Steering system

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Rack and pinion unit

1987 and 1988 model years

Introduction

The steering unit is a rack and pinion power assisted mechanism with centre connection to 'one-piece' track rods. Toe-in can be set by the movement of an intermediate adjuster linking the track rod inner and outer components. An anti-joggle valve is fitted into the hydraulic pressure line (located in the spool valve housing), to minimise any feedback to the steering wheel caused by road irregularities. The steering rack is fitted with internal lock stops.

Important Damage can be caused to the steering column and rack boots if the steering is operated without the engine running, i.e. distortion to the column, broken column mounts, and cut rack boots.

To overhaul the rack and pinion assembly, the following kits of parts are available.

Spool valve renewal kit
Rack overhaul kit
Bellows replacement kit.

Power assistance

Pressure is applied to the steering system rack in varying degrees. This provides assistance to the steering wheel, dependent on the effort required to move the road wheels.

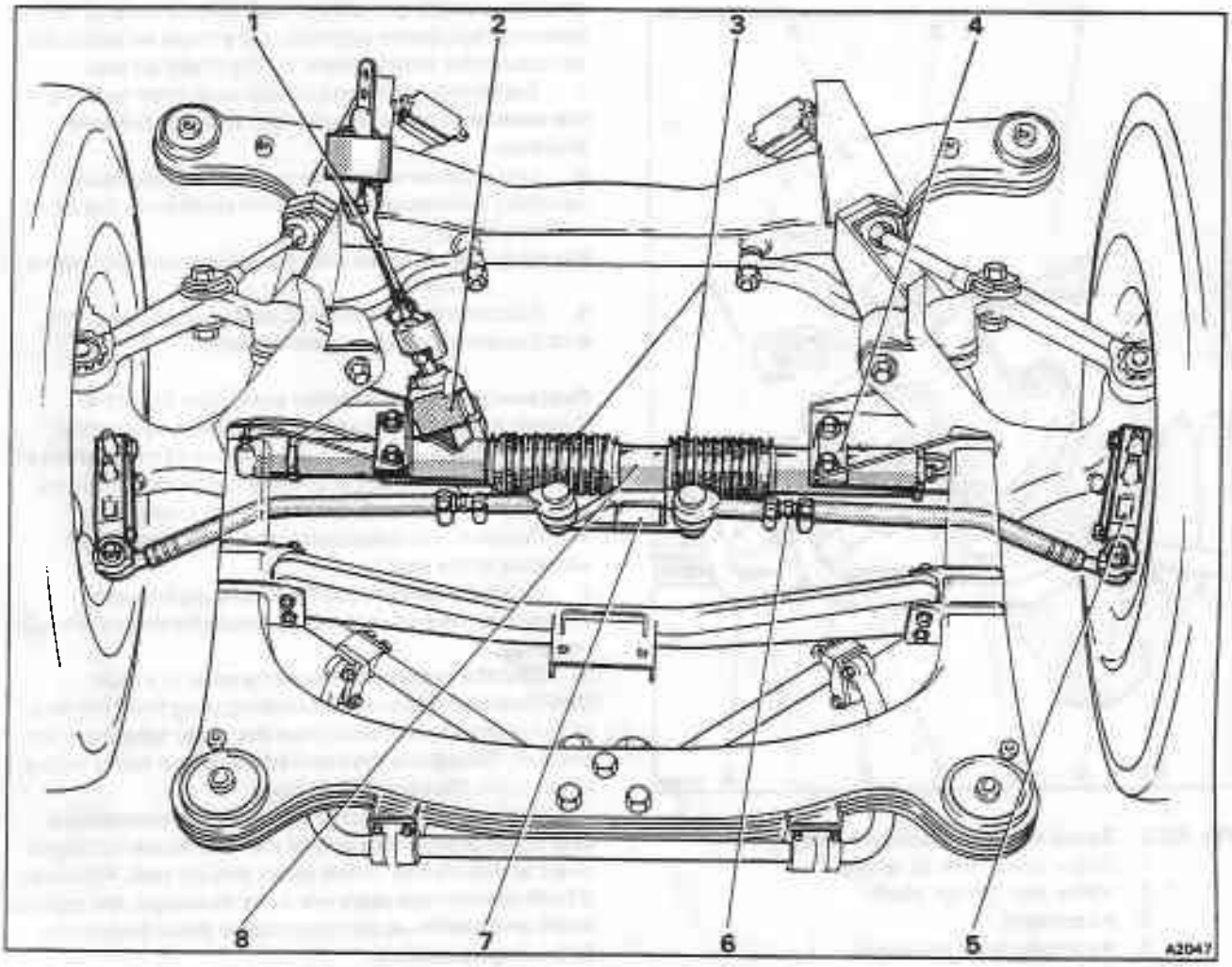

Fig. N2-1 Steering unit mounted in sub-frame

1 Intermediate link
2 Spool valve and pinion
3 Convoluted seals
4 Steering to sub-frame attachment
5 Side steering lever
6 Track rod adjuster
7 Inner ball joint bracket
8 Centre tube and seal

The amount of assistance is controlled by the passage or restriction of oil through a series of ports in the upper half of the pinion box. This creates a pressure differential across the rack, proportional to the load applied at the steering wheel.

The system operates by causing a small torsion bar to twist, immediately the steering wheel is moved, rotating the concentric valve components to provide the pressure differential required. A 'fail safe' device prevents the torsion bar from being overstressed by limiting the number of degrees through which it can twist.

Important The steering unit must be handled with exceptional care. Avoid impact loads on the input shaft and centre off-take, and damage to the convoluted seals which could cause premature failure of the unit.

Do not disturb the end plug or locking nut whilst the rack and pinion unit is fitted to the car.

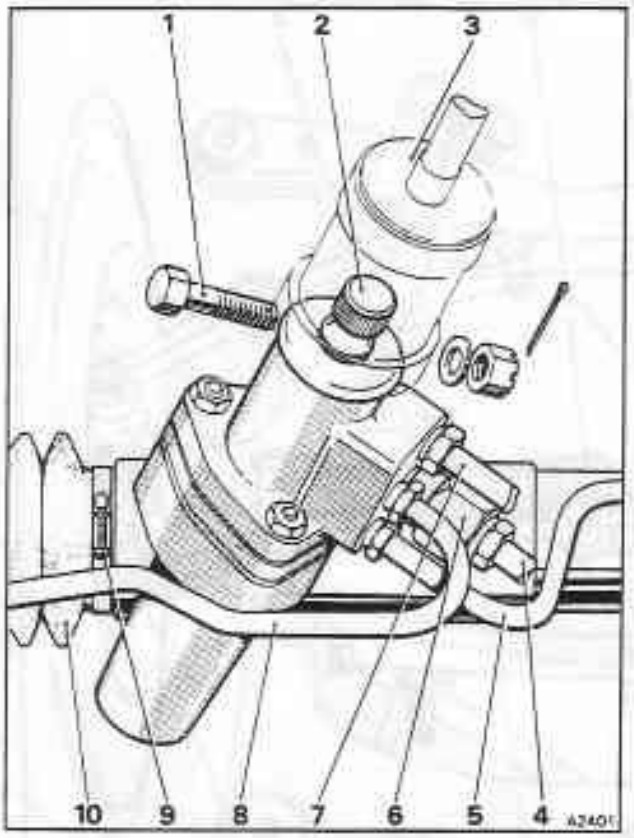

Fig. N2-2 Spool valve and pinion housing

1 Bolt – lower link to spline
2 Valve and pinion shaft
3 Heatshield
4 Hydraulic feed pipework
5 Fluid feed to end of rack
6 Anti-joggle valve adapter
7 Hydraulic return pipework
8 Fluid feed to end of rack
9 Seal attachment clip
10 Convoluted neoprene seal

The majority of the threads on the rack assembly are metric, except for the mounting bolts to the sub-frame and the lower steering column linkage. Therefore, always ensure the correct nuts and bolts are fitted.

Rack and pinion unit – To remove

1. Place the car on a ramp and remove fuse A6 from fuse panel F2 on the main fuseboard.
   Disconnect the battery.
2. Chock the road wheels and raise the ramp to a convenient working height.
3. Fit a clamp to the feed hose from the remote reservoir.
4. Position drip trays beneath the spool valve. Then, remove the pipe unions from the valve.
   Fit blanks to prevent the ingress of foreign matter.
5. Remove the split pin, castellated nut, and bolt securing the lower linkage to the pinion shaft splines (see fig. N2-2).
6. Straighten the tab-washer. Then, remove the setscrews holding the inner ball joint bracket to the steering rack centre position. Care must be taken not to disturb the steering rack centre block oil seal.
7. Support the rack and pinion unit, then remove the setscrews attaching the unit to the sub-frame brackets.
8. Lower the unit from beneath the suspension, carefully withdrawing the pinion shaft from the lower column linkage.

Warning Never strike the rack and pinion unit with a hammer.

9. Examine the convoluted seals for damage, etc., and the centre block oil seal for leaks.

Replacement of convoluted seals (see fig. N2-4)

If when a convoluted seal is removed due to splits and/or leakage, and there is evidence of the ingress of water and/or road dirt, a complete stripdown, clean, and inspection should be made of the unit.

1. Position drip trays under the ends and centre sections of the unit.
2. Carefully remove the hydraulic pipe union situated at the end of the unit, opposite the pinion box housing.
3. Grip the bracket, at the same end, in a vice. Unscrew and remove the blanking plug from the end of the rack tube and withdraw the outer tube from the bracket. Collect the dismantled parts and cover with a clean cloth. Discard the 'O' rings.

   If it is only necessary to replace the convoluted seal at the dismantled end of the unit, there will be no need to disturb the centre block and oil seal. However, if both convoluted seals are to be removed, the central block and seal must be removed as described in the following operations.
4. Unscrew the capscrew holding the central block in position against the rack gear, withdraw the block and oil seal. Protect the components by covering with a clean cloth.
5. Slacken the sealing clips screws that secure the convoluted seals in position.

Remove the ring clips, seals, and central spacer tube. The spacer tube must be covered to prevent the ingress of dirt.

6. Turn the unit over with the slot facing downwards. This will enable the lubricating oil to drain from the unit into a suitable tray.

7. Fit new convoluted seals, clipping these to the pinion box, outer tube, and the central spacer tube.

To enable service inspection checks on the tightness of the clips when the unit is fitted to the vehicle, ensure that the screw heads of all the retaining clips face downwards and towards the rear of the rack.

Lift the unit higher at the dismantled end and pour 0,057 litre (0.1 Imp pt; 0.12 US pt) of new approved lubricating oil (see Chapter D) through the slot in the central spacer tube.

8. Fit the centre block using the flexible bonding agent Silastic 732 RTV sealant on the mating surfaces of the seal, to ensure a leak free joint.

9. Fit a new 'O' ring and position the support bracket onto the outer tube. Apply Loctite 542 to the threads of the blanking plug, and fit a new 'O' ring. Carefully screw the blanking plug into position.

Note To ensure control of the parallelism of the two mounting bracket faces, place the assembled unit with the bracket face downwards onto a surface table or a similar flat fixture plate.

10. Lightly clamp the two mounting brackets of the unit onto the flat surface.

11. Torque tighten the blanking plug to the figures quoted in Section N8.

12. Screw the hydraulic pipe union into the blanking plug. Torque tighten to the figures quoted in Section N8.

Rack and pinion unit – To dismantle
(see figs. N2-8 and N2-9)

If the unit has an internal fault which necessitates the removal of the rack, dismantling to the stage of withdrawing the centre block should be completed before carrying out the following operations. Removal of the centre block is described under the heading Replacement of convoluted seals, Operations 1 to 6 inclusive.

1. After draining the lubricating oil, place the unit onto two 'Vee' shaped wooden blocks.

2. Remove the remaining feed pipe. Blank off the hole in the pinion box and cover.

3. Mark the relationship between the input shaft spline and pinion box housing with the steering in the straight ahead position. Use the screwed plug to ensure a correct setting.

4. Unscrew the nuts, and release the pinion and valve housing assembly by gripping the pinion spline with one hand, and keeping the two halves of the valve housing together with the other hand. With a turning movement lift the assembly **using the splined shaft**, clear of the pinion position (see fig. N2-5).

5. Release the lock-nut. Unscrew the remaining end cap. Discard the internal 'O' ring.

6. Using an appropriate sized wooden dowel,

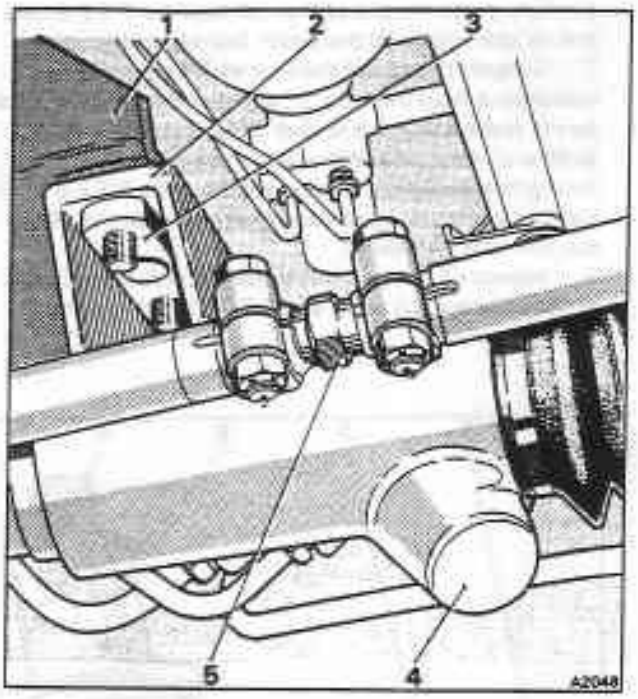

Fig. N2-3 Steering to sub-frame mounting
1 Sub-frame bracket
2 Steering unit mounting foot
3 Tapping block
4 Pinion housing
5 Track rod adjuster

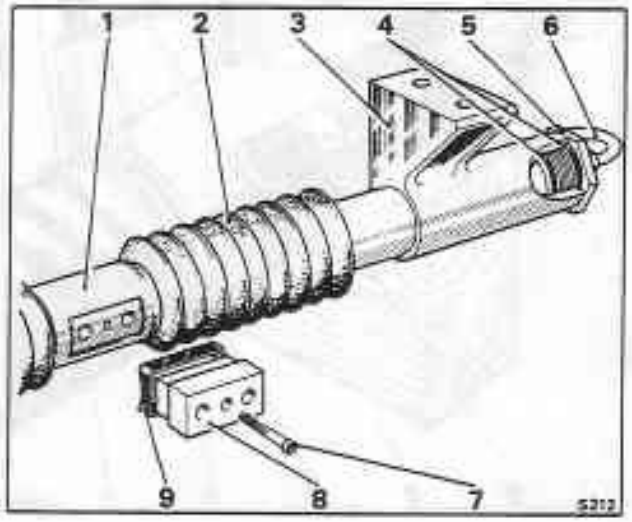

Fig. N2-4 Removal of convoluted seals
1 Centre tube
2 Seal
3 Mounting foot
4 'O' rings
5 Blanking plug
6 Fluid feed pipework
7 Cap head socket screw
8 Centre block
9 Shaped seal

carefully press the end of the rack until the P T F E ring and oil seal appear at the pinion box end of the unit.
7. Support the end of the rack whilst continuing to withdraw it from the tube. Ensure that the rack and tube do not make contact. It is easy to damage the internal surface of the tube and therefore care must be taken during this operation. Also, ensure that the P T F E bearing is not damaged during removal past the centre slot and pinion opening.
8. Inspect all components including the internal faces of the end caps, oil seals, and P T F E bearing carrier.

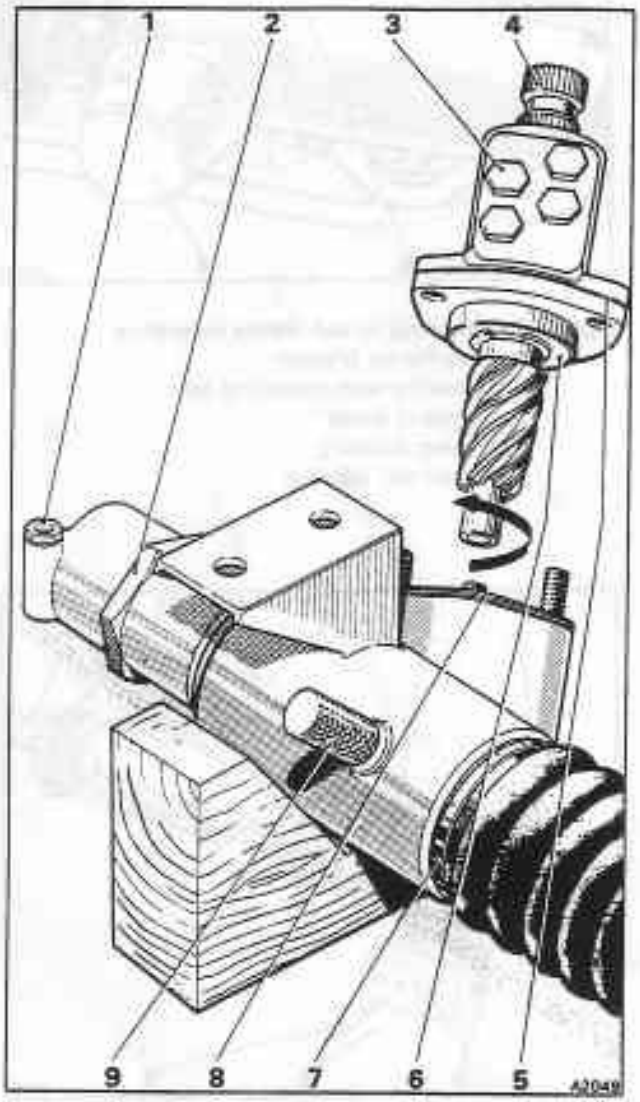

Fig. N2-5 Pinion and spool valve removal
1 Plastic dust cap
2 End cap lock-nut
3 Plastic dust caps
4 Pinion boss splines
5 Bearing pre-load shim
6 Bearing carrier
7 Seal clip
8 Pinion pre-load shims
9 Rack centring plug

Wash all metal parts in Genklene or an equivalent cleaning fluid.

Pinion and spool valve housing assembly
The pinion and spool valve housing assembly comprises the following main service items. An upper oil seal, P T F E sealing rings, lower oil seal, lower oil seal carrier, 'O' rings, paper joint washers, pre-load shims, and circlips.

Upper oil seal – To replace
1. Carefully lift the housing off the spool valve unit, ensuring that the P T F E rings are not damaged.
Ensure that the pre-load shim situated between the ball race carrier and pinion housing is not damaged.
2. Carefully remove the upper oil seal and 'O' ring from the housing and discard.
3. Fit a new upper 'O' ring and oil seal ensuring that the sealing lip is pointing downwards (see fig. N2-6).
Note This type of seal should be fitted dry. Do not use any lubricant.
4. Fit the spline cover tool RH 9120 over the splines and then lower the housing down onto the spool valve. Ensure that each P T F E ring enters the bore squarely with no pinching of the edges against the bore.

P T F E sealing rings – To replace
1. Carefully lift the housing off the spool valve unit.
2. Cut into the P T F E sealing rings with a sharp instrument having a smaller dimension than the width of the groove. Take care not to damage the finely machined surfaces of the spool valve. Use 'Vee' shaped wooden blocks to support the end diameters during removal of the rings.
3. Inspect the ring grooves of the valve pinion.
4. Immerse the new P T F E rings in warm oil prior to fitting onto the applicator RH 9117. Failure to warm the rings before fitting could cause cracking.
5. Place the tool over the input shaft spline and adjust until the bottom edge of the tool corresponds with the upper edge of the lowest 'O' ring groove.
6. Slide a P T F E sealing ring into the groove.
7. Adjust the tool to fit the remainder of the rings into their respective grooves.
8. Remove the sleeve tool then size the rings by carefully pressing the tool RH 9118 over the rings to reduce their diameter.
9. Fit the spline cover tool RH 9120 over the spool valve splines to protect the upper and lower seals whilst assembling the pinion and spool valve housing.
10. Fit the upper ball race carrier, spacers, and ball bearings. Locate these components by fitting a new circlip.
11. Carefully assemble the pinion and spool valve housing.

Lower oil seal – To replace
1. Carefully remove the housing off the spool valve unit. Avoid damage to the P T F E sealing rings.

2. Remove the carrier and lower seal from the housing.
3. Press out the lower oil seal from the carrier.
4. Inspect the carrier for damage.
5. Press a new oil seal into the carrier. Ensure that the lip face of the seal is uppermost. Fit the carrier into the housing.
6. Fit the spline cover tool RH 9120 over the spool valve splines to protect the upper and lower seals whilst assembling the pinion and spool valve housing.
7. Fit the upper ball race carrier, spacers, and ball bearings. Locate these components by fitting a new circlip.
8. Carefully assemble the pinion and spool valve housing.

Thrust ball race

If the spool valve and pinion unit is dismantled to the stage of inspecting the thrust ball race and it is found necessary to replace any thrust race components, the pre-load torque must be reset.

The following table gives a conversion of the spring balance readings quoted in the text, to a figure for use with Nm (lbf in and kgf m) torque spanner.

To protect the components wrap clear adhesive tape over the spline and spool valve rings.

Spring balance and arm		Torque spanner		
kgf	lbf	Nm	kgf m	lbf in
0,0544	0.120	0,054	0,0055	0.480
0,272	0.600	0,316	0,0320	2.400
0,510	1.125	0,508	0,0520	4.500
0,820	1.800	0,813	0,0830	7.200
0,910	2.000	0,904	0,0922	8.000
1,130	2.500	1,131	0,1153	10.010
1,950	4.300	1,943	0,1981	17.200
2,040	4.500	2,034	0,2074	18.000

1. Fit the ball race with any new components required and lubricate the assembly with a light application of new approved EP 90 grade oil. Ensure that the oil does not contaminate the area bounded by the two oil seals.
2. Replace the lower oil seal carrier as described in Lower oil seal – To replace.
3. If a new lower oil seal has been fitted, first place a new paper gasket onto the face of the lower oil seal carrier. Then place the original stack of shims plus one additional shim of at least 0,254 mm (0.010 in) thickness onto the carrier.

This additional shim will effectively remove any bearing pre-load when assembly is completed.

Shims are available in the following sizes.
0,063 mm (0.0025 in)
0,127 mm (0.005 in)
0,254 mm (0.010 in)
1,270 mm (0.050 in).

4. Remove the adhesive tape from the spool valve shaft only and wipe the spool valve assembly with a clean lint free cloth. Lightly lubricate the assembly with power steering fluid.

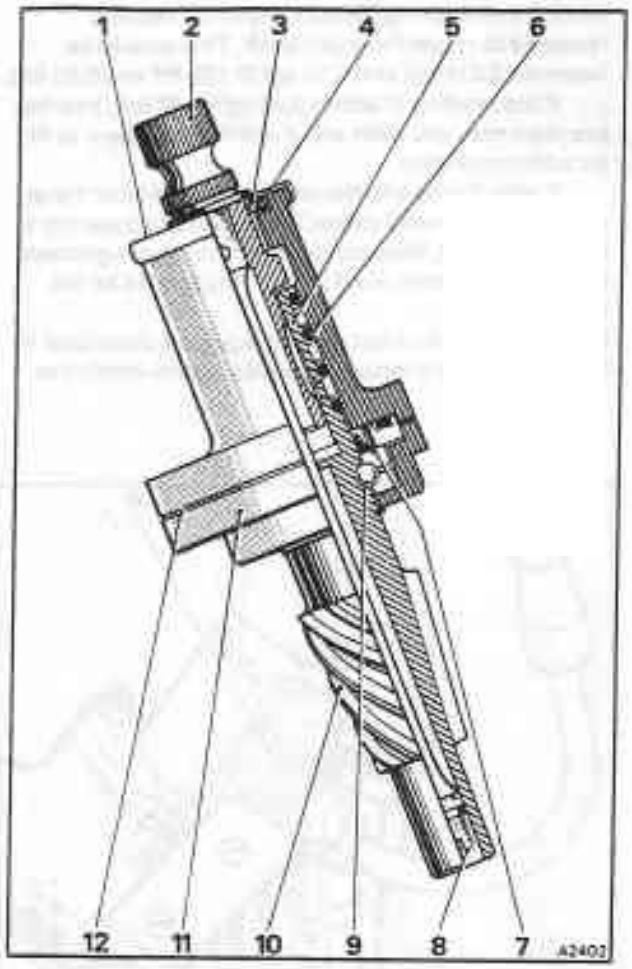

Fig. N2-6 Pinion and spool valve unit
1 Spool valve housing
2 Spline
3 Lip-type oil seal
4 'O' ring
5 Spool valve
6 P T F E rings (4)
7 Lower oil seal
8 Torque arm
9 Thrust ball race
10 Pinion
11 Ball race carrier
12 Pre-load shim(s)

Do not fit the lower oil seal carrier 'O' ring at this stage.

5. Carefully fit the spool valve housing onto the spool valve shaft. Ensure that each P T F E sealing ring enters the bore of the housing squarely with no pinching of the ring edges. **Do not use force to assemble.**
6. Lightly assemble the housing and carrier together, using three nuts and bolts. Then rotate the input shaft a number of turns to reduce initial drag.
7. Grip the sub-assembly in a soft jawed vice and fit the torque arm tool RH 9123 to the input shaft spline.
8. To measure the pinion seal drag and spool valve

friction use a spring balance. Note the reading required to rotate the input shaft. This should be between 0,016 kgf and 0,08 kgf (0.120 lbf and 0.60 lbf).

If the reading is above 0,08 kgf (0.60 lbf), bearing pre-load may still exist and it will be necessary to fit an additional shim.

If after fitting additional shims to the extent that no bearing pre-load exists, i.e. end-float appearing in the spool valve, then some other source of tightness such as incorrectly sized P T F E rings could be the cause.

9. Assemble and test the unit again as described in Operations 5 to 8 inclusive, until a figure within the limits quoted in Operation 8 have been achieved.

10. Dismantle the spool valve housing. Then, reduce the shims by one 0,063 mm (0.0025 in) shim.

Check that a spring balance reading of 0,510 kgf (1.125 lbf) is required to rotate the shaft. If this reading is not obtained reduce the shims (one at a time) until the correct reading is achieved.

Important Ensure that this procedure is carried out correctly otherwise excessive pre-load can damage the bearing parts.

11. Remove the spool valve housing to fit an 'O' ring into the lower oil seal carrier.

Ensure that paper gaskets are in good condition and fitted at the top and bottom of the shim stack.

12. Lubricate the spool valve and pinion seals with steering fluid and the upper oil seal with a light coating of molybdenum disulphide grease.

13. Carefully assemble the spool valve housing.

14. Ensure new paper gaskets are fitted to the underside of the ball race carrier and to the steering rack pinion housing face.

15. Fit the original number of shims and carefully fit the complete spool valve assembly into the pinion housing.

16. Ensure that the hydraulic pipe connections of the spool valve housing are in the correct relative position.

17. The correlation mark on the input shaft should align with the mark on the spool valve housing when the assembly is fully engaged with the rack in the central position.

18. Torque tighten the retaining nuts to the figures quoted in Section N8.

19. Replace any rack lubricating oil (EP 90 grade), that may have been lost during dismantling, up to the total amount of 0,057 litre (0.1 Imp pt; 0.12 US pt).

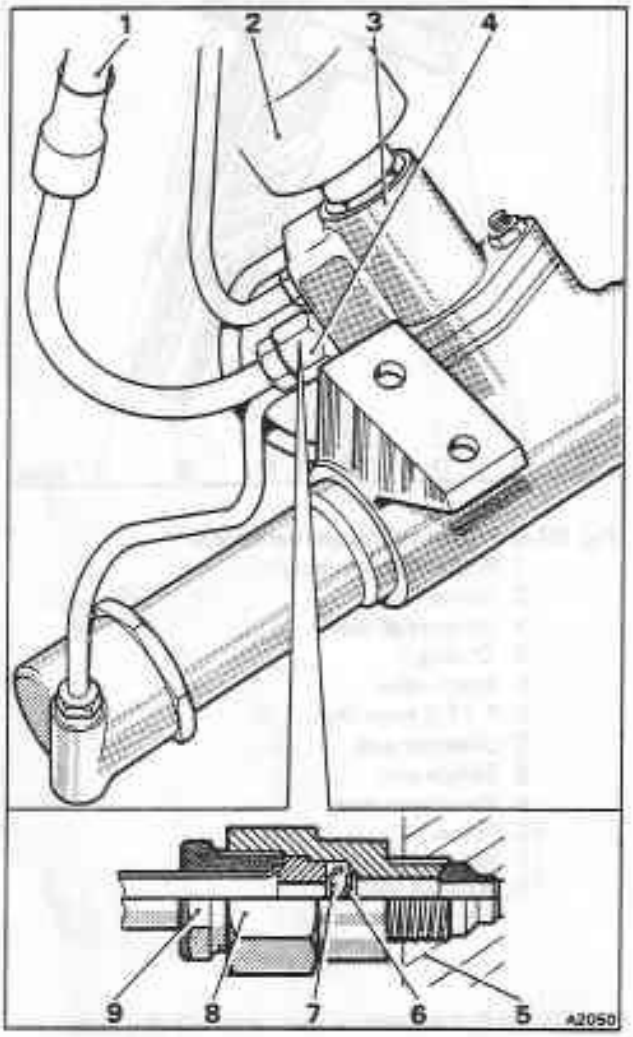

Fig. N2-7 Anti-joggle valve
1 High pressure fluid
2 Heatshield
3 Spool valve housing
4 Anti-joggle valve
5 Spool valve casting
6 Spring
7 Flap valve
8 Adapter
9 Pipe union

Anti-joggle valve (see fig. N2-7)

1. With the steering dismantled remove the anti-joggle valve.
2. Check that the spring and flap are functioning correctly by pressing a probe carefully onto the top of the flap. Ensure that adequate compression of the assembly occurs and the flap seats correctly.
3. Wash out the assembly in Genklene or an equivalent cleaning solution. Dry using a controlled jet of dry pressurized air into the male threaded end of the unit only.
4. Fit blanking plugs into each end of the adapter.

Pipe union

If the olive which forms the seating of the pipe union is found to be damaged it will be necessary to remove the spool valve housing before it can be renewed. It must be emphasized that cleanliness must be observed when carrying out this procedure.

Rack and pinion unit – To assemble

It is essential that the rack should only be removed or replaced from the pinion end of the unit. This ensures that the P T F E bearings or oil seals are not damaged

by the internal thread of the blanking plug end of the assembly.

At this stage, check the bore of the rack tube for scoring or damage.

1. With the rack unit out of the tube, fit the scarf jointed P T F E rack bearings into the respective grooves in each end of the rack.
2. Gently press each scarf joint together. Ensure that each gap has an initial (nominal) measurement of 2,03 mm (0.080 in).

In the case where the two ends of the P T F E ring butt together or in the event of a smaller than nominal gap being observed, it will be necessary to remove the ring and cut one end of the scarf joint until the correct figure is obtained.

3. Using sizing tools (in the following order) RH 9114, RH 9113, and RH 9112, progressively reduce the diameter of the P T F E bearings until these are a sliding fit in the rack tube.

At this stage ensure that the gap at the scarf joint has not gone below a minimum of 0,25 mm (0.010 in). Also ensure that it is positioned so as not to come into contact with the edges of the centre slot when the rack is assembled.

Remove any burrs from the slot. Wipe the area clean before assembly.

4. From the pinion end, press the rack slowly into the tube until the P T F E bearing reaches the mid-position of the centre slot.

Ensure that the bearing is not damaged when moving along the slot.

5. With the P T F E bearing visible in the centre slot, lightly lubricate a rack oil seal. Fit the seal through the slot in the tube and using finger pressure, press the seal onto the end groove of the rack. Turn the rack slowly during this operation, to assist in assembly of the seal.
6. Lubricate the other rack oil seal and again using finger pressure fit this seal onto the pinion end groove.
7. Slide the rack unit slowly into the tube. Ensure that no nipping occurs when the oil seal passes into the closed portion of the tube. The pinion end seal must be manipulated into the tube by the fingers.
8. Lock the rack into the mid-position using centring plug RH 9119.
9. Manipulate a new 'O' ring and fit it into the end cap of the unit. Fit the lock-nut onto the tube. A degree of feel must be applied when screwing on the cap to ensure the 'O' ring fits correctly.
10. Allow the end cap to butt against the inner face. Then screw back the cap approximately one full turn to allow for hydraulic pipe alignment.
11. Torque tighten the lock-nut to the figures quoted in Section N8 using the open ended torque wrench adaptor tool RH 9125.
12. Fit new convoluted seals as described in Replacement of convoluted seals.
13. Lift the unit higher at the dismantled end and pour 0,057 litre (0.1 Imp pt; 0.12 US pt) of new EP 90 lubricating oil through the slot in the centre sleeve.
14. To set the pinion mesh pre-load, ensure new

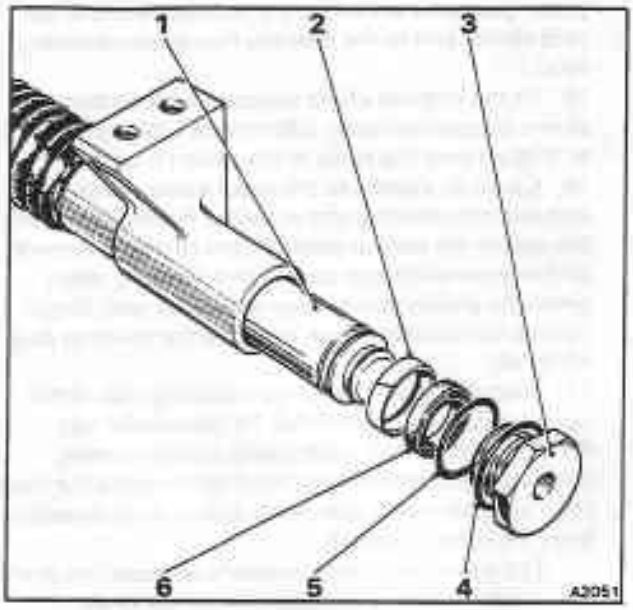

Fig. N2-8 Assembly of free end components

1 Rack spindle
2 P T F E seal
3 Blanking plug
4 End plug 'O' ring
5 Tube 'O' ring
6 Oil seal

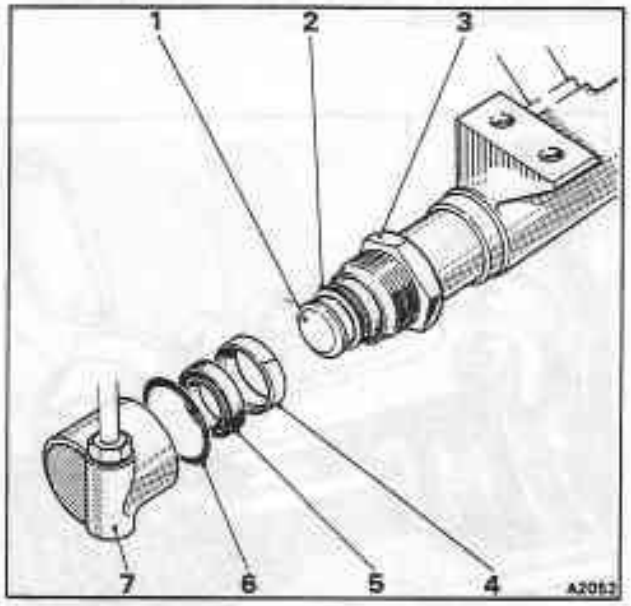

Fig. N2-9 Assembly of pinion box end components

1 Rack spindle
2 P T F E seal carrier
3 Lock-nut
4 P T F E seal
5 Oil seal
6 End cap 'O' ring
7 End cap

paper gaskets are fitted to the underside of the ball race carrier and to the steering rack pinion housing face.

15. Fit the original shims together with additional shims of approximately 3,80 mm to 5,08 mm (0.150 in to 0.20 in) over the studs of the pinion housing.

16. Carefully assemble the spool valve and pinion unit into the steering rack housing. Ensure that with the rack in the central position, the correlation mark on the input shaft and spool valve housing, align when the pinion is fully engaged in the rack. Finger tighten the retaining nuts. Remove the centring plug RH 9119.

17. Torque tighten the flange retaining nuts to the figures quoted in Section N8. Fit the special arm RH 9123 to the input shaft spline. Using a spring balance, measure the load required to rotate the input shaft approximately one revolution in each direction from the centre position.

The maximum load necessary to rotate the shaft to overcome both rack seal drag and spool valve friction should be 0,91 kgf (2 lbf).

If the force required is above this figure, then pinion mesh pre-load is still present. Therefore, additional shims must be fitted between the pinion and rack assembly.

Alternatively, the steering rack P T F E bearings could be incorrectly sized and the rack will have to be withdrawn. Reduce the diameter of the bearings further using sizing tools (in the following order) RH 9114, RH 9113, and RH 9112.

18. Carefully replace the steering rack ensuring no damage occurs to the P T F E bearings and oil seals. Fit the pinion unit.

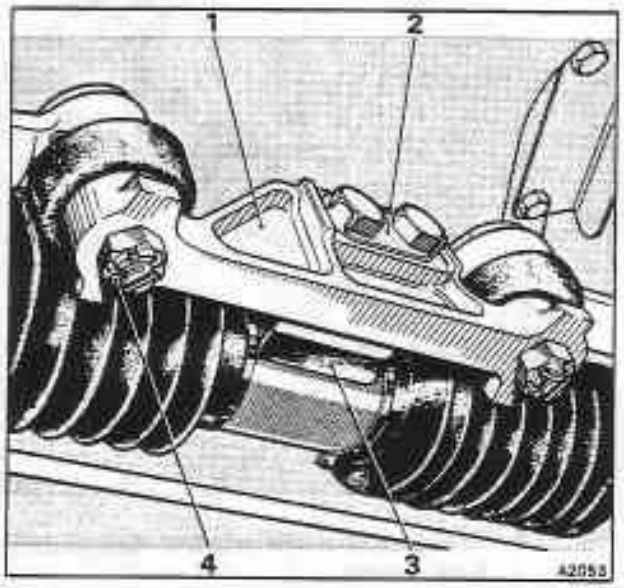

Fig. N2-10 Inner ball joint bracket in position
1 Bracket
2 Tab-washer
3 Centre block seal
4 Castellated nut and split-pin

Top-up the system with new lubricating oil, grade EP 90.

19. Using special arm RH 9123 and a spring balance, progressively reduce the number of shims to give a minimum figure of 1,13 kgf (2.50 lbf) above the seal drag and spool valve friction detailed in Operation 17.

The maximum total turning load should not exceed a spring balance reading of 2,04 kgf (4.50 lbf).

Example

If the total rack drag and spool valve friction is equal to 0,82 kgf (1.80 lbf) using a spring balance, then the minimum total load by progressively removing shims will be 0,82 kgf + 1,13 kgf = 1,95 kgf (1.80 lbf + 2.5 lbf = 4.30 lbf).

20. Return the rack to the straight-ahead position. Fit the centring plug RH 9119.

21. Carefully assemble the pinion unit to the steering rack housing. Ensure that the correlation marks on the input shaft and spool valve housing align when the pinion is fully engaged with the rack.

22. Torque tighten the flange retaining nuts to the figures quoted in Section N8.

23. Fit the centre block using the flexible bonding agent Silastic 732 RTV sealant on the mating surfaces of the seal to ensure a leak free joint. Secure the centre block in position using the socket headed capscrew.

24. Manipulate new 'O' rings before they are fitted to the blanking plug and lubricate them with power steering fluid to ensure that they fit correctly into their respective grooves.

Replace the outer tube and bracket assembly.

25. Set the two suspension brackets of the assembly squarely onto a surface table and clamp firmly into position.

26. Screw in the blanking plug to the torque figures quoted in Section N8.

27. Fit the pipe runs from the end caps to the pinion valve assembly using the torque figures quoted in Section N8.

28. The unit is now ready for fitting to the car, but do not remove the centring plug at this stage.

Rack and pinion unit – To fit to the sub-frame

1. Position and hold the steering wheel in its central position. Carefully fit the pinion box spline into the lower link universal coupling and support the unit in position. Finger tighten the pinch bolt.

2. Fit the setscrews and washers to the sub-frame brackets tapping blocks (see fig. N2-3). Torque tighten the setscrews to the figures quoted in Section N8, using the special tool arm RH 9122.

3. Align the spacer between the inner ball joint bracket and the steering unit centre block seal (see fig. N2-10).

4. Fit the new tab-washer and finger tighten the setscrews. Remove the centring plug RH 9119.

5. Torque tighten the inner ball joint bracket setscrews to the figures quoted in Section N8, carefully checking that the oil seal is not displaced. Lock the tab-washer to the setscrews, avoiding any impact to the unit. Also, torque tighten the lower

linkage universal couplings pinch bolt, in accordance with the figures quoted in Section N8.

6. Connect the pipework from the pump and oil cooler to the pinion box, ensuring that the union joints are wiped clean before fitting. Torque tighten in accordance with the figures quoted in Section N8.

Note Correct routing of the pipework is essential.

7. Fit the gearchange fuse (fuse A6 on fuse panel F2 on the main fuseboard).

8. Connect the battery.

1989 model year

Introduction

The steering unit is a rack and pinion power assisted mechanism with centre connection to 'one-piece' track rods. Toe-in can be set by the movement of an intermediate adjuster linking the track rod inner and outer components. An anti-joggle valve is fitted into the hydraulic pressure line (located in the pinion valve housing), to minimise any feedback to the steering wheel caused by road irregularities. The steering rack is fitted with internal lock stops.

Important Damage can be caused to the steering column and rack boots if the steering is operated without the engine running, i.e. distortion to the column, broken column mounts, and cut rack boots.

To overhaul the rack and pinion assembly, the following kits of parts are available.

Pinion valve overhaul kit
Rack overhaul kit
Bellows replacement kit
Pinion valve housing replacement kit.

Power assistance

Pressure is applied to the steering system rack in varying degrees. This provides assistance to the steering wheel, dependent on the effort required to move the road wheels.

The amount of assistance is controlled by the passage or restriction of oil through a series of ports in the upper half of the pinion box. This creates a pressure differential across the rack, proportional to the load applied at the steering wheel.

The system operates by causing a small torsion bar to twist, immediately the steering wheel is moved,

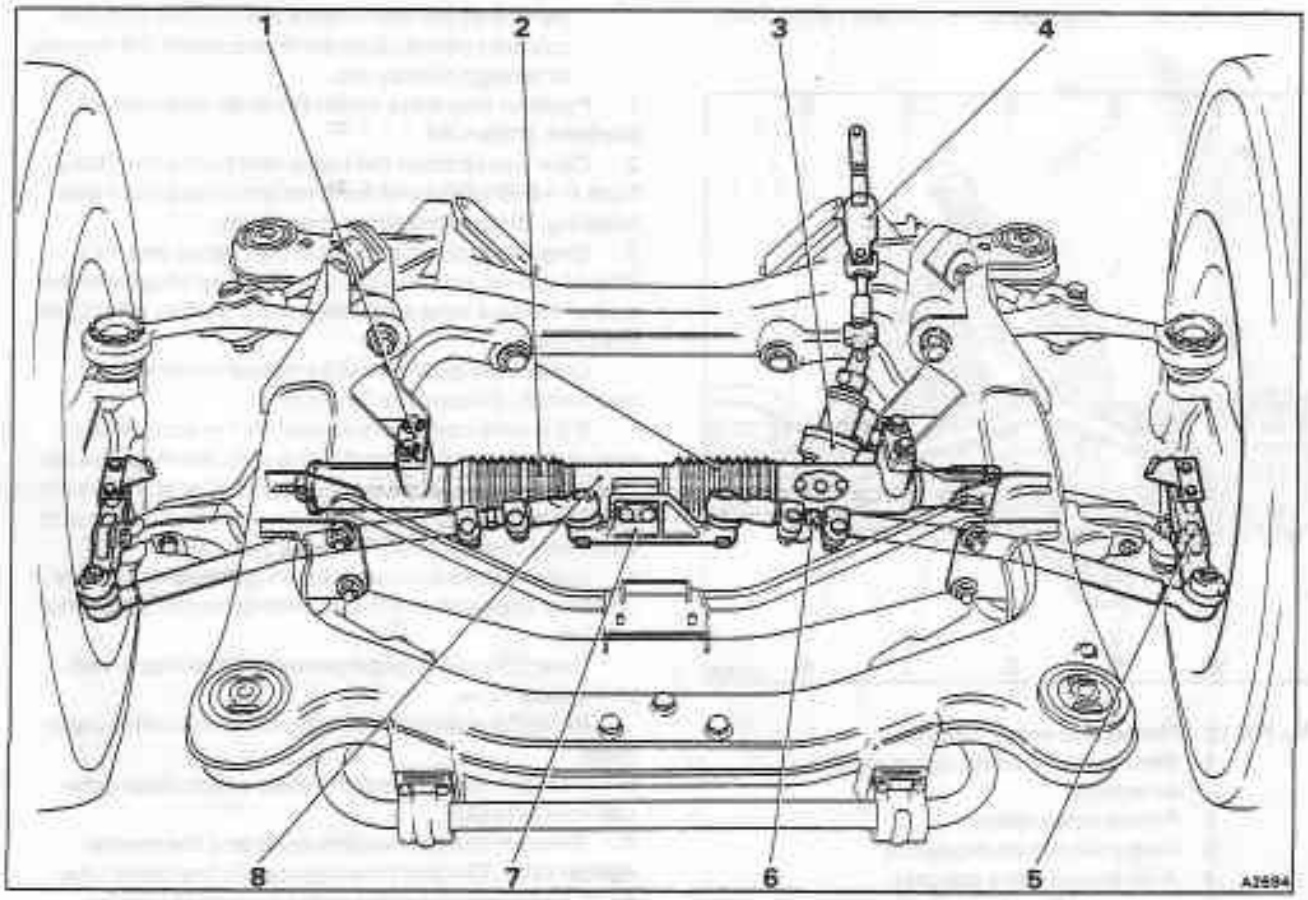

Fig. N2-11 Steering unit mounted in sub-frame

1 Steering unit mounting bolts
2 Convoluted seals
3 Pinion valve housing
4 Intermediate linkage
5 Side steering lever
6 Track rod adjuster
7 Inner ball joint bracket
8 Centre tube and seal

rotating the concentric valve components to provide the pressure differential required. A 'fail safe' device prevents the torsion bar from being overstressed by limiting the number of degrees through which it can twist.

Important The steering unit must be handled with exceptional care. Avoid impact loads on the input shaft and centre off-take, and damage to the convoluted seals which could cause premature failure of the unit.

Do not disturb the end plug or locking nut whilst the rack and pinion unit is fitted to the car.

The majority of the threads on the rack assembly are metric, except for the mounting bolts to the sub-frame and the lower steering column linkage. Therefore, always ensure the correct nuts and bolts are fitted.

Rack and pinion unit – To remove (see fig. N2-12)

1. Place the car on a ramp and remove fuse A6 from fuse panel F2 on the main fuseboard.
   Disconnect the battery.
2. Chock the road wheels and raise the ramp to a convenient working height.
3. Fit a clamp to the feed hose from the remote reservoir.
4. Position drip trays beneath the pinion valve. Then, remove the pipe unions from the valve housing.
   Fit blanks to prevent the ingress of foreign matter.
5. Remove the split pin, castellated nut, and bolt securing the lower linkage to the pinion shaft splines.
6. Straighten the tab-washer. Then, remove the setscrews holding the inner ball joint bracket to the steering rack centre position. Care must be taken not to disturb the steering rack centre block oil seal.
7. Support the rack and pinion unit, then remove the setscrews attaching the unit to the sub-frame brackets.
8. Lower the unit from beneath the suspension, carefully withdrawing the pinion shaft from the lower column linkage.

Warning Never strike the rack and pinion unit with a hammer.

9. Examine the convoluted seals for damage, etc., and the centre block oil seal for leaks.

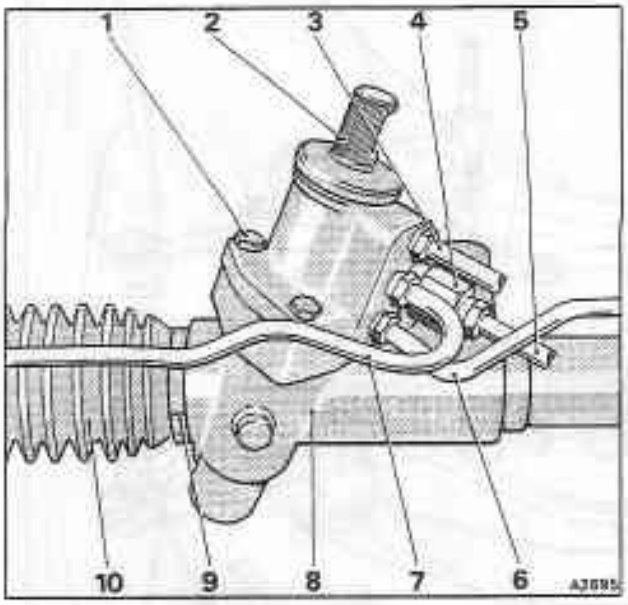

Fig. N2-12 Pinion and valve housing

1 Setscrew – housing to pinion box assembly
2 Pinion valve spline
3 Hydraulic return pipework
4 Anti-joggle valve adapter
5 Hydraulic feed pipework
6 Feed to end of rack
7 Feed to end of rack
8 Pinion box assembly
9 Seal clip
10 Convoluted seal

Replacement of convoluted seals (see fig. N2-13)

If when a convoluted seal is removed (due to splits and/or leakage) there is evidence of the ingress of water and/or road dirt, a complete stripdown, clean, and inspection should be made of the unit.

Note Whenever the steering rack unit is dismantled either partially or completely, cleanliness is of the utmost importance. Always ensure that any parts that are dismantled are cleaned and then covered with a clean cloth to prevent the ingress of foreign matter, etc.

1. Position drip trays under the ends and centre sections of the unit.
2. Carefully remove the banjo bolt hydraulic fitting from the end of the unit furthest from the pinion box housing. Discard the sealing washers.
3. Grip the support bracket at that same end, in a vice. Unscrew and remove the blanking plug from the *end of the rack tube and withdraw the outer tube from* the bracket.
   Collect the dismantled parts and cover with a clean cloth. Discard the 'O' rings.
   If it is only necessary to replace the convoluted seal at the dismantled end of the unit, there will be no need to disturb the centre block and oil seal. However, if both convoluted seals are to be removed, the centre block and seal must be removed as follows.
4. Unscrew the capscrew holding the central block in position against the rack bar. Withdraw the block and oil seal.
   Clean the sealing compound off the block, seal, and spacer tube.
   Protect the components by covering with a clean cloth.
5. Remove and discard the clips which secure the convoluted seals.
6. Remove the convoluted seals and the central spacer tube. The slot now exposed in the main tube must be covered to prevent the ingress of foreign matter.
7. Turn the unit over with the slot facing downwards. This will enable the lubricating oil to drain from the unit into a suitable tray.
8. Fit new convoluted seals and the central spacer

tube. **Do not** tighten the new securing clips at this stage.

9. Fit the centre block and seal using the flexible sealing agent (Silastic 732 RTV) on the mating surfaces of the seal to ensure a leak free joint.

10. Fit a new 'O' ring in the support bracket and assemble the support bracket to the tube.

11. Fit a new 'O' ring to the blanking plug. Then, carefully screw the blanking plug into position.

Note To ensure control of the parallelism of the two mounting bracket faces, place the assembled unit with the bracket mounting faces onto a surface table or a similar flat surface. Lightly clamp both bracket castings onto the flat surface.

12. Torque tighten the blanking plug to between 73 Nm and 80 Nm (7,5 kgf m and 8,1 kgf m; 54 lbf ft and 59 lbf ft).

13. Fit the banjo bolt hydraulic fitting, ensuring new sealing washers are fitted.

14. Clip the convoluted seals to the central spacing tube and the support bracket, using tool number RH 12212.

15. Lift the rack unit higher at the pinion end and pour 0,057 litre (0.1 Imp pt; 0.12 US pt) of approved lubricating oil (see Chapter D) into the convoluted seal.

16. Clip the convoluted seal to the pinion box casting, using tool number RH 12212.

Rack and pinion unit – To dismantle (see fig. N2-14)

Commence by following the instructions under the heading, Replacement of convoluted seals, Operations 1 to 7 inclusive.

1. After draining the lubricating oil, place the unit onto two 'Vee' shaped wooden blocks.

Note Cover the wooden blocks with clean cloths to ensure complete cleanliness.

2. Remove the remaining feed pipe. Discard the sealing washers.

3. Unscrew the retaining bolts to release the rack slipper coverplate. Remove the coverplate, shim(s), paper gaskets, spring, and rack slipper. Rotate the rack bar to aid removal of the rack slipper.

4. Unscrew the three setscrews. Then, release the pinion and valve housing assembly by gripping the pinion spline, and with a turning movement lift the assembly, **using the splined shaft**, clear of the pinion housing.

Note Do not remove the valve housing from the pinion at this stage.

5. Release the end cap lock-nut. Unscrew the end cap and discard the internal 'O' ring.

6. Using an appropriate sized wooden dowel, carefully press the end of the rack until the PTFE ring and oil seal appear at the pinion box end of the unit.

7. Support the end of the rack whilst continuing to withdraw it from the tube. Ensure that the rack and tube do not make contact. It is easy to damage the internal surface of the tube and therefore care must be taken during this operation. Also, ensure that the PTFE bearing is not damaged during removal past the centre slot and pinion opening.

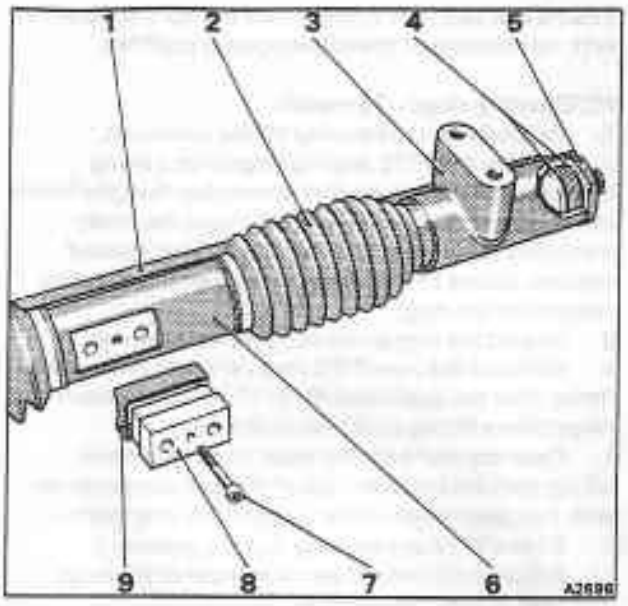

Fig. N2-13 Removal of convoluted seals

1 Fluid feed pipework
2 Convoluted seal
3 Mounting foot
4 'O' rings
5 Blanking plug
6 Centre tube
7 Capscrew
8 Centre block
9 Shaped seal

8. Inspect all components including the internal faces of the end caps, oil seals, and PTFE bearing carrier. Wash all metal parts in Genklene or an equivalent cleaning fluid.

Pinion and valve housing assembly

The pinion and valve housing assembly comprise the following main service items. Upper oil seals, PTFE sealing rings, lower oil seal, lower oil seal carrier 'O' ring, paper joint washers, pre-load shims, and circlip.

Note The upper oil seal is easily damaged by the spline on the valve. Therefore, it is important that when the valve housing is removed from the pinion and valve assembly, the splines on the valve are protected with clear adhesive tape.

Also, dismantling and assembly of these two components should not be carried out more times than is absolutely necessary.

Upper oil seal – To replace (see fig. N2-15)

1. Carefully lift the housing off the valve and pinion assembly, ensuring that the PTFE rings are not damaged.

2. Remove the upper oil seal and 'O' ring from the housing, and discard.

3. Fit a new upper 'O' ring and oil seal ensuring that the sealing lip is pointing downwards (see inset).

4. Fit the spline cover tool RH 9120 over the splines and then lower the housing down onto the valve.

Ensure that each PTFE ring enters the bore squarely with no pinching of the edges against the bore.

PTFE sealing rings – To replace

1. Carefully lift the housing off the valve unit.
2. Cut into the PTFE sealing rings with a sharp instrument having a smaller dimension than the width of the groove. Take care not to damage the finely machined surfaces of the valve. Use 'Vee' shaped wooden blocks to support the end diameters during removal of the rings.
3. Inspect the ring grooves of the valve pinion.
4. Immerse the new PTFE rings in warm oil prior to fitting onto the applicator RH 9117. Failure to warm the rings before fitting could cause cracking.
5. Place the tool over the input shaft spline and adjust until the bottom edge of the tool corresponds with the upper edge of the lowest PTFE ring groove.
6. Slide a PTFE sealing ring into the groove.
7. Adjust the tool to fit the remainder of the rings into their respective grooves.
8. Remove the sleeve tool, then size the rings by carefully pressing the tool RH 9118 over the rings to reduce their diameter.
9. Fit the spline cover tool RH 9120 over the valve splines to protect the upper seal whilst assembling the pinion valve housing.
10. Carefully assemble the pinion and valve housing.

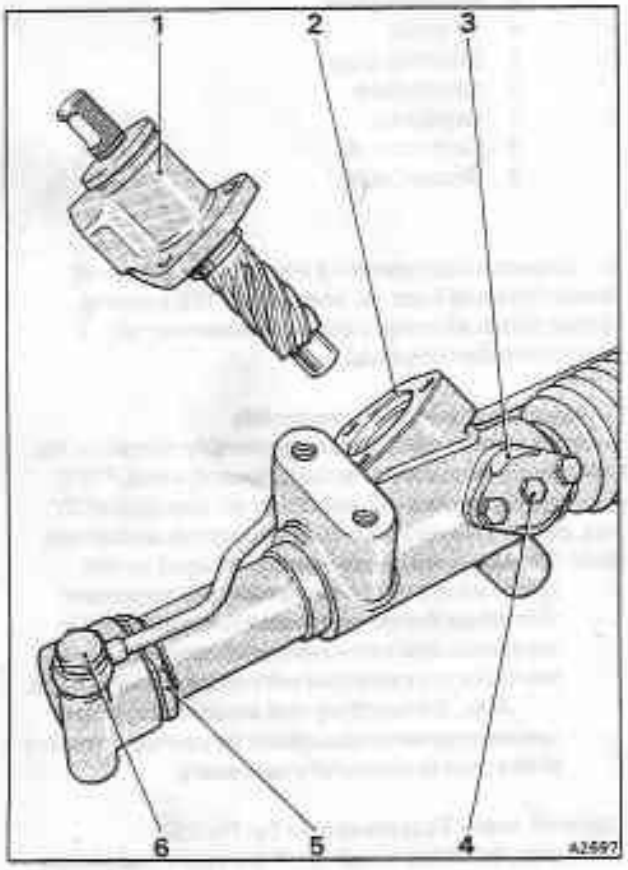

Fig. N2-14 Pinion and valve housing removal

1 Pinion and valve housing
2 Thrust ball race shim(s)
3 Slipper cover plate
4 Rack centring blanking plug
5 End cap lock-nut
6 Banjo bolt

Lower oil seal – To replace (see fig. N2-15)

1. Carefully remove the housing off the valve unit and remove the PTFE sealing rings.
2. Remove the backing spring from inside the lower lip seal. Then, remove the carrier and lower seal from the pinion.
3. Press out the lower oil seal from the carrier and discard the 'O' ring.
4. Inspect the carrier for damage.
5. Fit a new oil seal into the carrier, using tool RH 9121. Ensure that the lip face of the seal is uppermost. Fit the carrier onto the pinion until it abuts the ball race, using tool RH 9117.
6. Fit four new PTFE rings as described in, PTFE sealing rings – To replace.
7. Fit a new 'O' ring to the lip seal carrier.
8. Fit the spline cover tool RH 9120 over the valve splines to protect the upper seal whilst assembling the pinion and valve housing.
9. Carefully assemble the pinion and valve housing.

Thrust ball race – To replace (see fig. N2-15)

1. Remove the valve housing, PTFE rings, lip seal, and carrier as described in, Lower oil seal – To replace (Operations 1 to 4 inclusive).
2. Remove the upper half of the ball race.
3. Remove the circlip from beneath the lower race.
4. Remove the balls and lower race.
5. Examine all components and replace as necessary.
6. Replace the lower race complete with balls and hold in position by fitting the circlip.
7. Lubricate the balls with approved steering fluid (see Chapter D), and fit the upper half of the ball race.
8. Complete the assembly procedure as described in, Lower oil seal – To replace (Operations 5 to 9 inclusive).

Note When the pinion and valve housing assembly is fitted to the steering rack, the shim pack between the pinion box casting and the valve housing must be adjusted to give the correct pre-load to the ball race assembly, if any of the following components have been renewed.

Pinion and valve housing, pinion and valve, ball races, or lower seal carrier.

Thrust ball race assembly pre-load – To set

The pre-load must be adjusted with the rack bar removed from the pinion box and tube assembly.

1. Assemble the pinion and valve housing assembly to the pinion box and assess the thickness of the shim pack required, i.e. gap between valve housing and pinion box casting.
2. Produce a shim pack 0,25 mm (0.010 in) thicker than the dimension assessed in Operation 1. Place a

paper gasket at each end of this shim pack.

3. Position the shim pack between the valve housing and pinion box and fit the three retaining setscrews.

Note It is important to tighten these setscrews slowly and evenly, whilst rotating the pinion, to ensure that the ball race is not over pre-loaded.

4. Before torque tightening the three setscrews, the torque required to rotate the pinion to overcome seal drag should be measured and recorded. This should be between 0,06 Nm and 0,28 Nm (0,006 kgf m and 0,028 kgf m; 0.50 lbf in and 2.50 lbf in).

5. Carefully torque tighten the three setscrews to between 20 Nm and 25 Nm (2,1 kgf m and 2,5 kgf m; 15 lbf ft and 18 lbf ft).

Initially, the three setscrews should be able to be fully torque tightened without any increase occurring in the torque required to rotate the pinion. This initial tightening will compress the paper gaskets.

6. The shim pack should now be progressively reduced in thickness, until the torque required to rotate the pinion (with the setscrews torque tightened) is between 0,11 Nm and 0,28 Nm (0,011 kgf m and 0,028 kgf m; 1.0 lbf in and 2.5 lbf in) **above** the seal drag measured in Operation 4.

Rack and pinion unit – To replace oil seals and bearing rings (see figs. N2-17 and N2-18)

It is important that the pinion and valve housing assembly has been overhauled and the associated thrust ball race has been correctly shimmed before fitting the rack to the tube assembly.

Remove the pinion and valve housing assembly as described in, Rack and pinion unit – To dismantle. **Ensure that this assembly stays together.** Remove it by pulling on the splined input shaft. If the valve housing is allowed to slide up over the splined shaft, the upper and lower oil seals may be damaged.

There are three seals on each end of the rack bar.

(i) Wiper seal – Narrow black ring seal with a sharp outer diameter. Note which way it is fitted before removing (if necessary).

(ii) Bearing ring – Broad white PTFE ring with a scarf joint.

(iii) Piston seal – Black lip seal without an energising spring.

The wiper seals and bearing rings are fitted to the rack bar **before** it is fitted to the pinion box and tube assembly.

The piston seals are fitted to the rack bar **after** it has been assembled into the pinion box and tube assembly.

1. Grip the rack bar firmly in a padded vice. Remove the bearing rings and piston seals from both ends.

2. Examine the wiper seals for damage. If damage is apparent, using a suitable punch and hammer, remove the retaining pin from the floating piston assembly. Discard the pin and piston assembly.

3. To remove the fixed bearing ring carrier from the opposite end of the rack bar, secure tool RH 12213 in a vice and position the bearing ring carrier into the tool. Using a soft headed mallet, drive the rack bar out of the bearing ring carrier. Discard the carrier and seal.

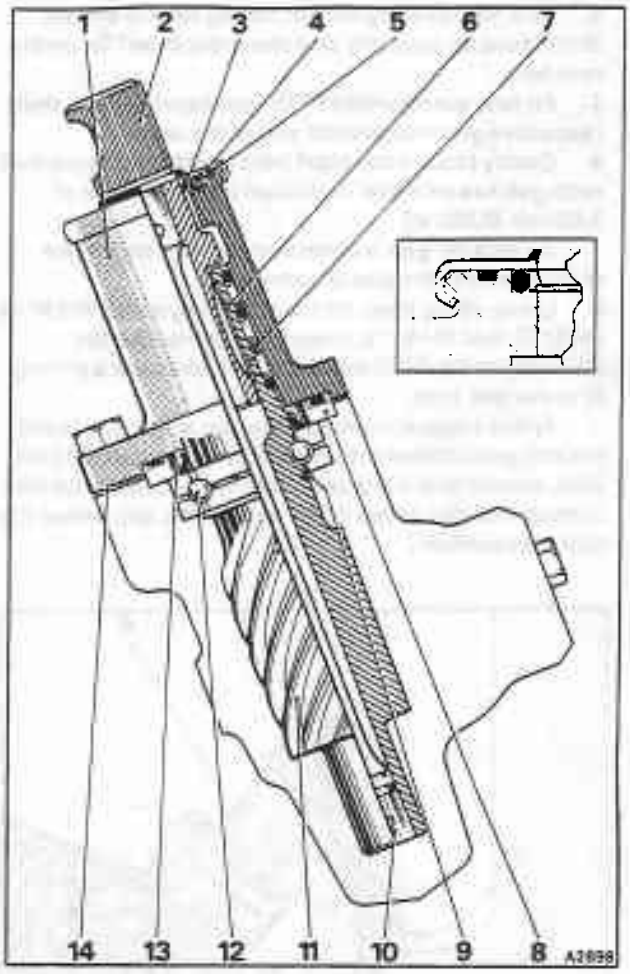

Fig. N2-15 Pinion and valve unit

1	Valve housing
2	Spline
3	Lip-type oil seal (upper)
4	'O' ring (top cap)
5	'O' ring (oil seal)
6	Valve
7	PTFE rings (4)
8	Lower oil seal carrier
9	Circlip
10	Torsion bar
11	Pinion
12	Thrust ball race
13	Lower oil seal
14	Pre-load shim(s)
Inset	Upper sealing arrangement

4. Fit a new floating piston assembly, complete with wiper seal, to the rack bar. Secure in position with a new retaining pin. Take care to drive the pin in squarely, so that it passes cleanly through the hole in the opposite side.

5. Fit a new wiper seal to the fixed bearing ring carrier end of the rack bar, ensuring that the sharp edge of the seal faces in towards the centre of the rack bar.

6. Fit a new bearing carrier, taking care to ensure that it goes on squarely and abuts the shoulder on the rack bar.
7. Fit new scarf jointed PTFE rack bearings into their respective grooves at each end of the rack.
8. Gently press each scarf joint together. Ensure that each gap has an initial (nominal) measurement of 2,03 mm (0.080 in).

If a smaller gap is observed, cut one end of the scarf joint until the gap is correct.

9. Using sizing tools (in the following order) RH 9114, RH 9113, and RH 9112, progressively reduce the diameter of the PTFE bearings, until they are a sliding fit in the rack tube.

At this stage ensure that the gap at the scarf joint has not gone below a minimum of 0,25 mm (0.010 in). Also, ensure that it is positioned so as not to come into contact with the edges of the centre slot, etc., when the rack is assembled.

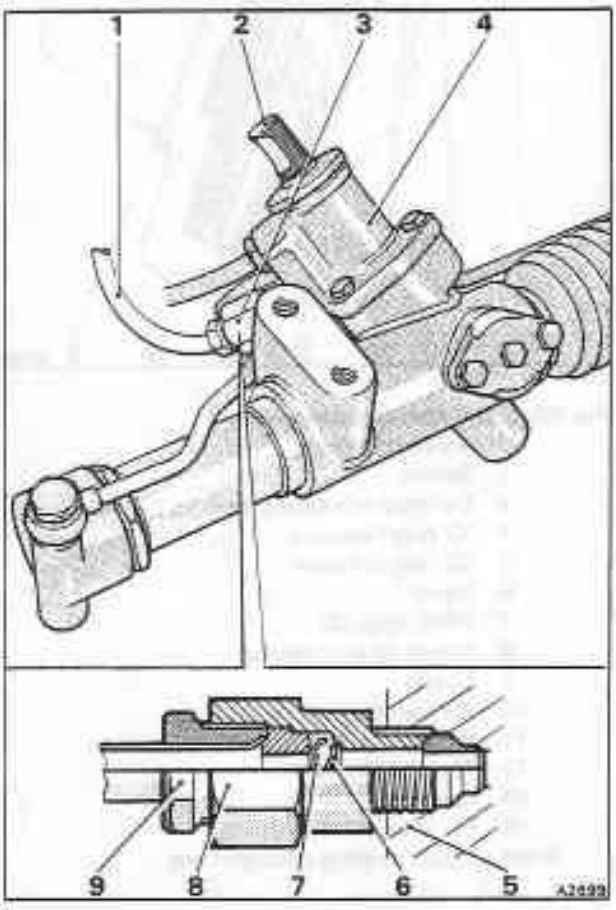

Fig. N2-16 Anti-joggle valve
1 High pressure fluid
2 Spline
3 Anti-joggle valve
4 Pinion valve housing
5 Valve housing casting
6 Spring
7 Flap valve
8 Adapter
9 Pipe union

Remove any burrs from the slot. Wipe the area clean before assembly.

Anti-joggle valve (see fig. N2-16)
1. With the steering dismantled remove the anti-joggle valve.
2. Check that the spring and flap are functioning correctly by pressing a probe carefully onto the top of the flap. Ensure that adequate compression of the assembly occurs and the flap seats correctly.
3. Wash out the assembly in Genklene or an equivalent cleaning solution. Dry using a controlled jet of dry pressurized air into the male threaded end of the unit only.
4. Fit blanking plugs into each end of the adapter.

Pipe union
If the olive which forms the seating of the pipe union is found to be damaged it will be necessary to remove the pinion valve housing before it can be renewed. It must be emphasized that cleanliness must be observed when carrying out this procedure.

Rack and pinion unit – To assemble (see fig. N2-19)
1. Remove the rack bar from the vice and replace it with the pinion box and tube assembly. Clamp the tube horizontally in the vice with the valve housing mounting face uppermost and the rack slipper hole facing towards the operator.
2. From the pinion box end (smooth bore end) of the tube, push the rack bar into its central position. Ensure that the centralizing hole is in the middle of the rack slipper hole.
3. Assemble the valve and pinion assembly (complete with shim pack, etc.) into the steering box.

Ensure that with the rack in the central position, the flat on the pinion spline is on the same side and at right-angles to the short tube for right-hand drive cars, and the long tube for left-hand drive cars.

4. Fit the three setscrews and lightly screw down. Do not torque tighten at this stage.

The torque required to rotate the valve should not exceed 0,9 Nm (0,09 kgf m; 8 lbf in). If it does exceed this figure, the rack PTFE bearing rings could be incorrectly sized. Withdraw the rack bar and using tools (in the following order) RH 9114, RH 9113, and RH 9112, progressively reduce the diameter of the PTFE bearings.

5. Torque tighten the three retaining setscrews to between 20 Nm and 25 Nm (2,0 kgf m and 2,5 kgf m; 15 lbf ft and 18 lbf ft) whilst rotating the pinion, to ensure that the pinion pre-load is still correct.
6. Fit the rack bar piston seals to each end of the rack using pusher tool RH 12214.

When fitting the seal to the long end tube, ensure that the seal is not damaged by the threaded bore.

Ensure each seal seats correctly in its location groove.

7. Fit the rack slipper (without the spring) and then fit the centre block to the rack.
8. Fit the slipper cover plate with a shimpack, including a paper gasket at either end. Ensure that the

shim pack is thick enough to produce between 1 mm and 2 mm (0.040 in and 0.080 in) radial free play of the centre block in the rack tube.

9. Progressively reduce the thickness of the shim pack until zero free play is achieved, with the rack in the central position and the pinion housing retaining setscrews torque tightened.

Add one extra 0,05 mm (0.002 in) shim to the shim pack and insert the spring into the rack slipper. Torque tighten the slipper cover plate retaining setscrews to between 20 Nm and 25 Nm (2,0 kgf m and 2,5 kgf m; 15 lbf ft and 18 lbf ft).

The torque required to rotate the valve should now be between 1,13 Nm and 1,69 Nm (0,12 kgf m and 0,17 kgf m; 10 lbf in and 15 lbf in), with the rack in the central position.

10. Fit the centring plug RH 12123.

11. Fit new convoluted seals as described in, Replacement of convoluted seals, Operations 8 to 16 inclusive. Prior to Operation 13, fit the long oil pipe to the valve housing and torque tighten the retaining nut to between 23 Nm and 27 Nm (2,4 kgf m and 2,7 kgf m; 17 lbf ft and 20 lbf ft).

12. Screw the lock-nut onto the threaded end of the rack tube and then clean the threads and prime with Loctite primer.

13. Fit a new 'O' ring into the groove in the end cap.

14. Commence to screw the end cap onto the tube. After 2 or 3 complete turns, apply a ring of Loctite 542 to the next three threads. Then, continue to screw on the end cap until it abuts the end of the tube.

Note Ensure when carrying out this operation that the 'O' ring is not displaced.

15. Fit the short oil pipe to the valve housing and unscrew the end cap up to one complete turn, until it lines up with the banjo fitting on the oil pipe.

16. Tighten the lock-nut to between 47 Nm and 54 Nm (4,8 kgf m and 5,5 kgf m; 35 lbf ft and 40 lbf ft), using tool RH 9125.

17. Torque tighten the short oil pipe into the valve housing to between 23 Nm and 27 Nm (2,4 kgf m and 2,7 kgf m; 17 lbf ft and 20 lbf ft).

Fit the banjo bolt hydraulic fitting, ensuring new sealing washers are fitted.

Torque tighten the banjo bolts to between 35 Nm and 41 Nm (3,6 kgf m and 4,1 kgf m; 25 lbf ft and 30 lbf ft).

18. The unit is now ready for fitting to the car, but do not remove the centring plug at this stage.

Rack and pinion unit – To fit to the sub-frame

1. Position and hold the steering wheel in its central position. Carefully fit the pinion box spline into the lower linkage coupling and support the unit in position. Finger tighten the pinch bolt.

2. Fit the rack and pinion unit to the sub-frame using the setscrews and washers. Torque tighten the setscrews to between 57 Nm and 61 Nm (5,8 kgf m and 6,2 kgf m; 42 lbf ft and 45 lbf ft), using tools RH 12124 and RH 12125.

3. Align the inner ball joint bracket and the steering rack unit centre block seal (see fig. N2-20).

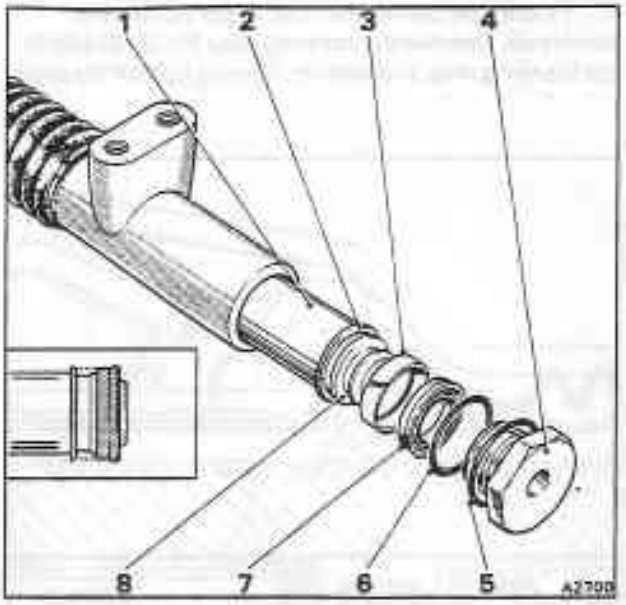

Fig. N2-17 Assembly of free end components

1 Rack bar
2 Wiper seal
3 PTFE seal
4 Blanking plug
5 Blanking plug 'O' ring
6 Tube 'O' ring
7 Oil seal
8 Bearing carrier

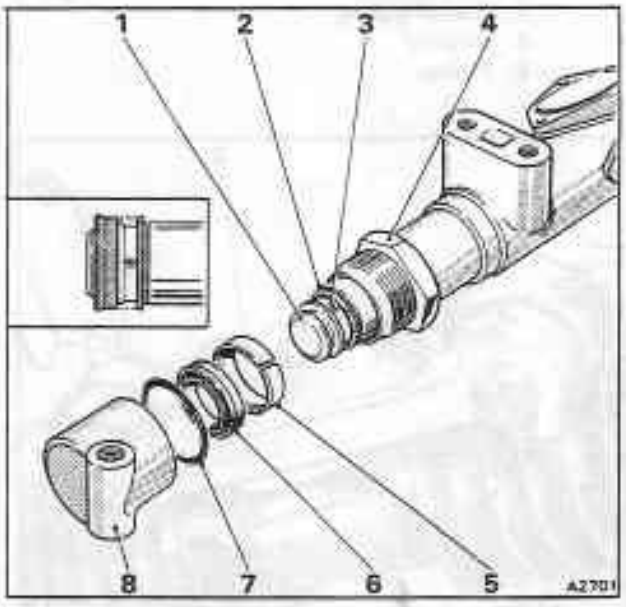

Fig. N2-18 Assembly of pinion box end components

1 Floating piston assembly
2 Wiper seal
3 Retaining pin
4 Lock-nut
5 PTFE seal
6 Oil seal
7 End cap 'O' ring
8 End cap

4. Fit the new tab-washer and finger tighten the setscrews. Remove the centring plug RH 12123 and fit the blanking plug and washer. Torque tighten the plug to between 7 Nm and 11 Nm (0,7 kgf m and 1,1 kgf m; 5 lbf ft and 8 lbf ft).

5. Torque tighten the inner ball joint bracket setscrews to between 38 Nm and 40 Nm (3,9 kgf m and 4,1 kgf m; 28 lbf ft and 30 lbf ft). Ensure that the oil seal is not displaced. Lock the tab-washer to the setscrews, avoiding any impact to the unit.

6. **On cars not fitted with a 'one-piece' lower linkage,** slacken the spline adjustment bolt and set the lower linkage coupling to the rack pinion, by lining up the shoulder of the lower yoke with the top of the pinion shaft (see fig. N5-6, A). Then, check for clearance between the lower coupling shaft and the universal joint spider (see fig. N5-6, B). Adjust on the rack pinion shaft, if necessary.

Note It is important that neither the pinion shaft or lower coupling shaft contact the universal joint spider.

On cars fitted with a 'one-piece' lower linkage, set the lower linkage coupling to the rack pinion using tool RH 12122, as shown in figure N5-7.

7. Torque tighten the lower pinch bolt(s) and castellated nut(s) to the figures quoted in Section N8, utilizing the torque allowance to allow the fitting and securing of the new split pin(s).

8. Connect the pipework from the pump and oil cooler to the pinion box, ensuring the union joints are wiped clean before fitting. Torque tighten in accordance with the figures quoted in Section N8.

Note Correct routing of the pipework is essential.

9. Fit the gearchange fuse (fuse A6 on fuse panel F2 on the main fuseboard).

10. Connect the battery.

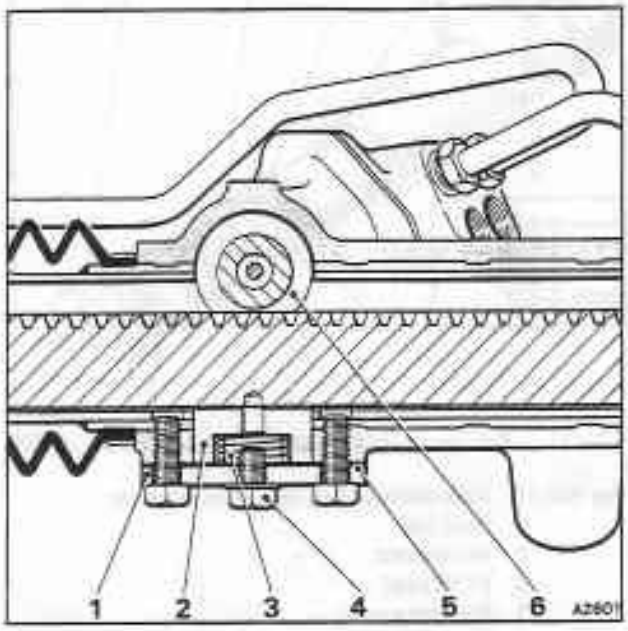

Fig. N2-19 Pinion mesh adjustment
1 Cover plate
2 Rack slipper
3 Spring
4 Blanking plug
5 Shim(s)
6 Pinion

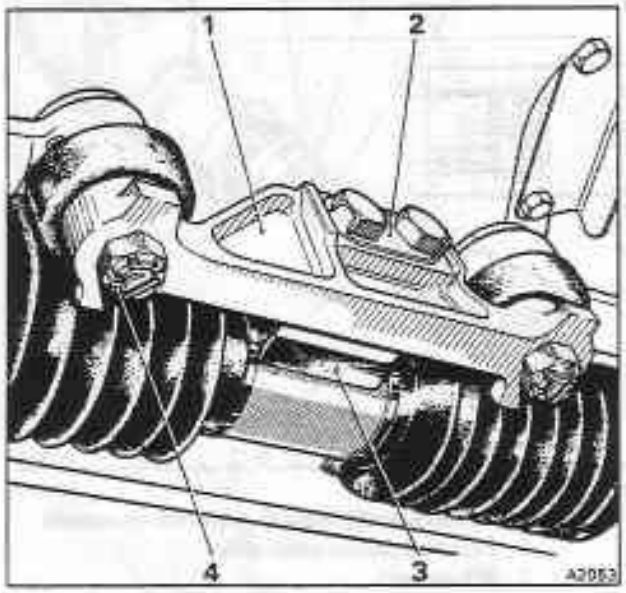

Fig. N2-20 Inner ball joint bracket in position
1 Bracket
2 Tab-washer
3 Centre block seal
4 Castellated nut and split pin

Rack and pinion unit - To assemble (unit incorporating an external adjuster) (see fig. N2-2)

N2-2 Pinion mesh adjustment (rack and pinion unit incorporating an external adjuster)

- 1.) Remove the rack bar from the vice and replace it with the pinion box and tube assembly. Clamp the tube horizontally in the vice with the valve housing mounting face uppermost and the rack slipper hole facing towards the operator.
- 2.) Smear 35 g (1.25 oz) of Rocol Sapphire grease onto the meshing gear of the rack bar, pinion, and pinion thrust ball race.
- 3.) From the pinion box end (smooth bore end) of the tube, push the rack bar into its central position. Ensure that the centralizing hose is in the middle of the rack slipper hole.
- 4.) Assemble the valve and pinion assembly (complete with shim pack, etc.) into the steering box.

Ensure that with the rack in the central position, the flat on the pinion spline is on the same side and at right-angles to the short tube for right-hand drive cars, and the long tube for left-hand drive cars.

- 5.) Fit the three setscrews and screw down. Do not torque tighten at this stage.

The torque required to rotate the valve should not exceed 0,9 Nm (0,09 kgf m; 8 lbf in). If it does exceed this figure, the rack PTFE bearing rings could be incorrectly sized. Withdraw the rack bar and using sizing tools (in the following order) RH 9114, RH 9113, and RH 9112, progressively reduce the diameter of the PTFE bearings.

- 6.) Torque tighten the three retaining setscrews to between 20 Nm and 25 Nm (2,0 kgf m and 2,5 kgf m; 15 lbf ft and 18 lbf ft) whilst rotating the pinion, to ensure that the pinion pre-load is still correct.
- 7.) Fit the rack bar piston seals to each end of the rack using fitting tool RH 12214.

When fitting the seal to the long end tube, ensure that the seal is not damaged by the threaded bore.

Ensure each seal seats correctly in its location groove.

- 8.) Fit the rack slipper, spring, spring seat, gasket, and coverplate. Torque tighten the setscrews to between 20 Nm and 25 Nm (2,0 kgf m and 2,5 kgf m; 15 lbf ft and 18 lbf ft). Then, fit the centre block to the rack.
- 9.) With the rack in the central position, adjust the rack mesh pre-load as follows.

Slacken the lock-nut and unscrew it at least one full turn. Then, screw in the adjuster screw (against spring pressure) until the pressure needed to rotate the screw begins to increase.

The torque required to rotate the valve should be between 1,13 Nm and 1,69 Nm (0,12 kgf m and 0,17 kgf m; 10 lbf in and 15 lbf in), with the rack in the central position.

If this torque figure is too high, screw out the adjuster screw in small steps (i.e. 20° at a time) until the correct torque figure is obtained, tighten the lock-nut. Then, check the centre block radial free play in the rack tube. This should be no more than 0,76 mm (0.030 in). Readjust if necessary.

- 10. Fit the centring plug RH 12465.
- 11. Fit new convoluted seals as described in, Replacement of convoluted seals, Operations 8 to 16 inclusive. Prior to Operation 13, fit the long oil pipe to the valve housing and torque tighten the retaining nut to between 23 Nm and 27 Nm (2,4 kgf m and 2,7 kgf m; 17 lbf ft and 20 lbf ft).
- 12. Screw the lock-nut onto the threaded end of the rack tube. Then, clean and prime the threads with Loctite primer.
- 13. Fit a new 'O' ring into the groove in the end cap.
- 14. Commence to screw the end cap onto the tube. After 2 or 3 complete turns, apply a ring of Loctite 542 to the next three threads. Then, continue to screw on the end cap until it abuts the end of the tube.

Note:
Ensure when carrying out this operation that the 'O' ring is not displaced.

- 15. Fit the short oil pipe to the valve housing. Unscrew the end cap up to one complete turn, until it lines up with the banjo fitting on the oil pipe.
- 16. Tighten the lock-nut to between 47 Nm and 54 Nm (4,8 kgf m and 5,5 kgf m; 35 lbf ft and 40 lbf ft), using spanner RH 9125.
- 17. Torque tighten the short oil pipe into the valve housing to between 23 Nm and 27 Nm (2,4 kgf m and 2,7 kgf m; 17 lbf ft and 20 lbf ft).

Fit the banjo bolt hydraulic fitting, ensuring new sealing washers are fitted.

Torque tighten the banjo bolts to between 35 Nm and 41 Nm (3,6 kgf m and 4,1 kgf m; 25 lbf ft and 30 lbf ft).

- 18. The unit is now ready for fitting to the car, but do not remove the centring plug at this stage.

Fig N2-2 Steering Rack Mesh Adjustment

Racks fitted with External Adjuster