

Chapter 10 Steering

For modifications, and information applicable to later models, see Supplement at end of manual

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Specifications

System type	Rack and pinion with universally-jointed column
Turning circle	9.2 m (30.2 ft)
Number of turns of steering wheel (lock to lock)	3.4
Wheel alignment and steering angles	
<i>All measurements are with car at kerb weight (ie unladen, but with coolant and all fluids, full fuel tank, spare wheel and tool kit)</i>	
Toe-out in turns:	
Inside roadwheel	33° 45' ± 1° 30'
Outside roadwheel	31° 30' ± 1° 30'
Camber angle	1° 30' ± 30' positive
Castor angle	3° ± 30' positive
Steering axis inclination/SAI – also known as kingpin inclination/KPI	Not available (set in production)
Toe setting	2.0 ± 2.0 mm (0.08 ± 0.08 in) toe-in

Rack lubricant

Type	Fiat K854 grease (refer to Fiat dealer)
Capacity (total)	80 to 100 g

Torque wrench settings

	Nm	lbf ft
Steering wheel nut	49	36
Steering coupling pinch-bolt	27	20
Steering gear mounting bolts	25	18
Tie-rod balljoint taper pin nut	34	25
Tie-rod end locknut	49	36
Steering column pressed steel mounting bracket bolts	8	6
Roadwheel bolts	86	63
Pinion bearing plate bolt	30	22
Rack damper cover plate bolt	30	22

1 General description

The steering gear is of rack and pinion type with a universally-jointed shaft supported in a tubular column.

The front wheel toe setting and castor are adjustable as described in Section 12, the camber angle is set in production.

A two-spoked steering wheel is fitted.

2 Maintenance

1 The steering rack and tie-rod end balljoints are sealed for life and require no lubrication.

2 At the intervals specified in Routine Maintenance, check the rack gaiters for splits. Extend the gaiters with the fingers in case splits at the base of the pleats are overlooked.

3 With an assistant moving the steering wheel a few degrees quickly in each direction, check for wear (lost movement) at the tie-rod end balljoints. If wear is detected, renew any worn components as described later in this Chapter.

4 At the specified periods, check the front wheel alignment as described in Section 12.

3 Tie-rod end balljoint – renewal

1 Wear of the tie-rod end balljoints can only be overcome by renewal, no adjustment being possible. The balljoints are grease-sealed and require no attention during their life, except to check their dust excluding boots for splits at the specified inspection intervals.

2 Jack up the front of the car and remove the roadwheel from the side on which the balljoint is to be renewed.

3 Unscrew the self-locking nut from the tie-rod end ball stud, but do not remove it (photo).

4 Using a suitable tool, disconnect the balljoint.

5 Release the locknut on the tie-rod, unscrewing it only just enough to be able to unscrew the tie-rod end from the tie-rod.

6 With the tie-rod end removed, wire brush the threads on the tie-rod without disturbing the position of the locknut; apply grease to the threads and screws on the new tie-rod end until the locknut can be tightened by turning it through the same amount of rotation it was given when unscrewed.

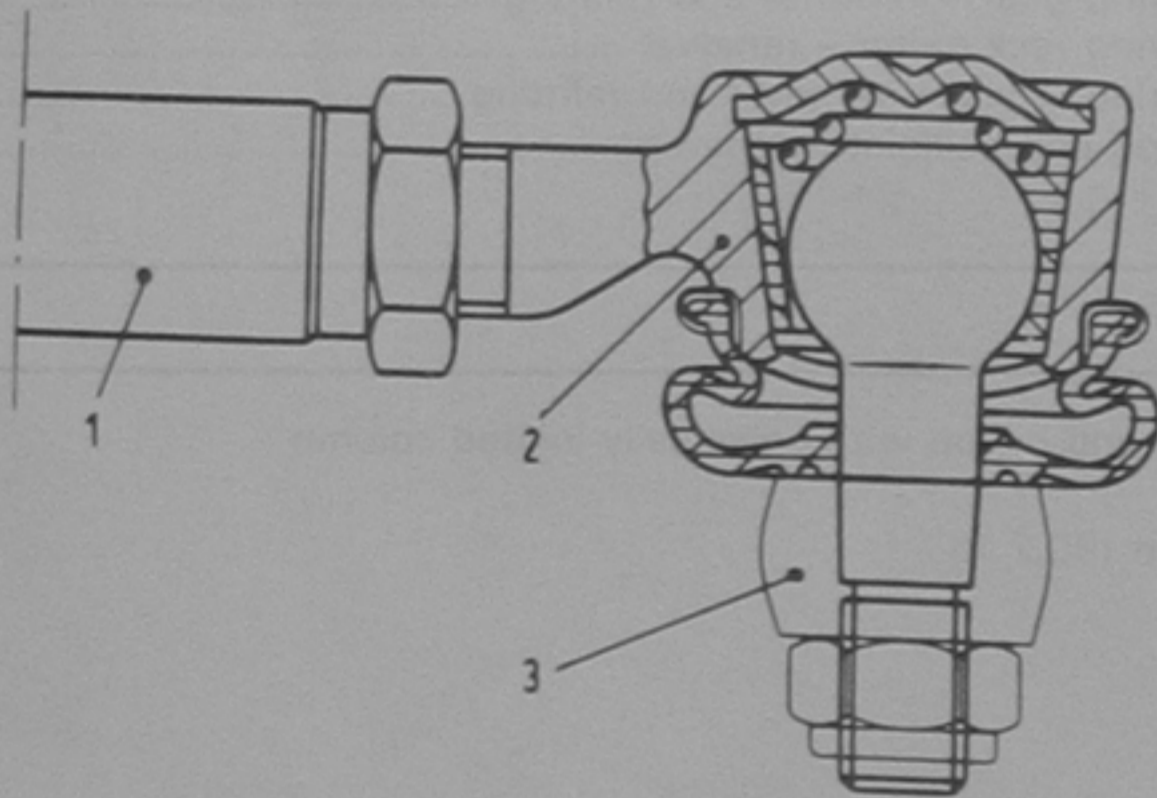
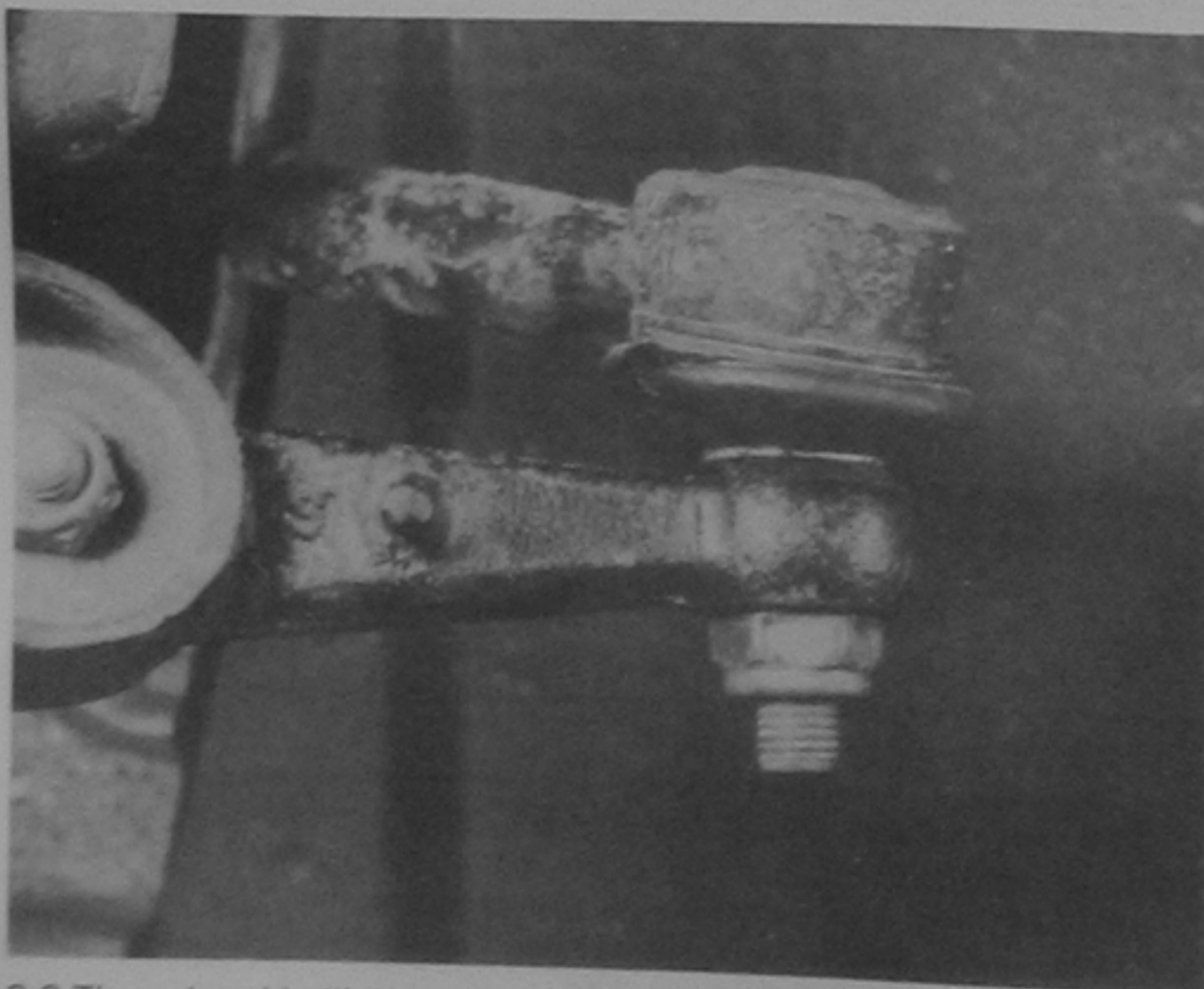


Fig. 10.1 Sectional view of typical balljoint (Sec 3)

1 Tie-rod
2 Balljoint socket

3 Steering arm



3.3 Tie-rod end balljoint

7 Reconnect the balljoint taper pin to the eye of the steering arm and tighten the retaining nut to the specified torque. *Never grease the taper pin or eye;* the pin will otherwise turn when the nut is tightened. If a taper pin is inclined to rotate when a nut is being tightened, apply pressure to the socket of the joint to force the taper pin into closer contact with the tapered hole in the eye. If a taper pin is pointing downward, a strong lever can be used to apply the extra pressure. Where the taper pin of a balljoint points upward, a jack placed under the joint socket will produce the desired result.

8 Although the careful fitting of the new tie-rod end will have approximately maintained the original front wheel alignment of the car, manufacturing differences alone of the new component make it essential to check the setting, as described in Section 12.

4 Steering rack gaiter – renewal

1 If lubricant is found to be leaking from the gaiters (at the ends of the housing), first check that the gaiter clips are secure.

2 If the lubricant is leaking from the gaiter through a split, the gaiter can be removed in the following way, without the necessity of withdrawing the gear from the car.

3 Remove the tie-rod end from the side concerned, as described in the preceding Section.

4 Release the gaiter clips; draw the gaiter from the rack housing and off the tie-rod.

5 If the gaiter has only just split, road dirt is unlikely to have entered and lubricant can be wiped away. If it is severely grit contaminated, the steering gear should be completely removed, the original lubricant flushed out and new lubricant pumped in.

6 If the gear does not have to be removed from the car, slide the new gaiter into position and secure it with the inboard clip.

7 On these models, the steering gear lubricant is grease, therefore reducing the possibility of oil seal leakage. When recharging the gaiter with this type of lubricant, give full steering lock to the side being replenished so that the extended section of the rack will take the grease into the housing as it returns.

8 Fit the outboard clip.

9 Fit the tie-rod end as described in the preceding Section and then check the front wheel alignment (Section 12).

5 Steering wheel – removal and refitting

1 Disconnect the battery negative lead.

2 Set the steering in the straight ahead attitude.

3 Prise out the horn button from the centre of the steering wheel (photo).

4 Extract the two horn switch contact springs now exposed (photos).

5 Unscrew and remove the steering wheel securing nut, then pull the wheel from the column shaft. If it is tight on its splines, thump the rear of the rim, at opposite points, with the palms of the hands.

6 Refit by reversing the removal operations. Set the wheel in the straight ahead position with the spokes in the lower part of the wheel.

7 Tighten the fixing nut to the specified torque.

6 Steering column – removal and refitting

1 Disconnect the battery.

2 Remove the steering wheel as previously described.

3 Working under the column shroud, extract the screw and bolt. The screw holds the shroud and the bolt secures the steering column combination switches (photo).

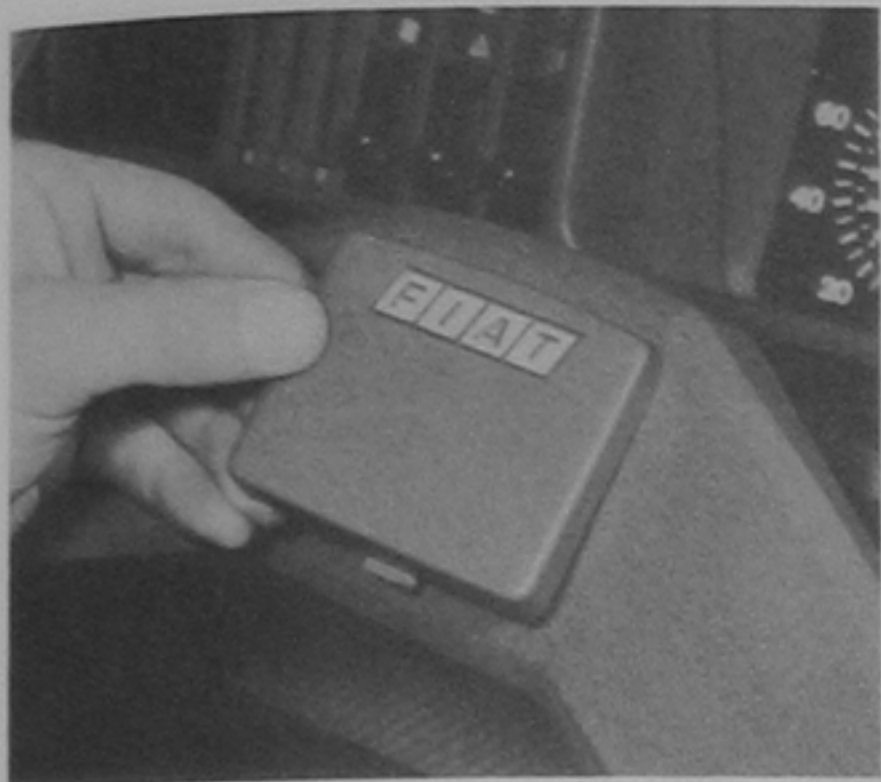
4 Release the screw which holds the clamp retainer for the switches. This screw is accessible through the large hole in the shroud (photo).

5 Disconnect the combination switch wiring harness plugs at the side of the steering column and withdraw the switches off the end of the column.

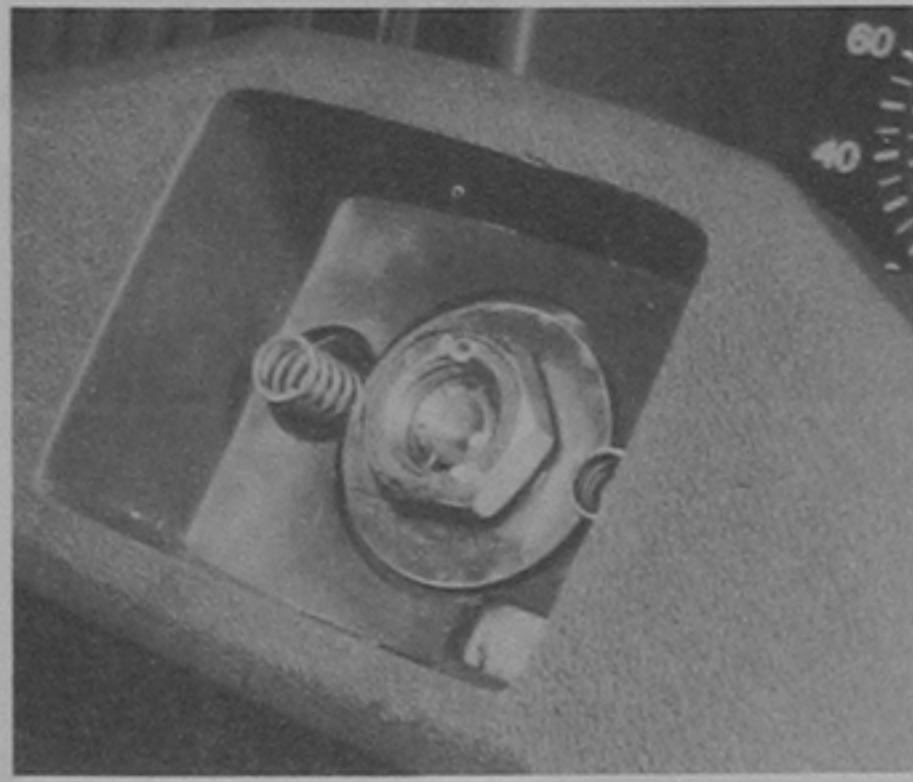
6 Disconnect the choke control cable from the carburettor.

7 Extract the end screws from the full width parcels shelf and lower the shelf (photo).

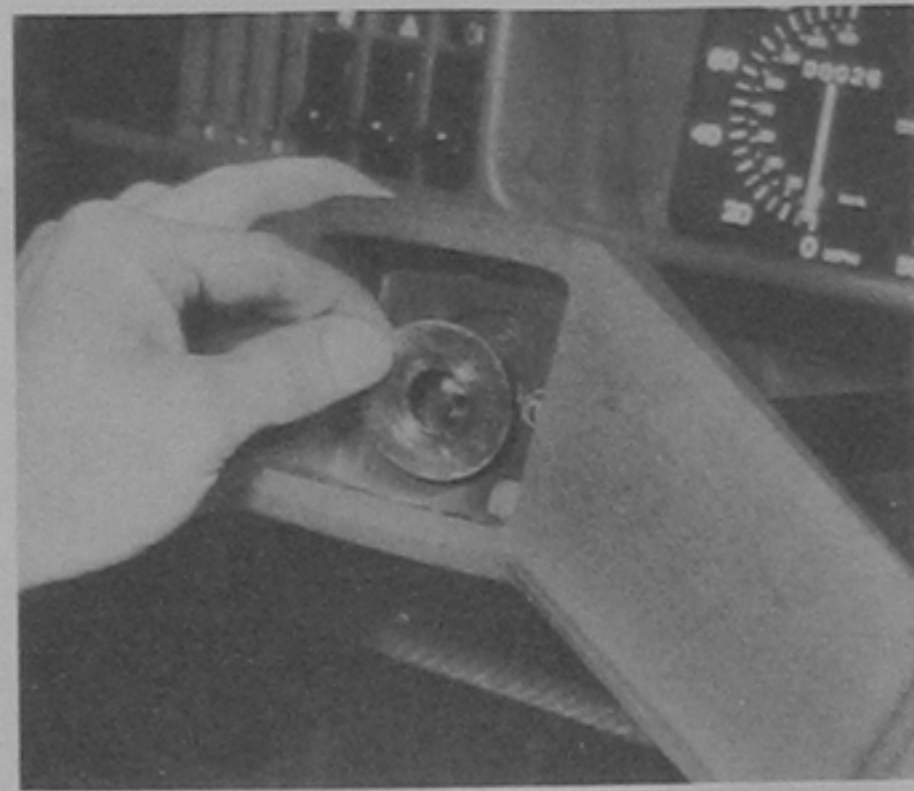
8 Withdraw the steering column shroud until the washer control connections can be disconnected and the shroud removed completely.



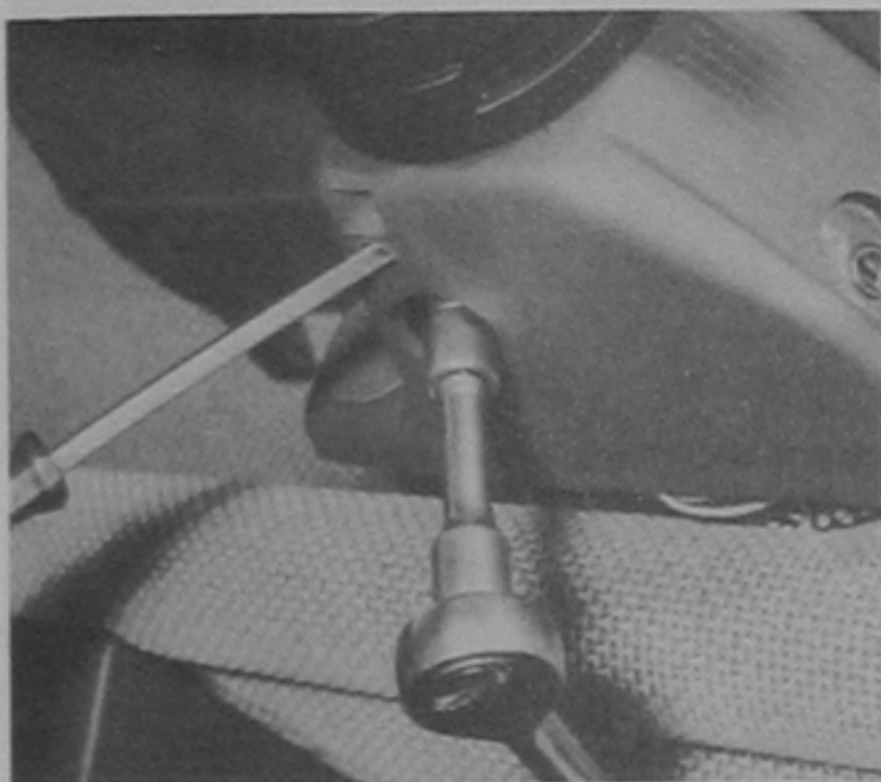
5.3 Removing horn pad



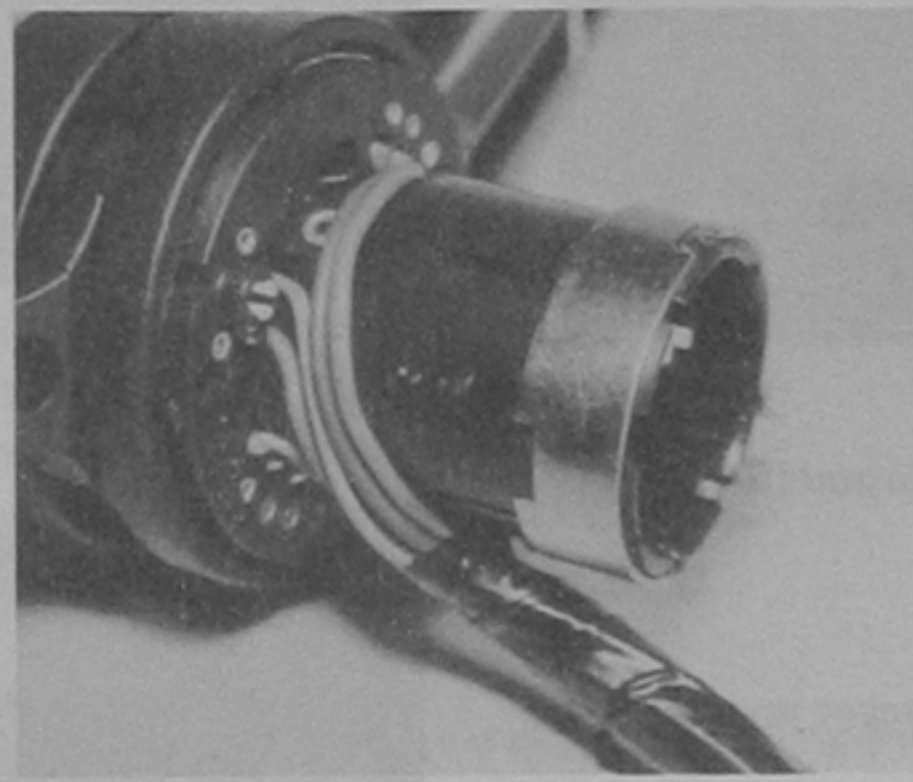
5.4A Steering wheel nut and horn contact springs



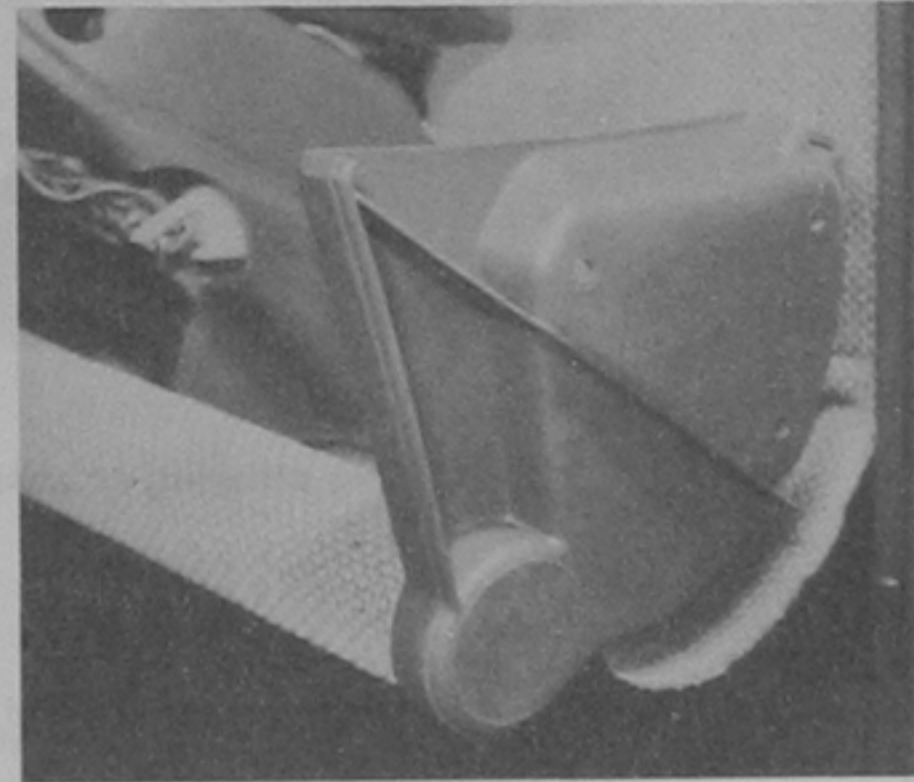
5.4B Steering wheel thrustwasher



6.3 Shroud fixing screw and column, switch clamp bolt



6.4 Steering column switch and clamp



6.7 Front parcel shelf end brackets

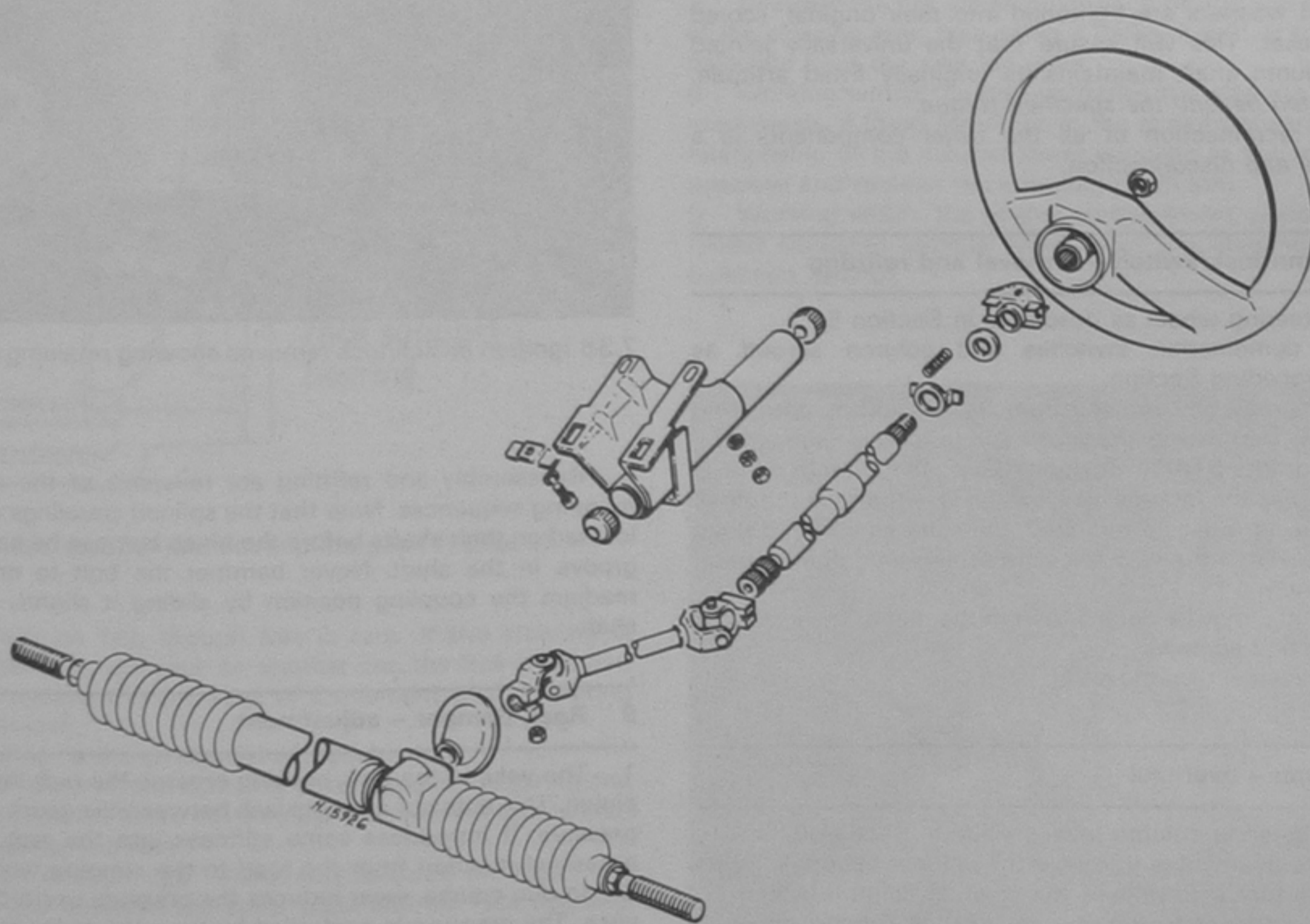


Fig. 10.2 Steering arrangement (Sec 6)



Fig. 10.3 Withdrawing steering column shroud (Sec 6)

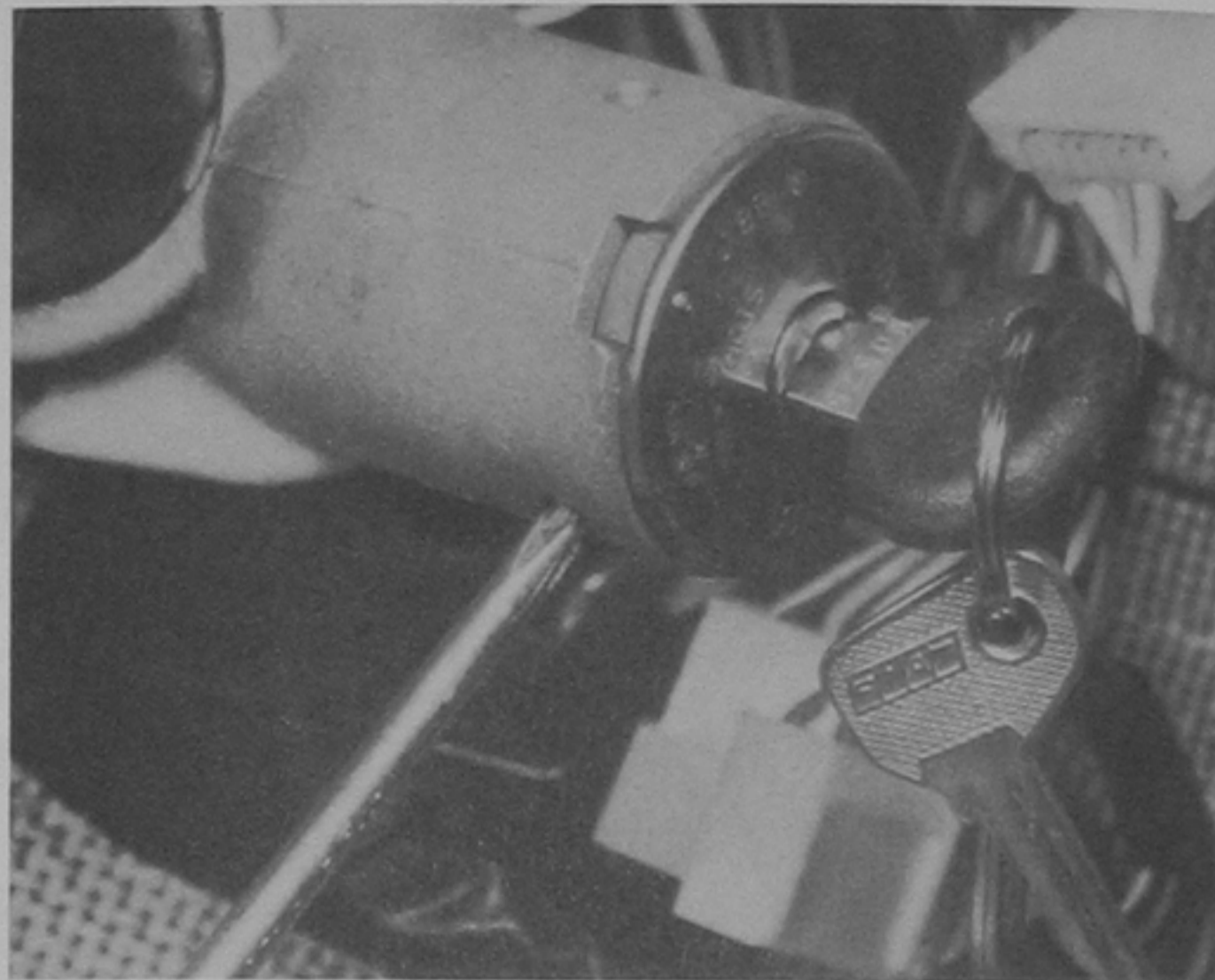
- 9 Unbolt the steering column pressed-steel bracket and lower the column to rest on the front seat.
 - 10 Working between the foot pedals, extract the pinch-bolt and pull the coupling from the splines of the pinion shaft of the steering gear. If the coupling is tight, open its jaws slightly with a screwdriver.
 - 11 Withdraw the column assembly from the car.
 - 12 Refit the upper mounting bracket after the bottom end of the column has been reconnected; try to position the bracket so that the retaining bolts and washers are tightened into their original, scored marks on the bracket. This will ensure that the universally jointed section of the column shaft maintains its originally fitted attitude.
- Note:** Do not tighten beyond the specified torque.
- 13 Refitting and reconnection of all the other components is a reversal of removal and disconnection.

7 Steering column lock/switch – removal and refitting

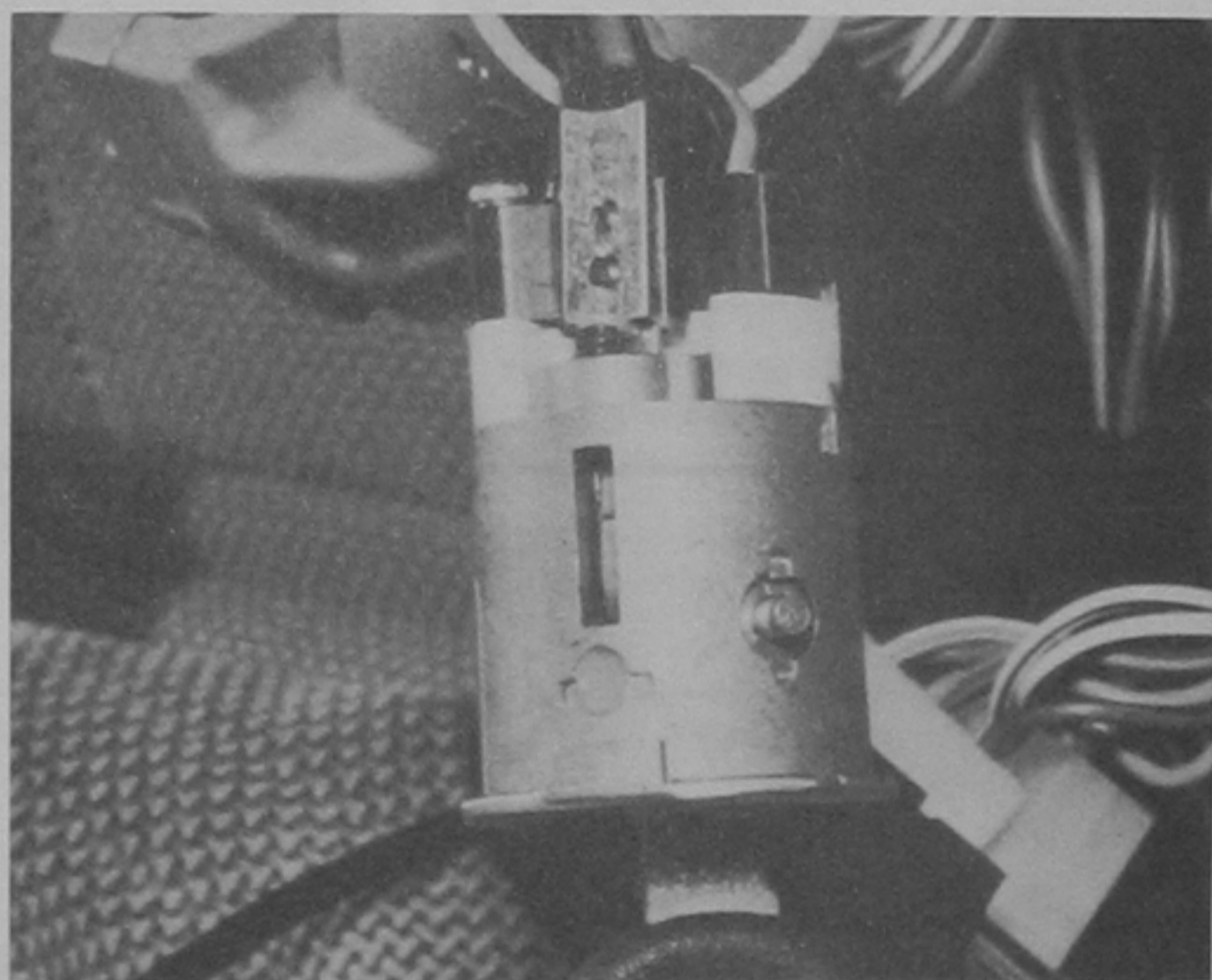
- 1 Remove the steering wheel as described in Section 5.
- 2 Remove the combination switches and column shroud as described in the preceding Section.
- 3 The lock/switch may be removed from its housing by extracting the retaining screw, depressing the small spring-loaded plunger and turning the key to the START position. Ease the wiring harness through the housing as the lock cylinder/switch is withdrawn (photos).
- 4 If the lock housing must be removed, then the shear-head bolts must be drilled out. When the new ones are screwed in, tighten them until their heads break off.
- 5 The ignition switch may be detached from the rear of the lock after extracting the retaining screws.
- 6 Refitting is a reversal of removal.

8 Steering column – overhaul

- 1 Withdraw the steering column as described in Section 6.
- 2 If the reason for overhaul is to renew the column bearings, insert the ignition key and turn it to release the steering column lock.
- 3 The bearing retaining staking at the ends of the column tube will have to be relieved and the shaft then pushed backwards and forwards to eject the bearings.
- 5 Apply grease to the bearings; tap them into position (until they seat against the crimped stops in the column tube), then stake over the split in the bush.



7.3A Ignition switch/lock fixing screw



7.3B Ignition switch/lock removed showing retaining plunger

- 6 Reassembly and refitting are reversals of the removal and dismantling sequences. Note that the splined couplings must be correctly located on their shafts before the pinch bolt can be passed through the groove in the shaft. Never hammer the bolt to drive it through – readjust the coupling position by sliding it slightly up or down the shaft.

9 Rack damper – adjustment

- 1 The yoke in the rack housing presses the rack into mesh with the pinion. This cuts out any backlash between the gears. Also owing to its pressure, it introduces some stiffness into the rack, which cuts out excessive reaction from the road to the steering wheel.
- 2 In due course, wear reduces the pressure exerted by the damping yoke. The pressure is controlled by the yoke cover plate and a spring.
- 3 The yoke setting should be reset if the rack has been dismantled for overhaul.
- 4 The need for resetting of the yoke if the car has run a long mileage, but the rack is not being dismantled, is not easy to detect. On bumpy roads the shock induced through the steering will give a feeling of play, and sometimes faint clonking can be heard. In extreme cases free-play

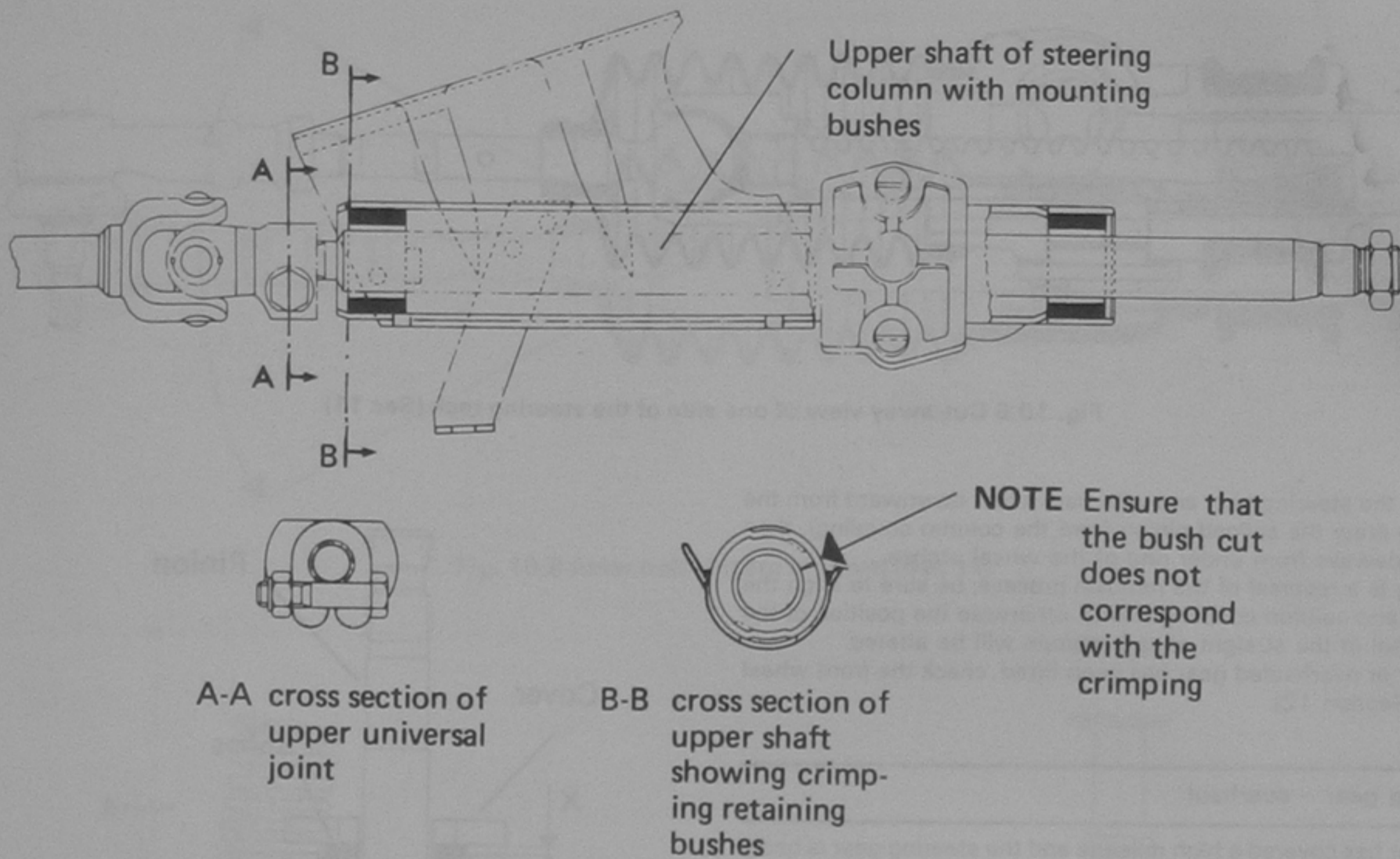


Fig. 10.4 Sectional view of steering column showing bushes (Sec 8)

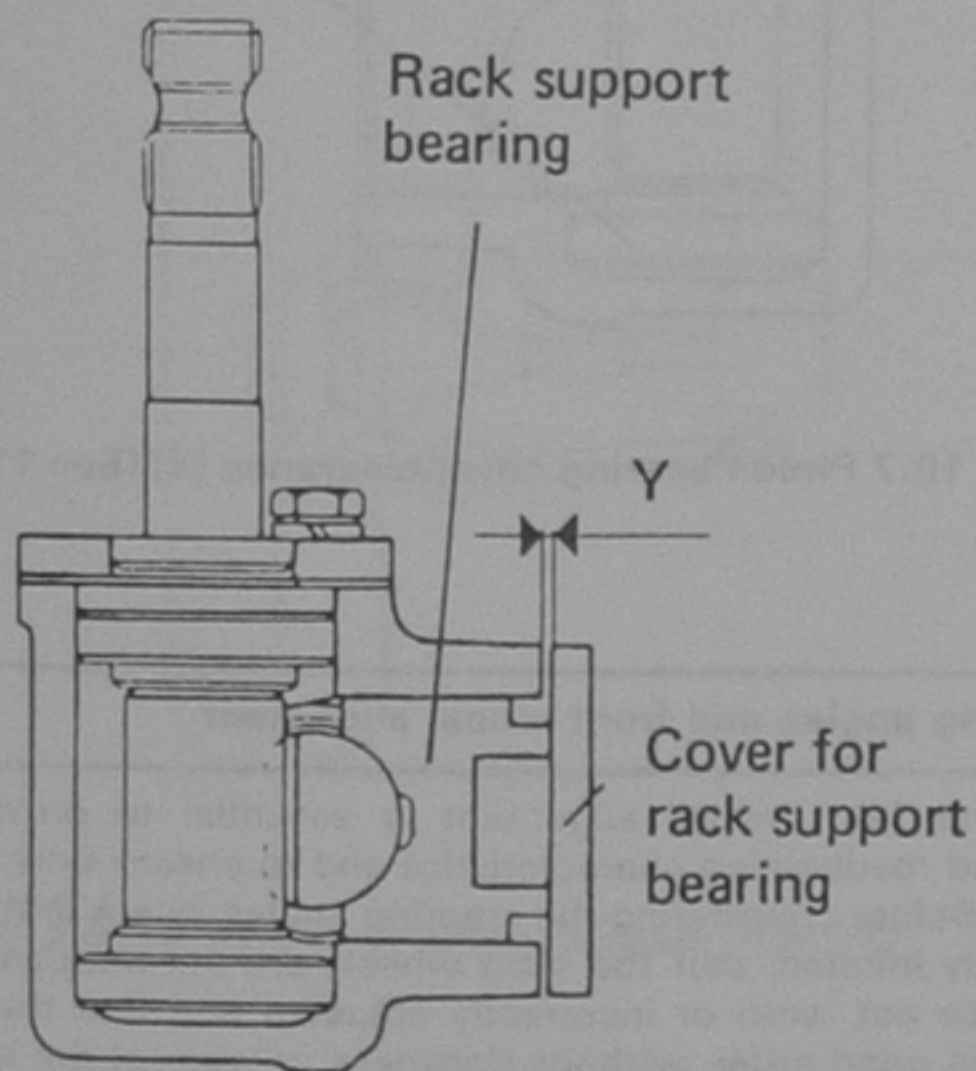
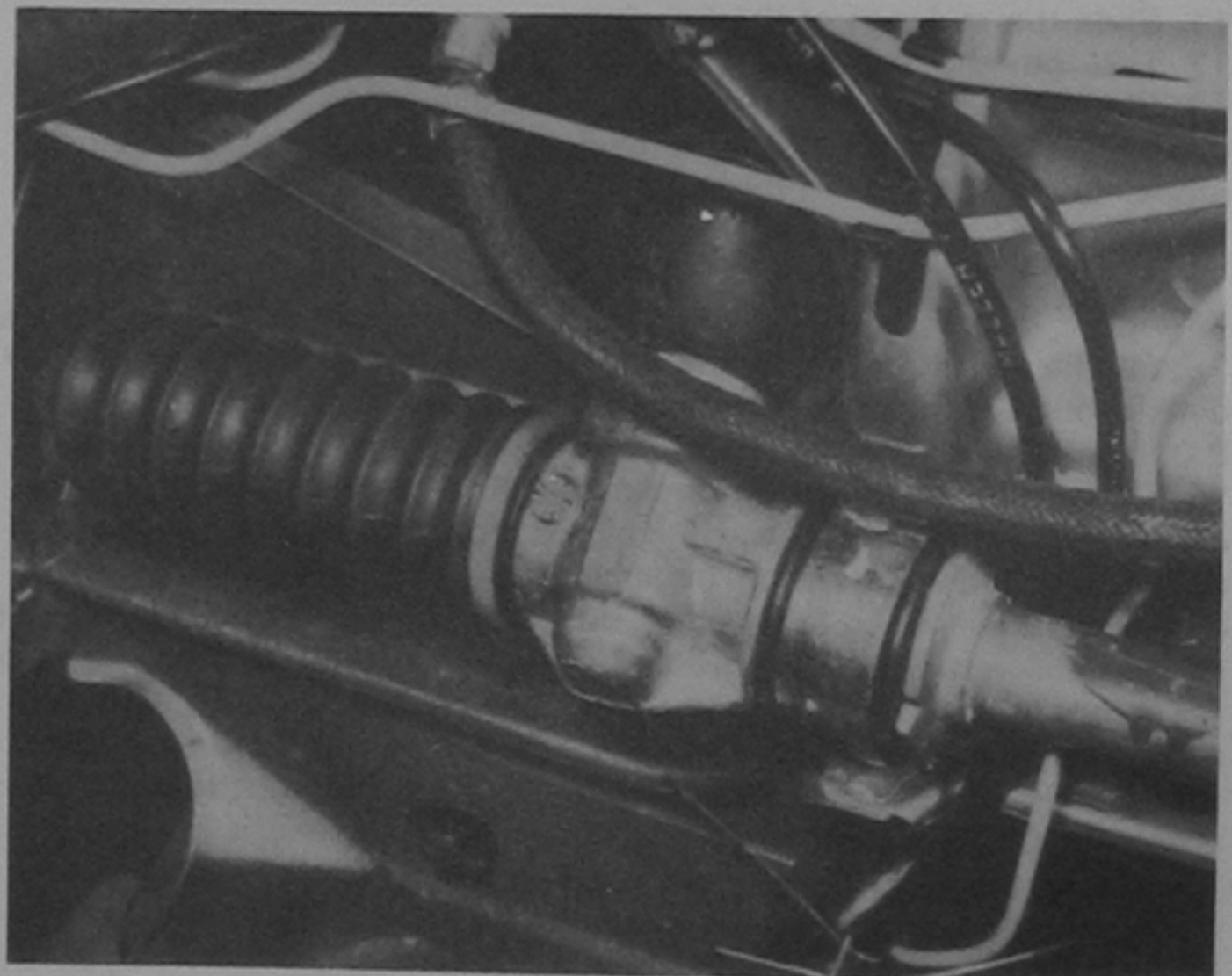


Fig. 10.5 Rack damper and cover plate gap (Y) (Sec 9)

10 Steering gear – removal and refitting

- 1 Raise the front of the car and support it securely.
- 2 Remove the roadwheels.
- 3 Unscrew the nut which holds each tie-rod end balljoint to the eye of the steering arm, then using a balljoint splitter tool, disconnect the balljoints from the steering arms.
- 4 Working within the car, centralise the steering wheel so that the roadwheels, if fitted, would be in the straight-ahead position. Mark the relationship of the column lower coupling to the splined pinion, then unscrew and remove the coupling pinch bolt.
- 5 Working within the engine compartment, unbolt and remove the rubber insulated clamps which hold the steering gear to the rear bulkhead (photo).



10.5 Steering rack and mounting clamp

in the steering may be felt, though this is rare. If the steering is compared with that of a new rack on another car, the lack of friction damping is quite apparent in the ease of movement of the steering wheel of the worn unit.

- 5 Turn the steering to the straight-ahead position.
- 6 Take the cover plate off the damping yoke, remove the spring and shims, and refit it. Refit the bolts, but only tighten them enough to hold the yoke firmly against the rack.
- 7 Turn the pinion through 180° either way to settle the rack.
- 8 Measure the gap between the cover plate and the rack housing. (See Fig. 10.5).
- 9 Select shims to a thickness 0.002 to 0.005 in. (0.05 to 0.13 mm) more than the measured gap. (Shims are available 0.1 and 0.15 mm thick).
- 10 Remove the cover plate again, and refit the spring.
- 11 Smear each shim with soft setting gasket compound, and fit them and the cover plate.

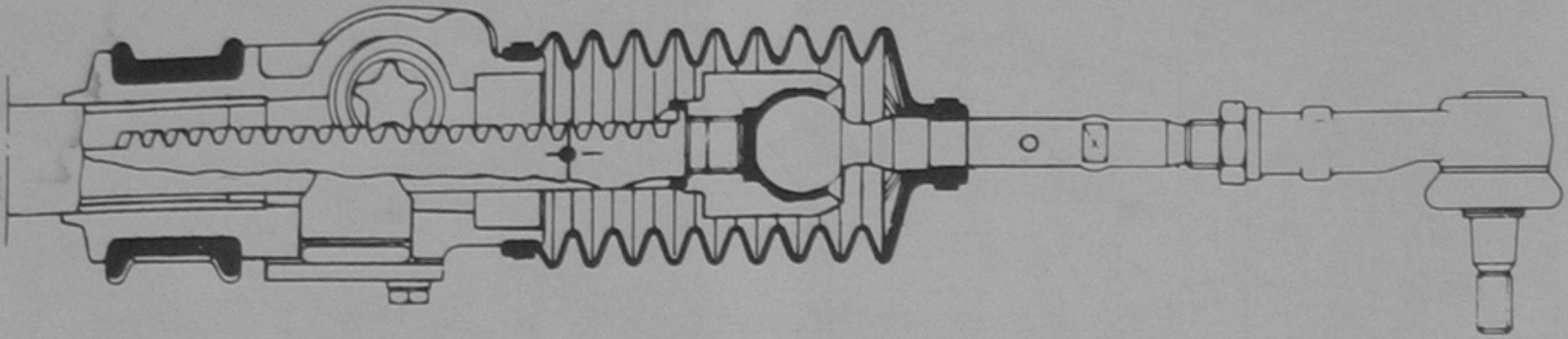


Fig. 10.6 Cut-away view of one side of the steering rack (Sec 11)

- 6 Support the steering gear and withdraw it first downward from the bulkhead (to draw the splined pinion from the column coupling), then remove it sideways from under one of the wheel arches.
- 7 Refitting is a reversal of the removal process; be sure to align the pinion shaft and column coupling marks, otherwise the position of the steering wheel in the straight-ahead attitude will be altered.
- 8 If a new or overhauled gear has been fitted, check the front wheel alignment (Section 12).

11 Steering gear – overhaul

- 1 If the car has covered a high mileage and the steering gear is badly worn, it is recommended that a factory-reconditioned or new unit is fitted rather than fit a large number of new components to the old one.
- 2 For those wishing to dismantle the original gear, proceed in the following way.
- 3 Remove the steering gear from the car as previously described and clean away external dirt.
- 4 Remove the tie-rod ends and gaiters.
- 5 Take off the clamps that held the rack to the car, and their rubber packing.
- 6 Take off its cover plate, and remove the rack damping yoke with spring, and shims, and oil sealing ring.
- 7 Remove the two bolts holding the pinion bearing plate to the housing. Take out the pinion, with oil seal, gasket, shim and top ball bearing.
- 8 Mount the rack housing in a vice, but be careful not to crush it.
- 9 Unstake the lock for the locknuts for the adjustable head for the balljoints at the ends of the rack. The locknut is the inner one. Undo the locknuts themselves.
- 10 Take off the ends of the rack housing the adjustable heads for the balljoints, bringing with them the balljoints, and their sockets and springs.
- 11 Slide the rack out of the housing.
- 12 Take out the lower bearing for the pinion.
- 13 Check all parts for signs of excessive wear or damage, or corrosion. New gaskets, a new seal for the pinion shaft, and new rubber boots should be fitted.
- 14 As the parts are refitted, smear them with specified grease.
- 15 Avoid scraping the rack housing bearings as the rack teeth pass through.
- 16 Fit the pinion bearing plate with a selected shim pack to give a dimension (X) Fig. 10.7 of between 0.025 and 0.13 mm (0.001 and 0.005 in). Shims are available in four sizes.
- 17 Check the torque necessary to start the pinion turning. In the absence of a suitable gauge, wind a cord around the pinion splines and attach the end to a spring balance. The turning torque should be between 19.5 and 28.5 kgf cm (16 to 25 lbf in) or a reading on the spring balance of between 6.8 and 9.0 kg (15.0 and 20.0 lb).
- 18 Reconnect the balljoints to the ends of the rack. Tighten the adjustable heads until the balljoints are slightly stiff to turn in their seats. Make sure that the trackrods will rotate through 360°, at an angle of 60°. Lock the heads and stake the locknuts.
- 19 Extend the rack fully in one direction, smear it with the specified grease and fit the gaiter. Repeat with the rack extended in the opposite direction. Divide the specified amount of grease equally between both sides of the rack.
- 20 Grease the threads and screw on the tie-rod end balljoints equally.

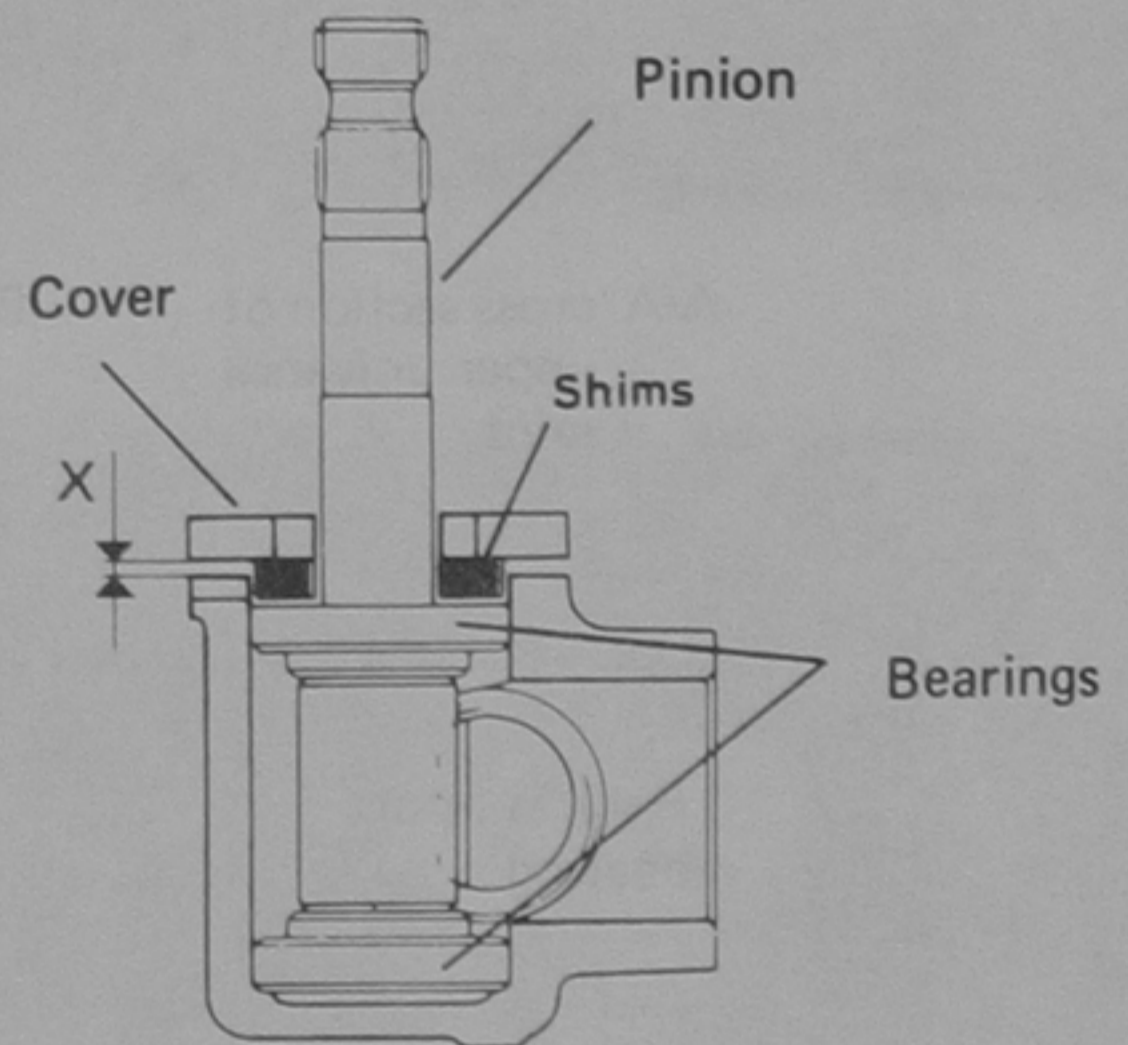


Fig. 10.7 Pinion bearing cover clearance (X) (Sec 11)

12 Steering angles and front wheel alignment

- 1 Accurate front wheel alignment is essential to provide good steering and roadholding characteristics and to ensure slow and even tyre wear. Before considering the steering angles, check that the tyres are correctly inflated, that the front wheels are not buckled, the hub bearings are not worn or incorrectly adjusted and that the steering linkage is in good order, without slackness or wear at the joints.
- 2 Wheel alignment consists of four factors:
 - Camber*, is the angle at which the road wheels are set from the vertical when viewed from the front or rear of the vehicle. Positive camber is the angle (in degrees) that the wheels are tilted outwards at the top from the vertical.
 - Castor*, is the angle between the steering axis and a vertical line when viewed from each side of the vehicle. Positive castor is indicated when the steering axis is inclined towards the rear of the vehicle at its upper end.
 - Steering axis inclination*, is the angle when viewed from the front or rear of the vehicle between vertical and an imaginary line drawn between the top and bottom strut mountings.
 - Toe*, is the amount by which the distance between the front inside edges of the roadwheel rims differs from that between the rear inside edges. If the distance between the front edges is less than that at the rear, the wheels are said to toe-in. If the distance between the front inside edges is greater than that at the rear, the wheels toe-out.
- 3 Due to the need for precision gauges to measure the small angles of the steering and suspension settings, it is preferable that adjustment of camber and castor is left to a service station having the necessary equipment.

$\alpha = \text{Angle of ball joint rotation } 60^\circ + \begin{matrix} 6^\circ \\ 0^\circ \end{matrix}$

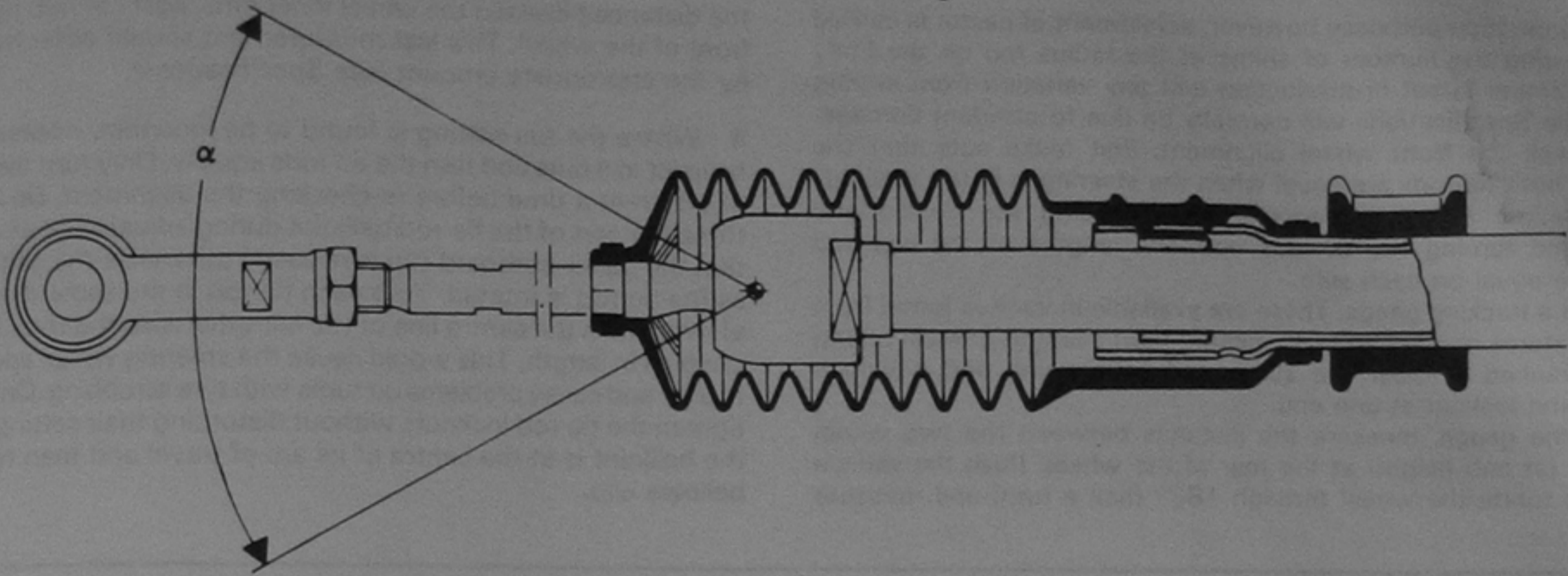


Fig. 10.8 Inner balljoint arc of travel (Sec 11)

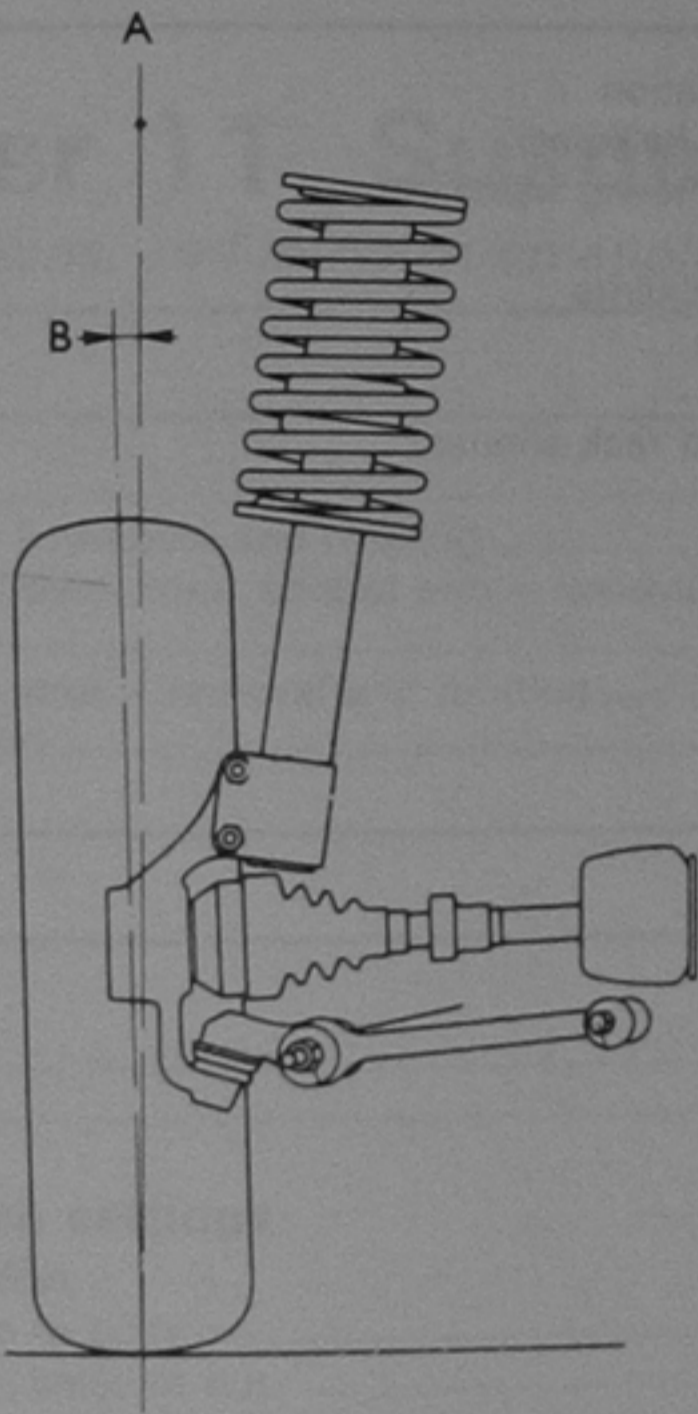


Fig. 10.9 Camber angle diagram (Sec 12)

A Vertical B Camber angle (positive)

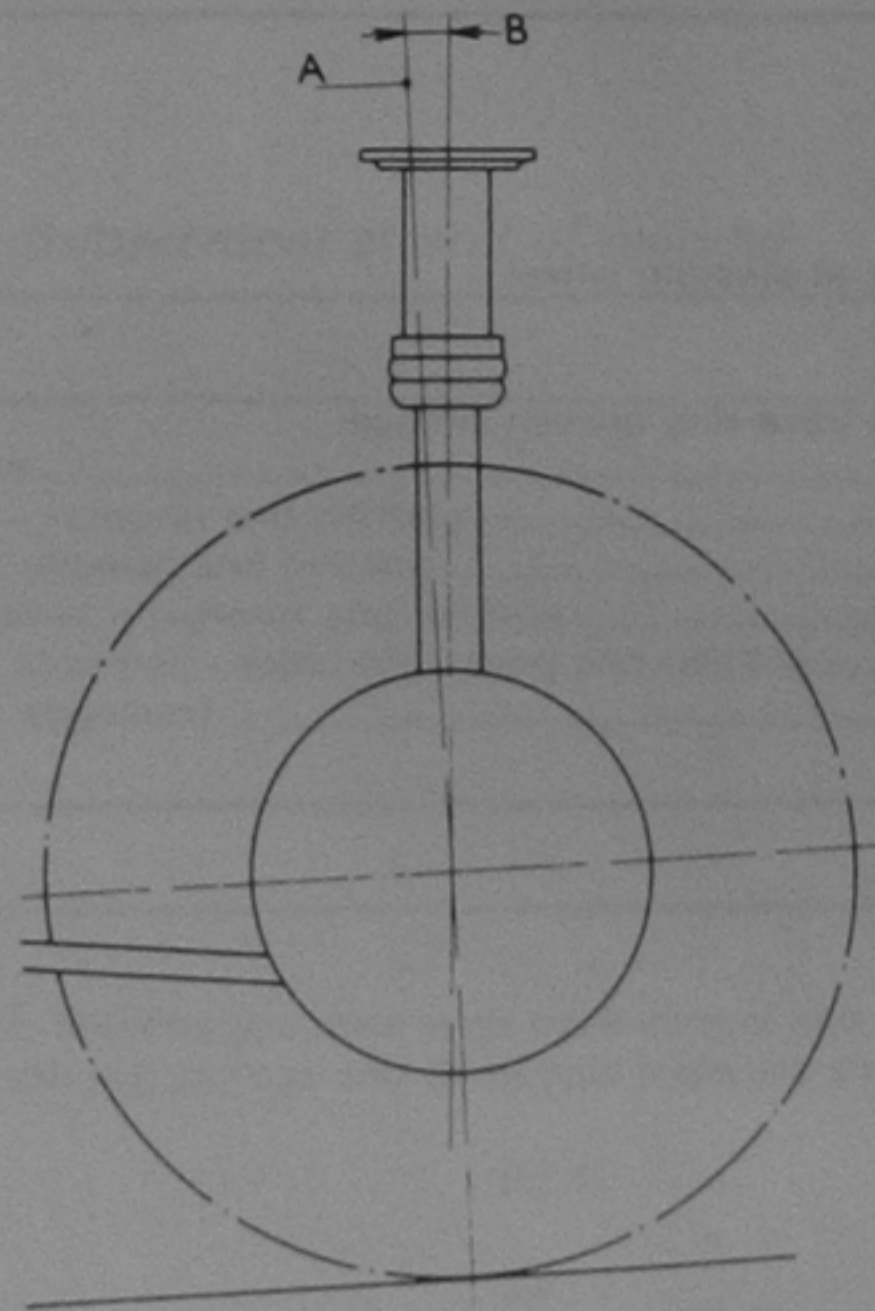


Fig. 10.10 Castor angle diagram (Sec 12)

A Vertical B Castor angle (positive)

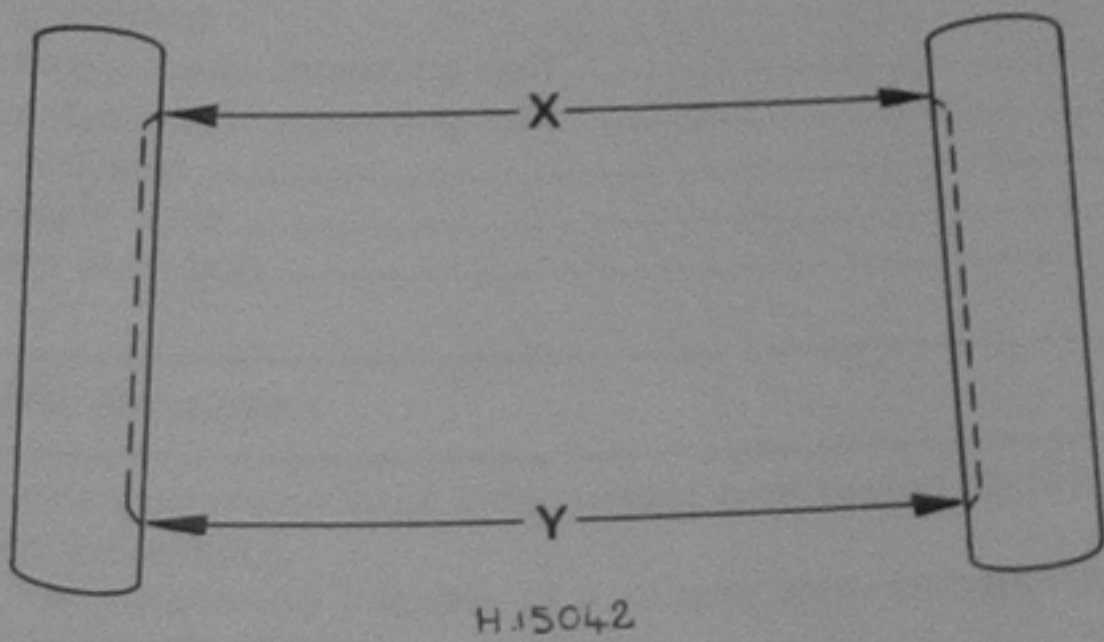


Fig. 10.11 Front wheel alignment diagram (Sec 12)

X = Front dimension Y = Rear dimension X - Y = toe-in

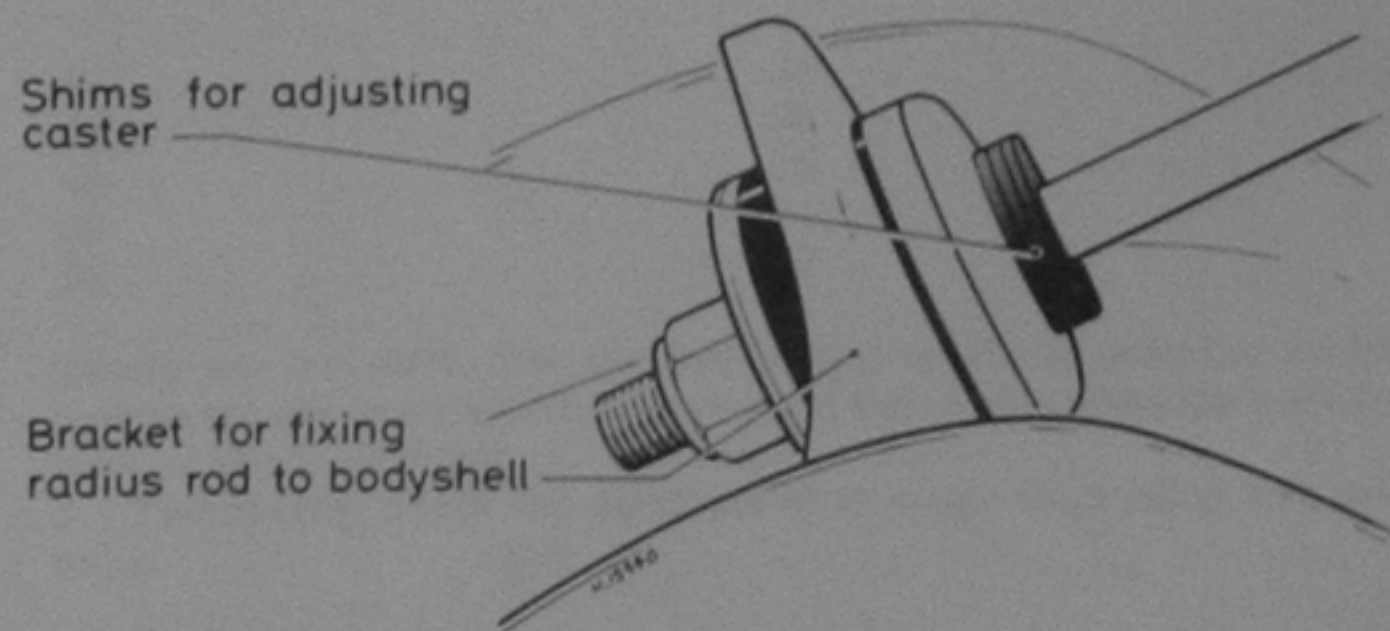


Fig. 10.12 Location of castor adjusting shims (Sec 12)

4 For information purposes however, adjustment of castor is carried out by altering the number of shims at the radius rod on the body bracket. Camber is set in production and any variation from setting given in the Specifications will normally be due to accident damage.

5 To check the front wheel alignment, first make sure that the lengths of both tie-rods are equal when the steering is in the straight-ahead position. Adjust if necessary by releasing the tie-rod end locknuts and turning the tie-rods until the lengths of the exposed threads are equal on each side.

6 Obtain a tracking gauge. These are available in various forms from accessory stores or one can be fabricated from a length of steel tubing suitably cranked to clear the sump and bellhousing and having a setscrew and locknut at one end.

7 With the gauge, measure the distance between the two wheel inner rims (at hub height) at the rear of the wheel. Push the vehicle forward to rotate the wheel through 180° (half a turn) and measure

the distance between the wheel inner rims, again at hub height, at the front of the wheel. This last measurement should differ from the first by the appropriate amount (see Specifications).

8 Where the toe-setting is found to be incorrect, release the tie-rod balljoint locknuts and turn the tie-rods equally. Only turn them a quarter of a turn at a time before re-checking the alignment. Do not grip the threaded part of the tie-rod/balljoint during adjustment and make sure that the gaiter outboard clip is released otherwise the gaiter will twist as the tie-rod is rotated. Turn each tie-rod in the same direction when viewed from the centre line of the car otherwise the rods will become unequal in length. This would cause the steering wheel spoke position to alter and cause problems on turns with tyre scrubbing. On completion, tighten the tie-rod locknuts without disturbing their setting, check that the balljoint is at the centre of its arc of travel and then retighten the bellows clip.

13 Fault diagnosis – steering

Symptom	Reason(s)
Stiff action	Lack of rack lubrication Seized tie-rod end balljoints Seized suspension lower balljoint
Free movement at steering wheel	Wear in tie-rod balljoints Wear in rack teeth
Knocking when traversing uneven surface	Incorrectly adjusted rack slipper