Notes on the Practical Work

for Subject No. 4

STEERING

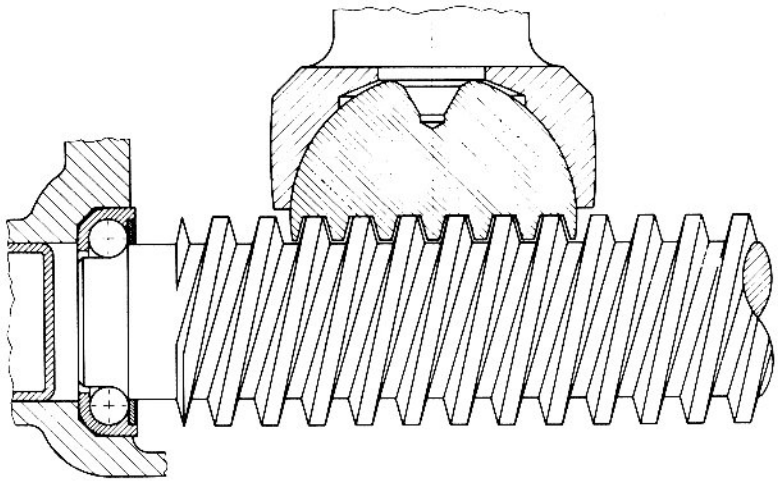
VOLKSWAGENWERK AG · SERVICE SCHOOL

518 104 20 / January 68

C O N T E N T S

WORM AND SECTOR STEERING GEAR

Steering gear set



The steering gear set consists of steering worm, sector and sector shaft.

A new sector bears only on the base of its threads and has a flank play of 0.01 - 0.02 mm.

Axial play in the steering worm

Tighten the adjustment sleeve until no more axial play can be felt but the steering worm can still be turned easily.

Axial play in the sector shaft

With this adjustment it is important to set the play between the thrust pin and sector shaft to the required value of 0.25 mm.

Adjustment instructions

1 - To adjust the radial play (thrust pin - sector shaft - sector - steering worm) the steering worm is turned so that the drop arm is at right angles to the steering worm (straight ahead position).

2 - Tighten the adjusting screw as far as it will go and then back it off approximately one sixth of a turn and then secure it with the lock nut.

After having installed a new steering set, the adjustment should be rechecked after an operating period of about 500 km. Readjust if necessary.

If in spite of careful adjustment no satisfactory result is obtained, this can be remedied as follows:

1 - Operation of steering too heavy:
Grind the thrust spring so that its length when untensioned remains 1.5 - 0.9 mm longer than the shaft of the thrust pin.

2 - Knocking sounds caused through insufficient spring tension:
Shorten the shaft of the thrust pin until it is only 0.2 mm longer than the fully compressed spring.

Installation position

Distance (front axle without stop) from centre of front axle up to centre of the filler screw.
Left hand drive: 260 mm
Right hand drive: 225 mm

The steering gear is correctly inclined, if the steering column sits centrally in the steering column tube.

Lubrication

125 cc gear oil SAE 90
Checking oil level:
Lock steering fully over to the right so that the sector is at the end of the steering worm. The oil level is correct if the base of the steering worm thread is just covered. If the oil level is too high the oil tends to leak from the adjustment sleeve.

Steering drop arm

The steering gear for a particular model is determined by the installation of the steering drop arm.
When the drop arm is in the installed position - larger diameter for the tie rod end socket points upwards - the tie rod end socket which lies furthest away to the rear should be on the left hand side for the left hand drive and on the right for the right hand drive.

1 - For all Models (except Karmann Ghia) compact, straight version.

111 514 371 A (left hand drive)
112 415 371 A (right hand drive)

2 - Only for Karmann Ghia Models compact, cranked version

141 415 371 (left hand drive)
142 415 371 (right hand drive)

ROLLER STEERING

Dismantling

The steering roller shaft can only be removed when it is in the central position. It is advisable to first take off the steering gear case cover (screw in the adjustment screw).

Steering gear case

If the steering roller shaft bushes are worn the case or the case cover are to be exchanged.

Steering roller shaft

The steering roller runs on a needle bearing.
Permissible axial play: 0.04 mm.
The adjusting screw in the roller shaft must be so adjusted that when in the bore it can just be turned by hand without any rock being felt.
Available shims:
2.0 mm - 2.5 mm in 0.05 mm steps.

Drop arm

The steering gear for a particular Model is determined by the installation of the steering drop arm. To avoid confusion the drop arms are marked with the Model number (e.g. 311).

Model	Drop arm Part No.	Marking
113, 117, 151	113 415 371	113
114, 118, 152	114 415 371	114
141, 143	141 415 371 A	141 A
142, 144	142 415 371 A	142 A
311, 313, 315 317, 361, 363 365, 367	311 415 371	311
312, 314, 316 318, 362, 364 366, 368	312 415 371	312
343, 345	341 415 371	341
344, 346	342 415 371	342

Since Aug. 65 all drop arms for Type 1 vehicles have an outrigger and stop surface to limit the wheel lock angle. The screws in the steering stops must be set so that there is always a gap of 10 mm ± 1 mm between the upper torsion arm and the tire when the load is taken off the front axle.

Steering gear mounting clamp

Type 1

The mounting clamp is made of drawn sheet steel and since Aug. 65 has two slots for correct location, they are marked as follows:

13 - for Models 11 and 15
14 - for Model 14

With left and right hand drive models the mounting clamp mustbe so installed that the slot for the various models points to the left as seen in driving direction.

Incorrect assembly leads to faults in the steering geometry.

When subsequently installing the mounting clamp from Aug. 65 in vehicles produced up to Aug. 65, the slots have no significance.

Type 3

The mounting clamp is a forged part and is to be fitted on the axle tube so that the lug on the tube engages in the correct slot in the clamp.

LHD vehicles:

31 - for Models 31 and 36
34 - for Model 34

RHD vehicles:

34 - for Models 31 and 36
31 - for Model 34

Assembly

1 - Insert the worm, under the upper tapered roller bearing is shim (e.g. 0.35 mm thick).

2 - Axial adjustment of the steering worm: tighten adjusting screw and back off again. Retighten the screw again until the steering worm turns a little stiffly (1.5 - 2.5 cmkg).

3 - Screw adjusting screw with roller shaft into housing cover as far as it will go.

4 - Install the roller shaft together with housing cover. When tightening the housing cover screws the cover must be pushed away from the worm, until it lays against the stop in the gear housing.

5 - Fit drop arm.

Adjustment

Requirement

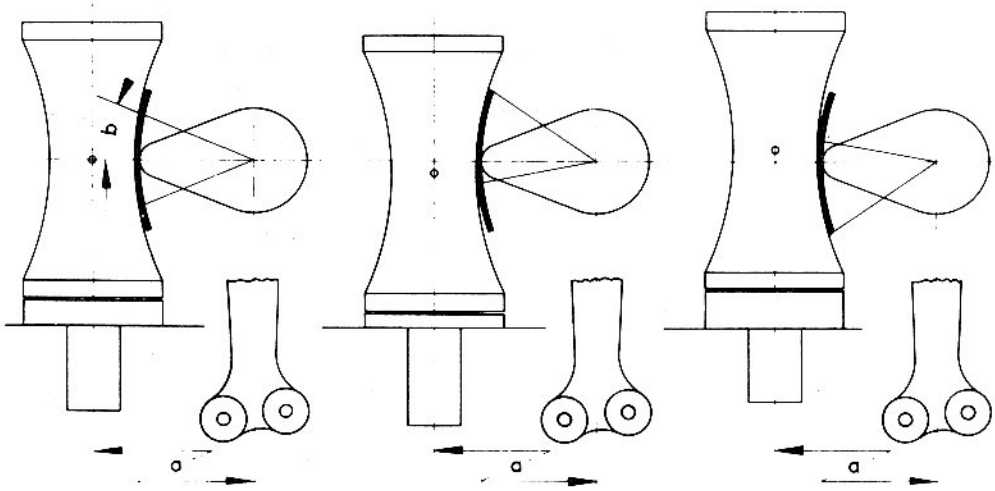
To so adjust the steering worm to the steering roller shaft, that the free of play contact range of the steering roller in the steering worm is the same as seen from the central position - when turning the steering to the right or left.

1 - If steering roller shaft and steering worm or one of these parts are replaced:

$11 \pm 2^{\circ}$ free of play contact range

2 - If no parts are replaced (correction):

$5 + 2^{\circ}$ free of play range.



a = parallel
b = free of play range

The required free of play range is set by selecting the appropriate shims - axial displacement of the steering worm. For this purpose there are shims of 0.2 - 0.5 mm thickness in stages of 0.05 mm.

They are identified by notches on the inside diameter of the shims (1 notch = 0.25 mm, 2 notches = 0.3 mm etc.).

After having carried out the adjustment the central position of the worm spindle must be marked when the steering is in the straight ahead position.
Marking ring: 311 415 213

Adjustment instructions

1 - Assemble steering gear and mount on the adjustment appliance (VW 280)

2 - Drop arm - ascertain central position (setting plate)

3 - Insert the scale from the adjusting device into the slot in the drop arm and clamp the pointer onto the housing. Set pointer at zero.

4 - Turn drop arm, e.g. about 11° to the left and set the free of play range.

5 - Check the free of play range on the other side. There must be no noticeable play at the drop arm up to an angle of 11 $\pm$ 2°.
If this has not been achieved, the check with the steering lock over to the right (points 4 and 5) must be carried out again.

If the free of play contact is outside the tolerance it can definitely be ascertained through analysis of the check results, whether the shim inserted is too thick or too thin.

> The steering worm is to be moved over to the side on which the largest free of play range is found!

Experience has shown that an alteration to the shim thickness of about 0.05 mm causes the free of play contact to be displaced about 2°.

6 - Check for easy operation (9-12 cmkg)

Checking adjustment (Maintenance service)

The steering need only be reset if the play occurs in the central position (permissible max. 25 mm).

This can be influenced by the following:

1 - Axial play of the spindle
2 - Play between the steering roller and steering worm
3 - Axial play of the adjustment screw in the steering roller shaft.

Axial play of the steering worm

Turn steering wheel to right or left. Move the spindle in an axial direction.

Play between the steering roller and the steering worm.

1 - Turn steering wheel 90° to left and right.

2 - Tighten the adjustment screw until no play is present.

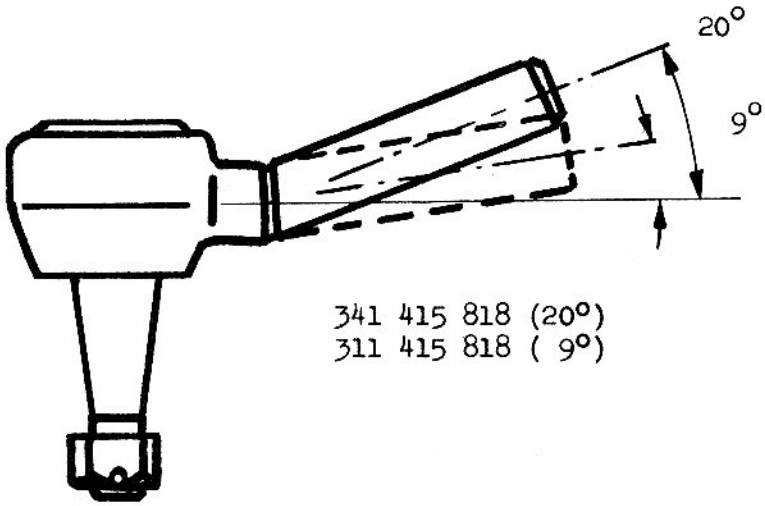
3 - Turn steering wheel 90° - from the central position - to the other side and check for play (approx. 25 mm permissible). If the play is too great, the steering roller shaft must be readjusted in this position.

Axial play of the steering roller

Any play which is still present after having carefully adjusted the steering worm or the steering roller to the steering worm, may be due to the axial play of the steering roller being too great or through the adjustment screw in the steering roller shaft.

Short tie rod

The shorter tie rods designed for the roller type steering are adjustable. The tie rod end with the left hand thread is always to be fitted on the outside end (steering knuckle). This rule is necessary because the tie rod end, which must be attached to the steering arm, is inclined to the threaded shaft.



341 415 818 (20°)
311 415 818 (9°)

Long tie rod

When installing the long tie rod the tie rod end with the right hand thread is attached to the steering arm of the steering knuckle.

Lubrication

Up to Aug. 64 the steering gear was filled with 160 cc of SAE 90 Hypoid oil.

From Aug. 64 the steering has been lubricated with 160 cc of transmission grease.
Because of this the steering gear case cover was modified. The oil filler screw was discontinued. In place of the screw, the cover was provided with two drillings which are sealed with plastic plugs. When subsequently changing over from oil to grease the modified cover must be used.

From Aug. 67

All Type 1 and Type 3 Models are fitted with a safety steering column. The steering column has a tubular expanded metal section which collapses and absorbs the forces applied to the column.

The steering column tube is secured to the luggage compartment floor by a special attachment with guide piece held by plastic rivets. Should the driver be forced against the steering wheel in an accident, the plastic rivets shear off and the guide pieces fall out of the attachment. The steering column and its tube are then forced through the hole in the cross panel and cause the safety section of the column to deform.

The safety section must be checked for cracks and deformation after every accident.

Even if the safety section is only slightly damaged, the complete steering column must be replaced.

ROSS TYPE CAM AND PEG STEERING GEAR

With left hand drive vehicles Ate steering gears were intermittently installed instead of the ZF make of steering gear.
Basically both steering gears differ only be the different axial adjustment of the steering worm.

ZF steering:
Axial adjustment on lower part of housing

Ate steering:
Axial adjustment from top, on adjustment flange.

as seen in installed position

The following parts from both makes are not interchangeable.

	Ate	ZF
1 - base cover	211 415 131 A	211 415 131
2 - adjustment screw	211 415 143	111 415 143
3 - end cover with guide tube	211 415 163 A	211 415 163
4 - shim	rectangular	square
5 - lock plate	211 415 225 A	211 415 225

Steering worm

Up to March 55
Left hand drive: Worm has left hand pitch.
Right hand drive: Worm has right hand pitch.

From March 55
Left hand drive: Worm has a right hand pitch.
Right hand drive: Worm has a left hand pitch.

Bearing race

Bearing race with 42 mm outside diameter:

Ate steering - at top on steering worm spindle
ZF steering - at bottom on steering worm spindle

Bearing race with 41 mm outside diameter:

Ate steering - at bottom on steering worm spindle
ZF steering - at top on steering worm spindle

To complete the bearing each race is provided with 14 balls (1/4").

Steering lever shaft

The steering lever shaft is supplied as a complete part, i.e. with peg-tapered roller bearing.
The upper and lower tapered roller bearings each have 16 rollers.

Drop arm

The alignment mark on the tapered splined boss is on the left hand side on left hand drive vehicles and on the right hand side on right hand drive vehicles, as seen with the eye for the drag link above the tapered splined boss.

Axial play of the steering worm

Shims are available in the following thickness for correcting the axial play:

ATE: 0.05; 0.30 mm
ZF: 0.10; 0.125; 0.15; 0.30 mm

Adjustment: free of play but easy

Play between peg and worm

1 - Steering gear installed:
Tighten the adjustment screw, so that with the front axle unloaded, a perceptible resistance can be felt in the central position.

2 - Steering gear removed:
Tighten the adjustment screw, until a slight "drag" of 24 cmkg can be felt in the central position.

Drag link adjustment

1 - Install the steering gear free of tension.

2 - Bring steering to central position (pressure point).

3 - Fit the drop arm so that the mark on the arm aligns with the mark on the end face of the splines of the steering lever shaft.

4 - Front wheels are in the straight ahead position.

5 - Adjust drag link end.

Steering linkage

	up to March 55	from March 55
Drag link	curved	cranked
Tie rod, left	short, non adjustable	long, adjustable
Tie rod, right	long, adjustable	long, non adjustable

Lubrication

Up to Aug. 66: 250 cc Hypoid oil SAE 90
From Aug. 66: 250 cc Transmission grease

The subsequent change over to transmission grease is possible.

Modification

Since Aug. 67 the steering gear case and steering column have been joined by a coupling with a flexible rubberised disc. The peg in the lever shaft is made of one piece. 16 tapered rollers are inserted in the lever shaft on either side of the peg. Insert the tapered rollers so that the smaller diameters of the tapered rollers are opposite one another. Tighten the hexagon nut of the peg with a torque of 25 cmkg. The frictional torque should be 2 - 3 cmkg. After adjusting, lock the hexagon nut by bending over a tab of the toothed washer. The play between the peg and worm is correctly set, if the worm can be turned over the pressure point (central position of steering) with a torque of 24 cmkg.

Printed in Germany 1968