

# SERVICE MANUAL

CARS AND VANS

P 544

Part 6

FRONT AXLE AND STEERING GEAR

*Service Department*

AKTIEBOLAGET

# VOLVO

GÖTEBORG SWEDEN

**GROUP 60**

**WHEEL ALIGNMENT**

In order for the vehicle to have good steering properties and minimum tyre wear, the front wheels must have certain, pre-determined settings which are generally known as wheel alignment. This includes caster, camber, king pin inclination, toe-out and toe-in.

**CASTER**

This refers to the longitudinal inclination of the king pin (forwards or backwards) (A, Fig. 1). This means easy steering since the wheels have a tendency to maintain the straight-forward position.

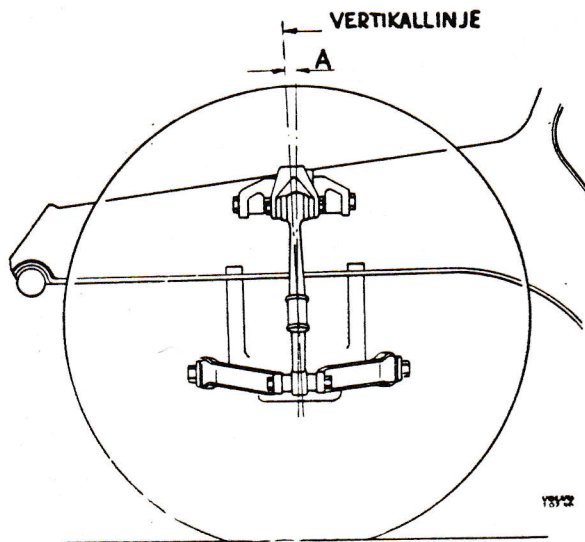


Fig. 1. Caster  
Vertikallinje = Vertical line

**CAMBER**

This refers to the inwards or outward inclination of the wheel. Camber is reckoned to be positive if the wheel is inclined outwards and negative if it is inclined inwards. Positive camber is shown at C in Fig. 2. Faulty camber means uneven tyre wear.

**KING PIN INCLINATION**

This refers to the inward inclination of the king pin (B, Fig. 2). King pin inclination means that the centre lines of the king pin and the wheel approach each other towards ground level. The wheel is thus easier to turn. The king pin inclination also influences the tendency of the wheels to turn straight ahead since the vehicle is lifted slightly when the steering wheel is turned.

**TOE-OUT**

When driving round a curve, the wheels have varying radii of rotation. In order to have the same turning centre with resulting minimum tyre wear, the front wheels must be turned to a varying extent. This relationship, the toe-out, is determined by the construction of the steering rods and steering arms. See Fig. 3.

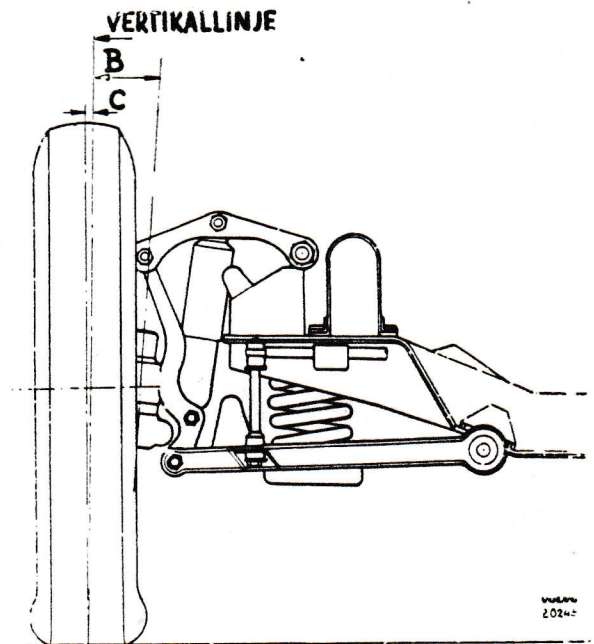


Fig. 2. Camber and king pin inclination  
Vertikallinje = Vertical line

**TOE-IN**

The difference in the distances (E and G, Fig. 3) between the wheels measured at hub height at the rear and front of the tyres is called toe-in. The purpose of toe-in is to reduce tyre wear.

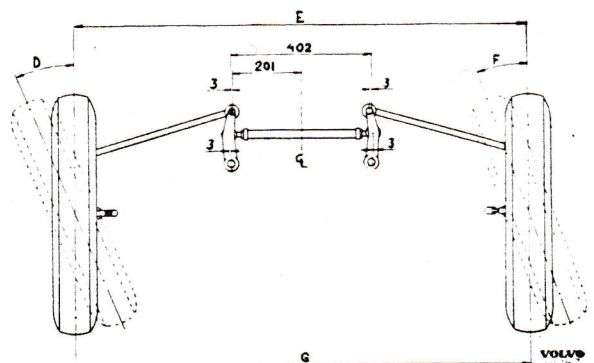


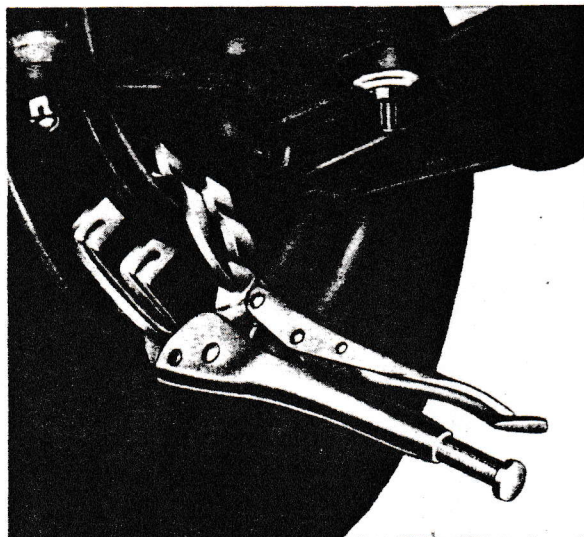
Fig. 3. Toe-out

## MEASURING AND ADJUSTING WHEEL ALIGNMENT

Wheel alignment is measured by means of special instruments of which many different types are available. For this reason, no general instructions concerning the procedures to be adopted are given, with the exception of toe-out and toe-in. The principle of measurement is that camber is measured directly when the wheels are in the straight-forward position. Caster and king pin inclination cannot be measured directly. Instead, measurements of the angular difference are carried out on the instrument when the wheels are turned from 20° outwards to 20° inwards.

Most types of modern measuring tools for wheel alignment require that the wheels are locked by means of a pedal jack or similar device. This is not sufficient on vehicles equipped with Duo-Servo type brakes since the brake shoes in this system have a certain amount of reciprocating movement. On such vehicles, therefore, the brake drum should be locked mechanically to the brake backing plate when measuring. This can be done by applying welding pliers between the drum and brake backing plate on each front wheel (see Fig. 4), when it is not necessary to use a pedal jack.

**When carrying out wheel alignment measurements, always follow the instructions given with the measuring instruments concerned.**



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Fig. 4. Locking the brake drum

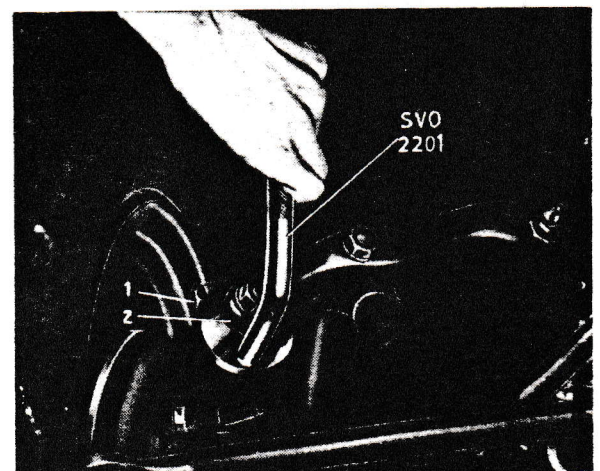
### Measures to be taken before adjusting wheel alignment

Before any adjustments are made, the following points must be checked and any faults corrected.

1. Check the tyre pressure on all wheels.
2. Check that the front wheel tyres are equally worn. If not, change around with a rear wheel or the spare wheel.
3. Check that the wheel warp and out-of-roundness do not exceed 2.5 mm (3/32"), and that the radial throw does not exceed 2.5 mm (3/32").
4. Check the front wheel bearings, king pin and bushes as well as the shock absorbers.
5. Check that the control arms are not damaged and that they are firmly attached to the front axle member. Check that the control arm bushes do not have excessive play.
6. Check that the springs are in good order and are not fatigued.
7. Check the play and adjustment of the steering mechanism. With the steering mechanism in the central position, the wheels should point straight forward.
8. Check the steering rods, steering arms and idler arm.
9. Check that the vehicle has normal equipment (oil, water, petrol and tools), but is otherwise unloaded.

### Adjusting caster

Caster should be  $-3/4^{\circ}$  -  $+1/4^{\circ}$ . This is adjusted by loosening the clamp bolt (1, Fig. 5) and then turning the eccentric bush (2). Use wrench SVO 1411 if the bush is early production with a width across flats of 28.5 mm (1 1/8") and wrench SVO 2201 if the bush is late production with width across flats of 34.3 mm (1 11/32"). One complete turn alters the angle by  $1/2^{\circ}$ .



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Fig. 5. Adjusting caster and camber

1. Clamping screw
2. Eccentric bush

**Note** that if the wheel has the correct camber, one complete turn must be given, otherwise the camber will be altered. Tighten the clamp bolt before checking the caster.

### Checking camber

After the caster has been checked, adjust the camber. This should be  $-1/4^\circ$  -  $+1/2^\circ$ . It is adjusted by loosening the clamp bolt and turning the eccentric with wrench SVO 1411 or SVO 2201, see Fig. 5. Altering the camber also means a slight alteration of the caster, but this is negligible.

### Adjusting toe-in

The toe-in should be 0—3 mm (0—0.12 ins.). This is adjusted by slackening the clamping bolts or locknuts respectively and turning the tie-rod in the required direction. By turning in the normal direction of rotation of the wheels, the distance between the tyres at the front is reduced, that is to say, the toe-in increases. Thus a 1/4 turn of the tie-rod represents a toe-in of about 3 mm (0.12"). When the correct toe-in has been obtained, the clamping bolts are tightened to a torque of 1.1—

1.4 kgm (8—10 lb.ft.). In the case of the late production tie-rods, the locknuts can be tightened to a torque of 7.5—9 kgm (55—65 lb.ft.).

### Checking king pin inclination

As a precautionary measure, the king pin inclination should also be checked. This should be  $5^\circ$  when the camber is  $0^\circ$ .

### Checking toe-out

1. Place the front wheels on turntables and ensure that they are pointing straight forward. When the vehicle is placed on them, the turntables should be set to zero and locked.
2. Turn one of the wheels  $20^\circ$  inwards and read off the turning angle of the other wheel. This should be  $22 \pm 1^\circ$ .
3. Turn the wheel in the other direction and read off the angle of turn on the other wheel in the same way.
3. There is no possibility of adjusting the toe-out. If it should be faulty, check the steering arms and steering rods and replace any damaged parts.

## GROUP 61

## FRONT AXLE

## DESCRIPTION

The PV 544 and P 210 have independent front wheel suspension. There is thus no front axle as such, this being replaced by a robust box-section front axle member. This member is bolted to the front part of the integral body (on P 210, to the frame). The front engine mounting rests on the centre part of the member. The wheel suspension and springs are fitted on the ends of the member. The whole construction of the front axle is illustrated in Figs. 6—9.

The inner ends of the upper and lower control arms (2 and 8, Fig. 6) are pivoted on the front axle

member (6) by means of pins and bolts. At the outer end the control arms are attached to the steering knuckle (1) by means of bolts and threaded bushes. The upper bush is eccentric for adjusting camber.

The stub axle (6, Fig. 7) is carried by the king pin (18) on which the steering knuckle is pivoted. The axial thrust of the steering knuckle support is taken up by a ball bearing (39).

The stabilizer bars (4, Fig. 6) are attached to the lower control arms and to the body (on P 210, to the frame).

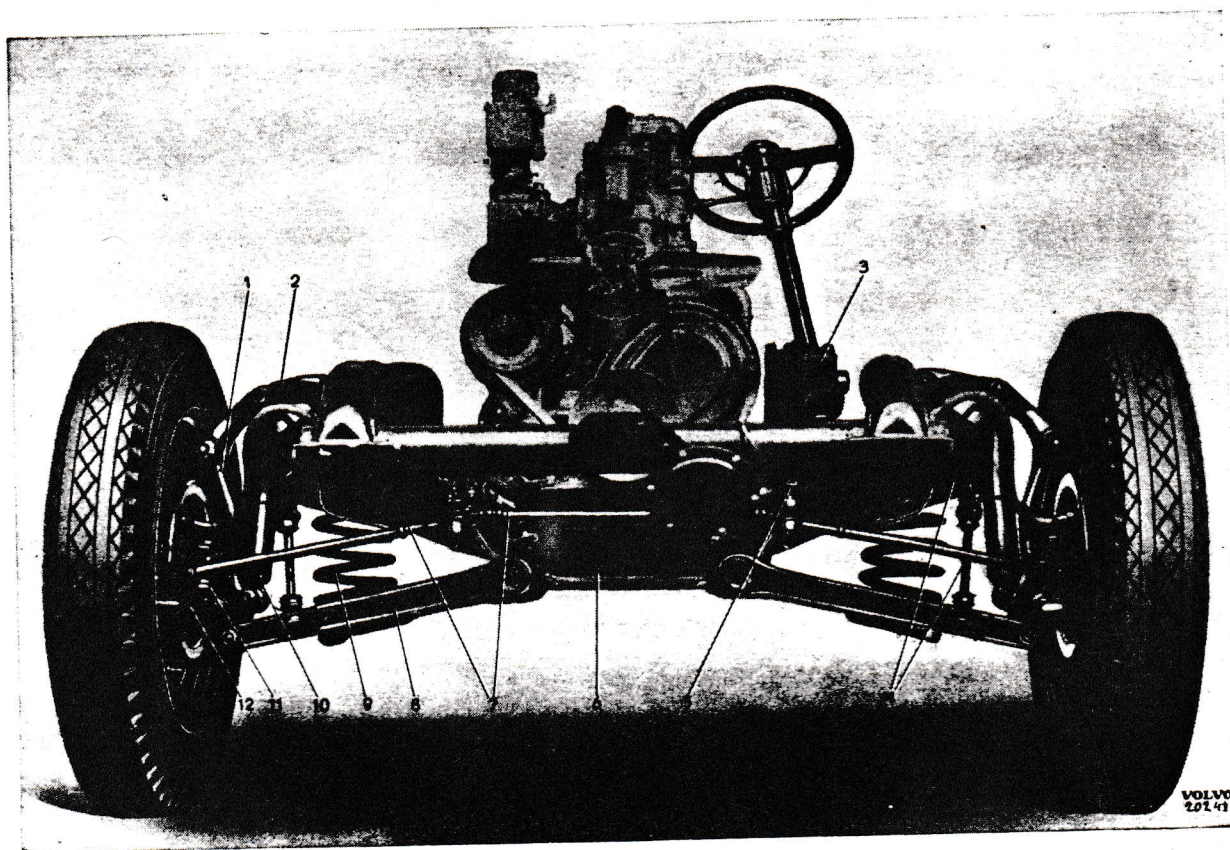


Fig. 6. Front axle and steering gear

- |                      |                             |
|----------------------|-----------------------------|
| 1. Steering knuckle  | 7. Steering rod and tie rod |
| 2. Upper control arm | 8. Lower control arm        |
| 3. Steering box      | 9. Spring                   |
| 4. Stabilizer        | 10. Shock absorber          |
| 5. Pitman arm        | 11. Stub axle               |
| 6. Front axle member | 12. Steering arm            |

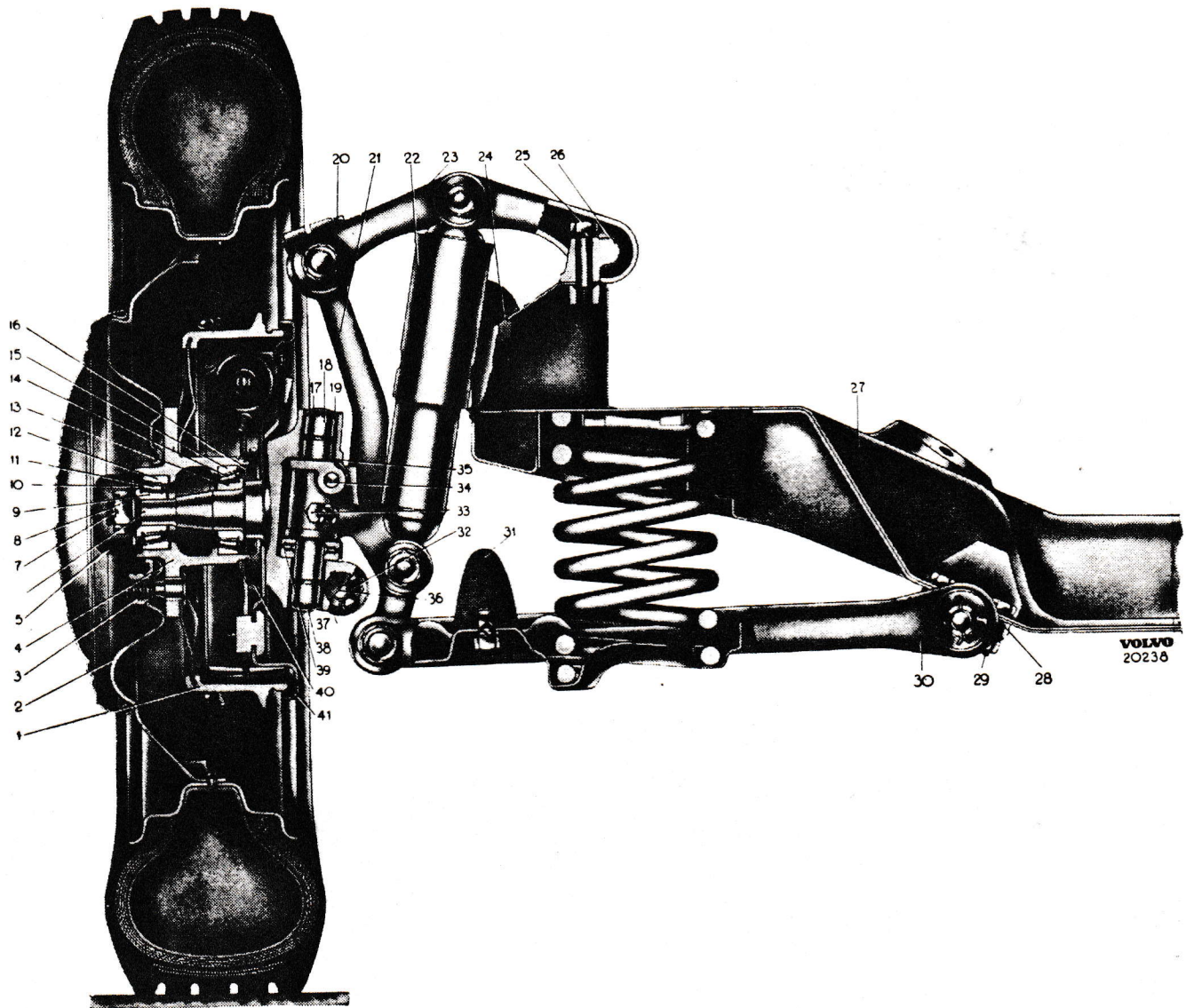
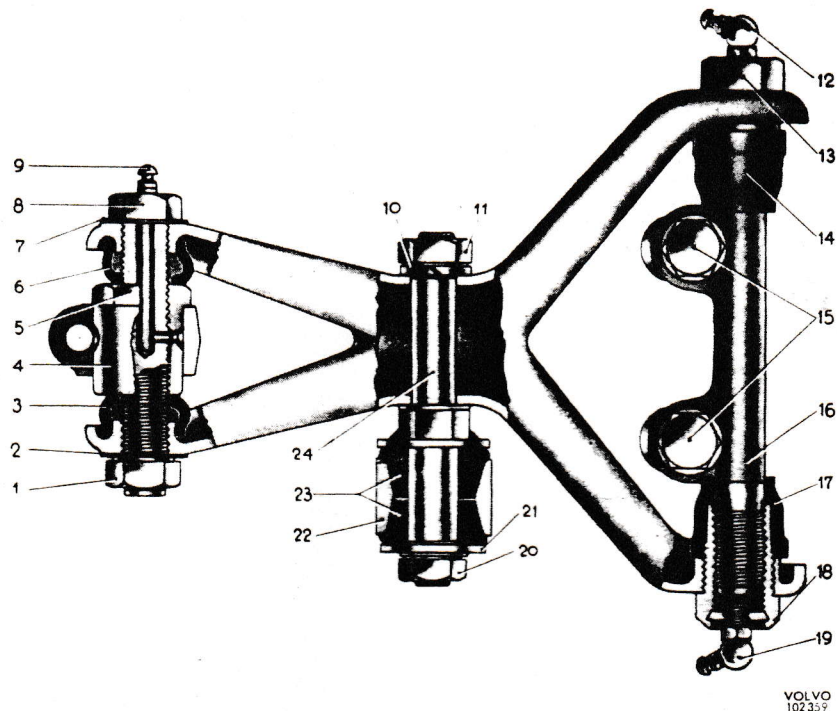


Fig. 7. Front axle

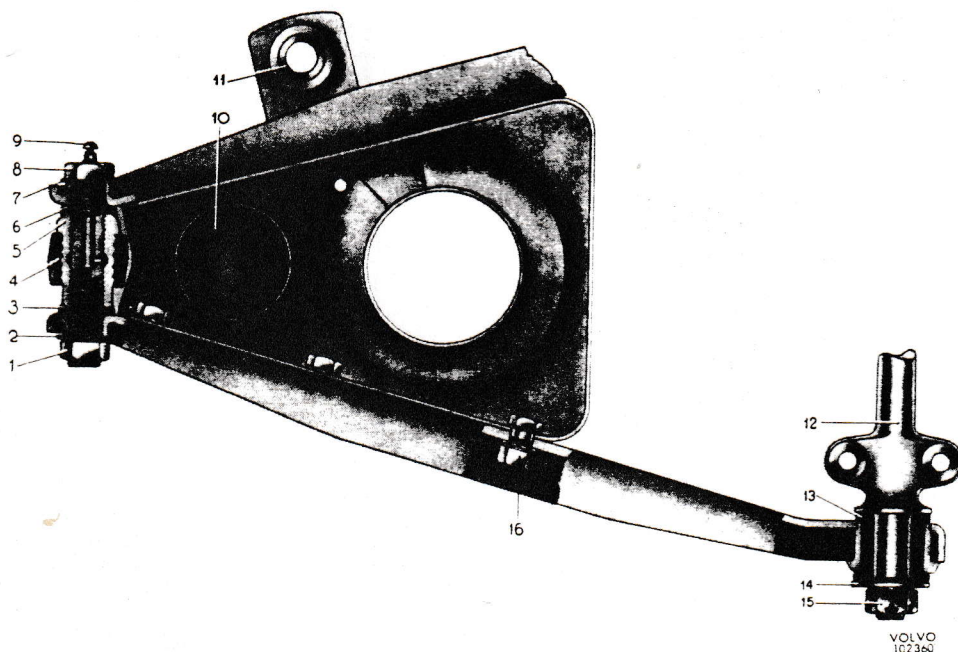
- |                               |                               |                         |
|-------------------------------|-------------------------------|-------------------------|
| 1. Brake drum                 | 15. Outer ring, inner bearing | 29. Bolt                |
| 2. Wheel                      | 16. Sealing ring              | 30. Lower control arm   |
| 3. Wheel nut                  | 17. Sealing washer            | 31. Rubber buffer       |
| 4. Hub                        | 18. King pin                  | 32. Stop screw          |
| 5. Grease cap                 | 19. King pin bushing          | 33. Stop screw          |
| 6. Stub axle                  | 20. Clamping screw            | 34. King pin stop key   |
| 7. Split pin                  | 21. Steering knuckle          | 35. Adjusting shim      |
| 8. Castle nut                 | 22. Shock absorber            | 36. Steering arm        |
| 9. Inner ring, outer bearing  | 23. Upper control arm         | 37. King pin bushing    |
| 10. Washer                    | 24. Rubber buffer             | 38. Sealing washer      |
| 11. Roller bearing            | 25. Bolt                      | 39. Roller bearings     |
| 12. Outer ring, outer bearing | 26. Pin for upper control arm | 40. Splash guard        |
| 13. Inner ring, inner bearing | 27. Front axle member         | 41. Brake backing plate |
| 14. Roller bearing            | 28. Pin for lower control arm |                         |



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Fig. 8. Upper control arm

- |                     |                   |                 |                    |
|---------------------|-------------------|-----------------|--------------------|
| 1. Nut              | 7. Lock washer    | 13. Bush        | 19. Grease nipple  |
| 2. Locking washer   | 8. Bolt           | 14. Rubber seal | 20. Nut            |
| 3. Rubber seal      | 9. Grease nipple  | 15. Bolt        | 21. Washer         |
| 4. Steering knuckle | 10. Spring washer | 16. Pin         | 22. Shock absorber |
| 5. Eccentric bush   | 11. Nut           | 17. Rubber seal | 23. Rubber bush    |
| 6. Rubber seal      | 12. Grease nipple | 18. Bush        | 24. Bolt           |



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Fig. 9. Lower control arm

- |                     |                           |   |
|---------------------|---------------------------|---|
| 1. Nut              | 6. Rubber insert          | 12. Pin                                   |
| 2. Lock washer      | 7. Lock washer            | 13. Rubber bushing                        |
| 3. Rubber insert    | 8. Bolt                   | 14. Washer                                |
| 4. Steering knuckle | 9. Grease nipple          | 15. Nut (in late production<br>Nyloc nut) |
| 5. Bush             | 10. Rubber buffer         | 16. Bolt with washer and nut              |
|                     | 11. Stabilizer attachment |   |

## REPAIR INSTRUCTIONS

### REMOVING COMPLETE FRONT WHEEL SUSPENSION

1. Remove the hub caps and slacken the wheel nuts slightly.
2. Place a jack under the front axle member and lift up the front end of the vehicle so that the wheels are free. Place blocks under the body (for P 210 the frame) behind the front axle member.
3. Remove the wheel nuts and lift off the wheels.
4. Disconnect the stabilizers from the lower control arms.
5. Pull off the pitman arm. Use tool SVO 2370 as shown in Fig. 28.
6. Put a wooden block under the brake pedal. Disconnect the front wheel brake line at the master cylinder. Plug the connections to prevent dirt from entering the brake system.
7. Screw off the nuts at the front engine mountings. Remove the front engine guard plate. Place a wooden block (1, Fig. 10, size about  $62 \times 6 \times 6 \text{ cm} = 24 \frac{1}{2} \times 2 \frac{1}{2} \times 2 \frac{1}{2}''$ ) above the support members but under the fan hub (3). Insert the wooden block from below. In addition, on P 210 two blocks (2, size  $4 \times 6 \times 6 \text{ cm} = 1 \frac{1}{2} \times 2 \frac{1}{2} \times 2 \frac{1}{2}''$ ) should be placed between the frame and the above-mentioned wooden block. On late production models a recess must be made in the block. If the vehicle is not to be moved and an overhead hoist is available, the engine can be suspended in this instead.
8. Unscrew the four bolts on each side which hold the front axle member to the body (on P 210, to the frame).
9. Lower the jack carefully. (Sometimes it is necessary to slacken one of the upper control

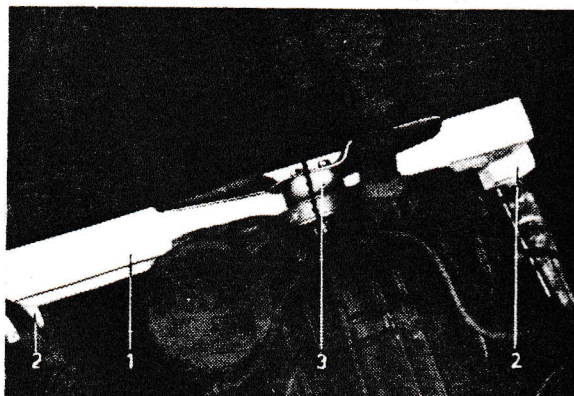


Fig. 10. Engine support

1. Wooden block 2. Wooden block 3. Fan hub

arm inner attachments at the front axle member in order that the front suspension unit can be lowered.) When the brake backing plates have reached the floor, the jack and front wheel suspension unit are pulled out.

When about to carry out work on the front axle member, place it in fixture SVO 2560 and stand SVO 2520, see Fig. 11.

### FITTING COMPLETE FRONT WHEEL SUSPENSION

1. Lift up the front wheel suspension unit on a hydraulic jack and move it under the vehicle.
2. Place two guide pins into the body (the frame on P 210). Raise the jack so that the front axle member comes into position and bolt in on.
3. Remove the wooden block for supporting the engine and tighten the engine down onto the front engine mountings. Connect the brake lines.
4. Fit the pitman arm (see instructions under "Steering gear").
5. Fit the stabilizers.
6. Air-vent the front wheel brake system. See Part 5.
7. Lift on the wheels after having cleaned the contact surfaces between wheel and hub free from sand and dirt, and tighten the nuts sufficiently so that the wheel cannot be disturbed on the hub. Lower the vehicle and tighten the wheel nuts. Tighten every other nut a little at a time until all are tightened to a torque of 10—14 kgm (72—101 lb.ft.). Fit the hub caps.
8. Check the wheel alignment. (See under the heading "Wheel Alignment", page 1.)

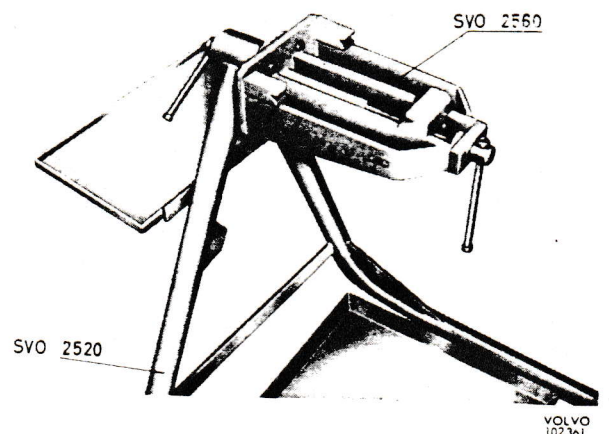


Fig. 11. Fixture for front axle member

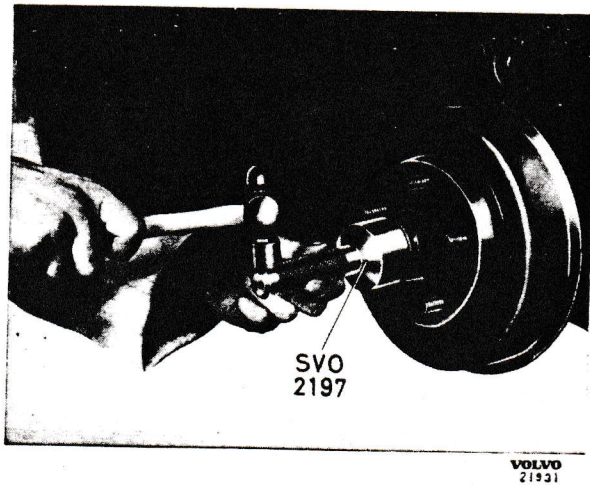


Fig. 12. Removing grease cap

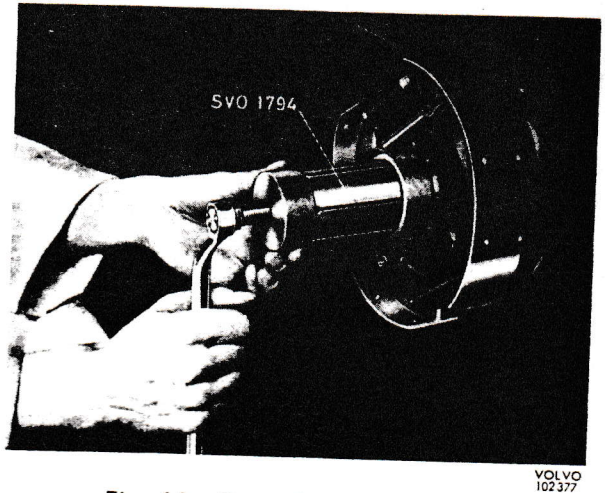


Fig. 14. Removing inner bearing

### REPLACING KING PIN AND OUTER CONTROL ARM BOLTS WITH BUSHES

The clearance in the threaded bushes should normally be 0.3—0.6 mm (0.012—0.023"). The maximum permissible clearance is 0.8 mm (0.032"). The radial clearance of the king pin should not exceed 0.3 mm (0.012").

#### Removing

1. Remove the hub caps and slacken the wheel nuts slightly.
2. Lift up the front end of the vehicle so that the wheels are free and place trestles under the lower control arms. Remove the wheel.
3. Remove the grease cap with tool SVO 2197 (see Fig. 12). Remove the split pin and castle nut. Pull off the front hub with puller SVO

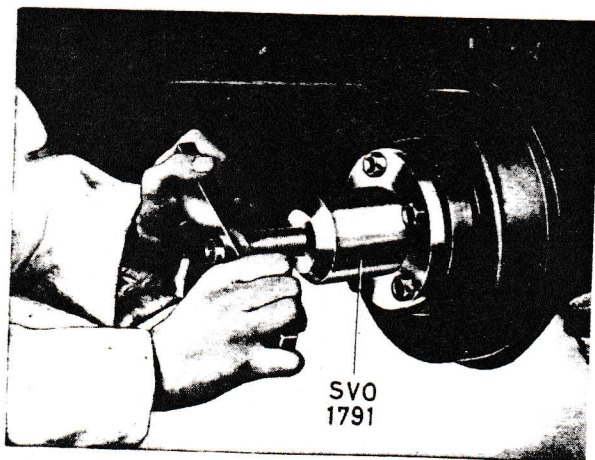


Fig. 13. Removing hub

1791 as shown in Fig. 13. Pull of the inner bearing ring, if necessary (see Fig. 14) with SVO 1794.

4. Remove the four bolts which hold the brake backing plate in place (41, Fig. 7) and splash guard (40) to the stub axle (6). Lift off the brake backing plate, after which it should be tied up with a piece of wire or similar so that the brake hose is not damaged.
5. Remove the split pin and nut for the steering rod ball joint. Screw back the tensioning screw on tool SVO 2294 and place the tool on the ball joint as shown in Fig. 15. Press in the tool properly and ensure that the thread of the ball joint enters the countersink in the tool. Screw in the tensioning screw until the ball joint releases.
6. Slacken the nut and screw out the upper control arm bolt. Take off the clamping bolt and remove the eccentric bush.
7. (Only when replacing control arm bolts with bushes.) Slacken the nut and screw out the lower control arm bolt. Disconnect the shock absorber at the bottom. Lift off the steering knuckle support. Screw out the lower bush.

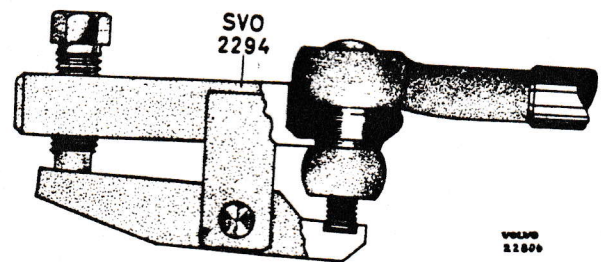


Fig. 15. Removing ball joint

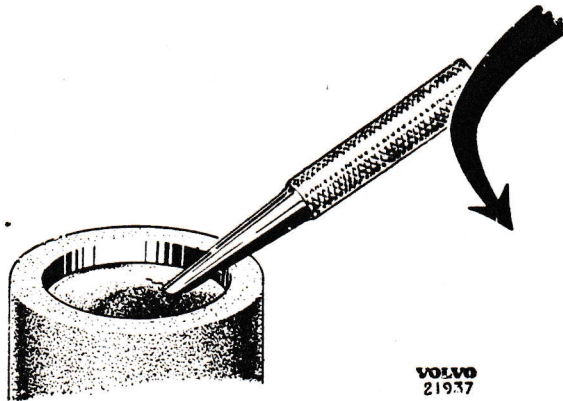


Fig. 16. Removing the sealing washer

8. Drive out the stop key with a drift. Remove the sealing washer with a pointed punch as shown in Fig. 16. Drive out the king pin downwards with tool SVO 2224 as shown in Fig. 17. Place in the extensions as required. If the king pin fits very tightly it should first be knocked up a little with the help of a straight, thick drift.
9. Remove the grease nipples. Drive out the king pin bushes with drift SVO 1442.

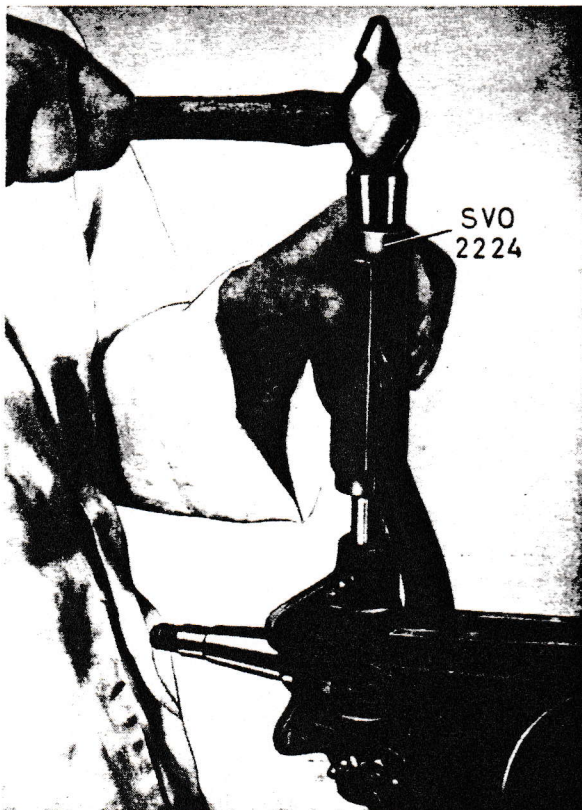


Fig. 17. Removing king pin

### Fitting

1. Clean the steering knuckle. Clean off any burr at the bush positions. Press in the new bushes with drift SVO 1442. Make sure that the lubricating hole comes opposite the grease nipple and that the short lubricating groove faces the sealing washer, see Fig. 18.

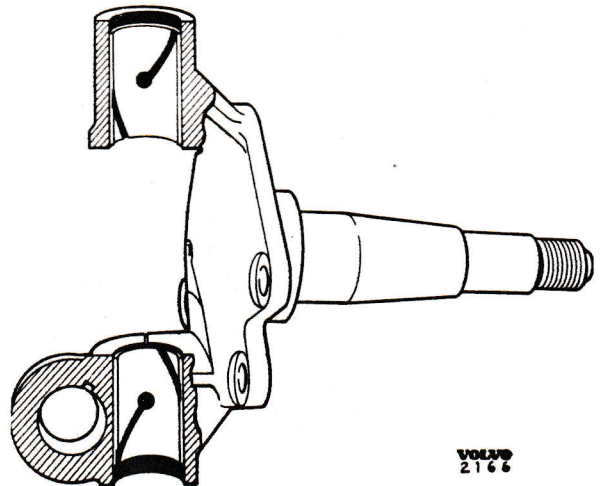


Fig. 18. King pin bushes

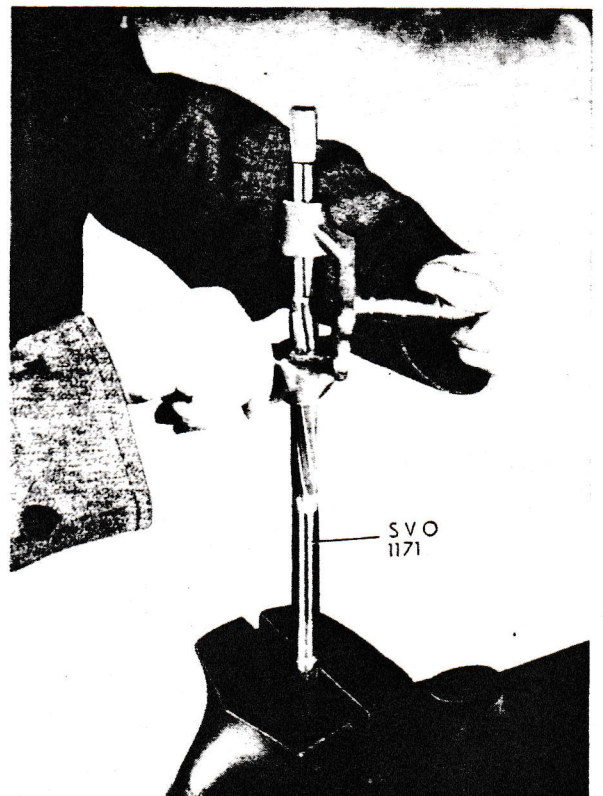


Fig. 19. Reaming king pin bushes

2. Ream the bushes with reamer SVO 1171 as shown in Fig. 19. With a new king pin the play should then correspond to a running fit. Fit the grease nipples. Coat the bushes with chassis grease.
3. Place the stub axle, thrust bearing and adjusting shims in position and place the centring mandrel SVO 4005 in the upper bushing. Change the shims until the bearing take-up corresponds to a friction torque of 5—65 kg/cm (4.33—56.3 lb.in.) when turning the spindle. A spring balance attached to the split pin hole of the spindle should then give a reading 0.3—4.3 kg (0.66—9.46 lb.) when pulled at right-angles to the spindle, see Fig. 20. Then drive in the king pin ensuring that it comes in the correct position. Fit the stop key. Check that the steering knuckle turns easily. Fit the sealing washers by placing them in position with the dished side outwards and then knocking them flat with a hammer and drift.

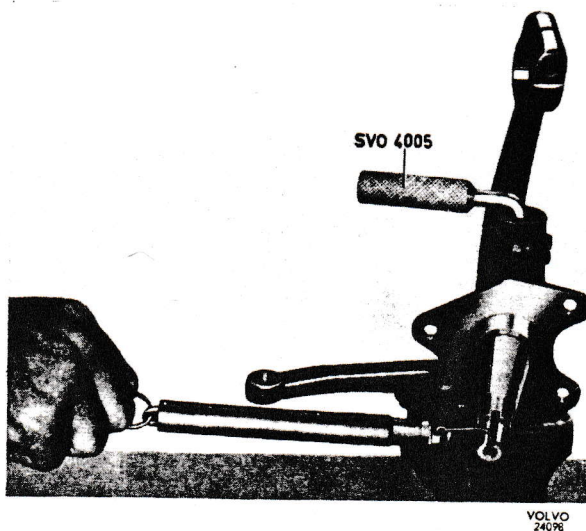


Fig. 20. Measuring friction torque

4. Fit the steering knuckle with bushes, guard plate and bolts. Fit the steering rod to the steering arm. Then turn the ball joint so that the split pin hole comes across the longitudinal direction of the rod. Tighten the castle nut to a torque of 3.2—3.8 kgm (23—27 lb.ft.).
5. Fit the brake backing plate and splash plate on the stub axle.
6. Fit the hub and wheel in accordance with points 8—12 under "Replacing and adjusting front wheel bearings", Part. 7.
7. Check the front wheel alignment.

## RECONDITIONING THE CONTROL ARM SYSTEM

Straightening of damaged control arms may only be carried out to a minor extent, and then only in a cold condition. If an old part differs considerably when compared with a new one, it should be replaced.

### Upper control arm REMOVING

1. Slacken the wheel nuts slightly.
2. Lift up the front end of the vehicle so that the wheel is free and place a trestle under the lower control arm.
3. Unscrew the wheel nut and lift off the wheel.
4. Disconnect the shock absorber attachment at the upper control arm bolt (24, Fig. 8).
5. Unscrew the nut (1), after which the bolt (8) is screwed out.
6. Unscrew the bolts (15) which hold the pin (16) to the front axle member, after which the control arm is lifted out.

### REPLACING PIN

1. The pin (16) is removed from the control arm by screwing out the grease nipples (12 and 19) and then the threaded bushes (13 and 18) at the ends of the pin.
2. Secure fixture SVO 2300 in a vice ensuring that the top edge of the plate is clear.
3. Fit the rubber protector on the new pin and insert this into the control arm. Screw the bushes onto the pin about two turns. It should then be possible to move the pin axially, if not the bush must be screwed back slightly.
4. Place the control arm in the fixture so that the peg on the cap fits into the U-profile on the control arm and the holes in the shoulders of the pin fit on both the guide pins. Move the cap towards the control arm, tighten the wing nut slightly, screw in the stop screw and tighten up the wing nut. See Fig. 21.
5. Lubricate the bushes externally and screw them in until the hexagon comes against the control arm. Place the rubber protector in position on the bushes and fit the grease nipples.
6. Slacken the wing nut and stop screw and lift off the control arm..

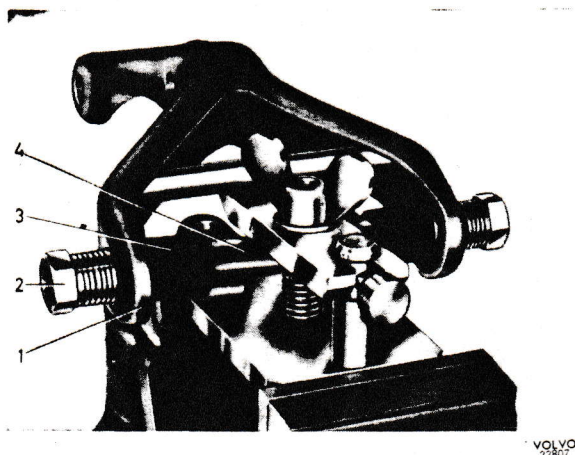


Fig. 21. Fitting pin in upper control arm

1. Control arm
2. Bush
3. Rubber protector
4. Pin

### FITTING

1. Place the control arm in the correct position after which the bolts (15, Fig. 8) which hold the pin (16) to the front axle member are fitted. Tighten the bolts to a torque of 5.5—6.2 kgm (40—45 lb.ft.).
2. Fit new rubber seals (3 and 6), and then the bolt (8) (hexagon flat forward) with the nut (1). Do not forget the locking washers (2 and 7). Check that there is clearance. This should normally be 0.3—0.6 mm (0.012—0.023").
3. Lubricate the king pin and bushings and check that the grease penetrates through to all the lubricating points.
4. Fit the shock absorber and wheel. Lower the vehicle. Tighten the wheel nuts to a torque of 10—14 kgm (72—101 lb.ft.).
5. Check the wheel alignment, see under the heading "Wheel alignment".

### Lower control arm

#### REMOVING

1. Slacken the wheel nuts slightly.
2. Lift up the front end of the vehicle so that the wheels are free and place trestles under the front axle member.
3. Remove the wheel. Disconnect the stabilizer from the attachment (11, Fig. 9).
4. Place a jack under the control arm pin. Remove the nuts for the attachment in the front axle

member and lower the jack, see Fig. 21. Remove the spring. Screw off the nut (1, Fig. 9) and bolt (8) and lift off the control arm to the front.

### REPLACING PIN OR BUSHINGS

Remove the nuts (15, Fig. 9) and washers (14). Remove the two inner bolts (16) which hold both parts of the control arm together and slacken the outer one slightly. Turn both the parts of the control arm away from each other and remove the pin and bushes. Fitting is done in the reverse order and is facilitated if the rubber bushes are coated with soap solution.

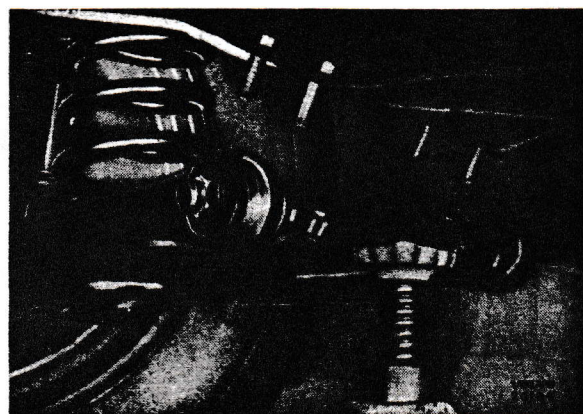


Fig. 22. Removing lower control arm

### FITTING

1. Fit new rubber seals (3 and 6, Fig. 9) and then the bolt (8) (hexagon flat forward) with locking washer (7). Place on the washer (2) and tighten the nut (1). Check that there is a clearance of 0.3—0.6 mm (0.012—0.023") in the bush.
2. Place the spring in position with the straight end downwards. Move up the control arm pin into position with the help of a jack, see Fig. 22. Secure the pin and lock with split pins.
3. Lubricate the bolt and check that grease penetrates through the bush.
4. Fit the stabilizer and wheel. Lower the vehicle. Tighten the wheel nuts to a torque of 10—14 kgm (72—101 lb.ft.). Check the wheel alignment.

### **Replacing outer control arm bolts with bushes**

1. Slacken the wheel nuts slightly. Lift up the front end of the vehicle and place a trestle under the lower control arm centrally below the spring. Remove the wheel.
2. Slacken the nut (1, Figs. 8 and 9) and screw out the bolt (8). The upper bush can be replaced after the clamping bolt has been removed. The lower bush is screwed out.
3. Fit the new bushes. Place the steering knuckle and new rubber seals in position and screw in the control arm bolt with lock washer, (see Figs. 3 and 4). Place on the lock washer (2) and tighten the nut (1). Check that there is a clearance of 0.3—0.6 mm (0.012—0.023") in the bush.
4. Lubricate the bolts and check that grease penetrates through the bush.
5. Fit the wheel. Lower the vehicle. Tighten the wheel nuts to a torque of 10—14 kgm (72—101 lb.ft.). Check the wheel alignment.