swing axle	
Model 11 from Chassis No. 117 000 001	+1° ± 1°
permissible minimum camber	-1°
Model 14 from Chassis No. 147 000 003	+15' ± 1°
Model 15 up to Chassis No.157 000 002	
permissible minimum camber	-1°30'
all models up to Chassis No.116 1 021 298	+2°30' ± 1°
permissible minimum camber	0°
all models up to Chassis No. 2 528 668	+3° ± 30'
permissible minimum camber	+2°
Maximum permissible difference between sides	
All models with double joint rear axle	45'
All models with swing axle	20'
Total rear wheel toe with camber correctly set	
All models with double joint rear axle	0° ± 15'
All models with swing axle	-5' ± 10'
Maximum permissible deviation in wheel alignment	max. 10'

*)

Note:

When checking the rear wheels with an optical measuring device and the camber values have exceeded the limit in a negative direction, (settling after considerable mileage), the camber can be corrected within specific limits as follows:

1 - With the vehicle standing on its wheels loosen the bolts connecting the spring plate and diagonal arm flange. The diagonal arm will be lifted thereby, and the camber altered in the positive direction (approx. 45').

2 - With the diagonal arm in this position retighten the bolts to the prescribed torque.

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Type 2

Front axle

Total toe, wheels not pressed	
from Chassis No. 218 000 001	+15' ± 15'
up to Chassis No. 217 148 459	+ 5' ± 10'
Total toe, wheels pressed	
from Chassis No. 218 000 001	+ 5' ± 15'
up to Chassis No. 217 148 459	- 5' ± 10'
Applied pressure	33 ± 6 lbs. (15 ± 3 kg)
Maximum permissible difference between total toe with wheels pressed and not pressed	25'
Camber in straight-ahead position	
from Chassis No. 218 000 001	+40' ± 20'
up to Chassis No. 217 148 459	+40' ± 30'
Maximum permissible difference between sides	30'
Toe angle difference at 20° lock to left and right(not pressed)	-2°30' ± 30'
Offset between stub axles in direction of motion	max. 8 mm
Caster angle of a wheel	
from Chassis No. 218 000 001	3° ± 40'
up to Chassis No. 217 148 459	max. 1°
Corresponds to camber difference of a wheel on a lock from 20° left to 20° right	
from Chassis No. 218 000 001	2° ± 25'
up to Chassis No. 217 148 459	max. 40'