WHEEL ALIGNMENT

WHEEL ANGLES

For the vehicle to have good steering properties and a minimum of tyre wear, the front wheels must have certain pre-determined settings, generally known as the wheel angles. The wheel angles refer to the caster, camber, king pin inclination, toe-out and toe-in.

CASTER

Caster generally refers to the longitudinal inclination (forwards or backwards) of the king pin. As this vehicle does not have a king pin, the caster consists of the angle between a vertical line and a line through the centre of the ball joints (Fig. 6-4).

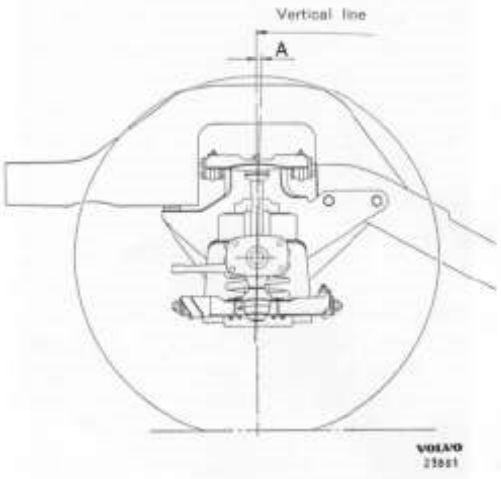

Fig. 6-4. Caster
A=Caster

CAMBER

Camber is the inclination of the wheel itself outwards or inwards. It is positive if the wheel is inclined outwards (see C, Fig. 6-5) and negative if the wheel inclines inwards. Faulty camber causes uneven tyre wear.

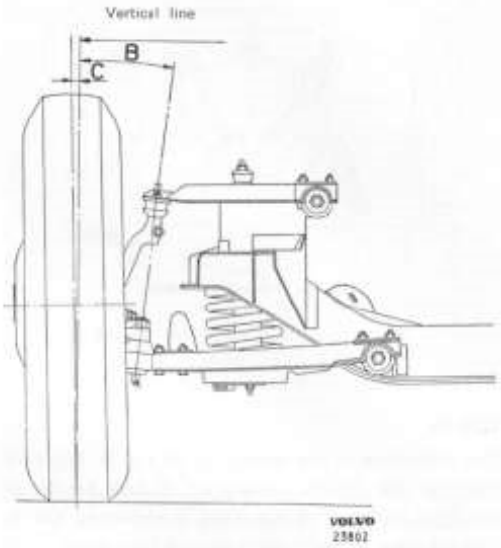

Fig. 6-5. Camber and king pin inclination
B=King pin inclination C=Camber

KING PIN INCLINATION

King pin inclination means the inclination of the king pin inwards. Since this car does not have a king pin, the inclination is represented by an angle made between a vertical line and a line through the centre of the ball joints (B, Fig. 6-5).

King pin inclination causes the centre lines of the ball joints and the wheel to approach each other towards the road surface. This makes the wheel easier to turn. The inclination also assists the tendency of the wheel to run straight forwards since the car is lifted very slightly when the wheels are turned.

TOE-OUT

When driving round a bend, the wheels roll at different radii. For them to have the same pivoting centre, and consequently minimum tyre wear, the front wheels must be turned to different extents. This relationship is determined by the shape of the steering rod and steering arms, see Fig. 6-6.

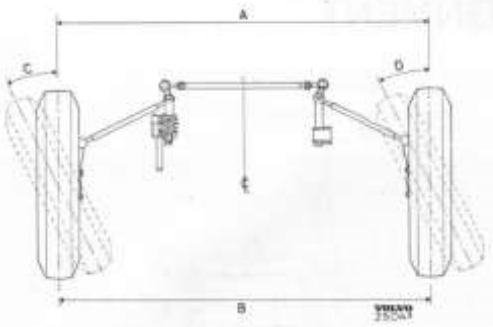

Fig. 6-6. Toe-out and toe-in

TOE-IN

The difference in the distances (A and B, Fig. 6-6) between the wheels measured at hub height at the front and rear of the tyres is knows as toe-in. The purpose of toe-in is to reduce tyre wear.

PROCEDURE BEFORE WHEEL ADJUSTING

The factors listed below can influence the wheel angles. Therefore, any faults should be remedied before measuring and adjusting.

1. Difference in tyre pressure and wear.
2. Looseness in front wheel bearings.
3. Looseness in ball joints or wishbone attachments.
4. Broken springs.
5. Abnormal (temporary) equipment or loading.

Other factors which can influence the steering during operation without making themselves directly known during the measuring of the wheel angles are:

1. Wheel throw greater than 2.5 mm (0.1").
2. Poor shock absorbers.
3. Steering gear incorrectly adjusted.
4. Looseness in relay arm journalling or steering rod parts.

MEASURING WHEEL ANGLES

The wheel angles are measured with special measuring instruments of which there are many different types. No general description can, therefore, be given as to how measuring should be carried out except in the case of the steering geometry. The measuring principle is that camber is measured directly with the wheels pointing straight forwards. Caster and king pin inclination cannot be measured directly. Instead, the angular alteration which occurs when the wheel is turned from 20° outward to 20° inwards is measured on the instrument.

Most types of modern wheel alignment measuring instruments require that the wheels are locked with, for example, the help of a pedal jack.

When measuring the wheel angles, follow the instructions for the measuring instruments concerned.

CHECKING KING PIN INCLINATION

The king pin inclination, which on this vehicle is represented by the inclination of the centre line of the ball joints, should be 8° at a camber of 0°. This cannot be adjusted and is difficult to measure exactly due to the tension and resilience in the parts, so that the angle read off on the instruments will not be the exact king pin inclination but can serve as a guide.

CHECKING TOE-OUT

1. Place the vehicle front wheels on turntables and make sure that the wheels point straight forwards. Before the car is placed on them, the turntables must be set to zero and locked.
2. Turn the wheels to the left until the right wheel has turned 20° inwards. The scale on the left turntable should then read 22.5 ± 1°.
3. Check the position of the right wheel in the same manner by turning the wheels to the right until the left wheel has turned 20° inwards, when the right turntable scale should give the same reading as previously indicated on the left. Both measurements should thus lie within the above-mentioned tolerances, otherwise it means that the steering gear or front end is distorted.
4. There are no adjusting possibilities, but if the toe-out is incorrect, the steering arms and steering rods should be checked. Replace any parts that are damaged.

ADJUSTING WHEEL ANGLES

N.B. The front wheel angles must always be adjusted in the following order:

1. Caster
2. Camber
3. Toe-in

From a labour-saving point of view, it may be, however, suitable to adjust the caster and camber at the same time, see under "Camber".

CASTER

The caster for each wheel should be within the tolerance range 0° to +1°, that is, it should be min. 0° and max. 1° positive. However, the difference between both the sides should not exceed 1/2°.

The caster can be adjusted either with shims (3, Fig. 6-7) at the wishbone shaft or with shims (2, Fig. 6-8) at the side-member. The first alternative is selected when the camber is also to be adjusted, and the second when only the caster is to be seen to.

Method 1 (at wishbone shaft)

Bend up the lock washer (3, Fig. 6-7) and slacken the attaching bolts (2) som much that the shims (1) can be lifted up. The caster is adjusted, for example, to **positive** either by **adding** shims to the **rear** bolt or by **removing** shims at the **front** bolt. The shim thicknesses required to alter the angle

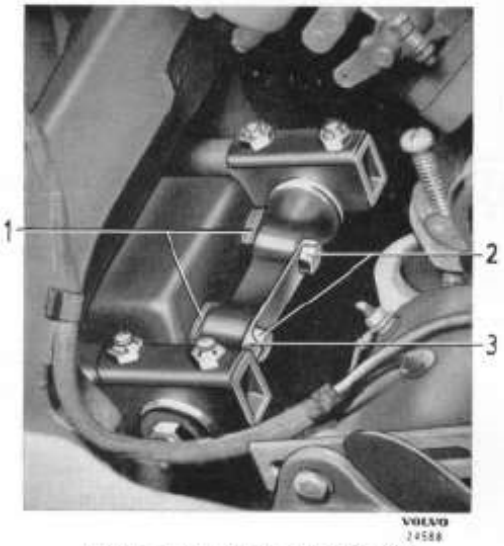

Fig. 6-7. Adjustment parts at wishbone shaft
1. Shims 2. Bolts 3. Lock plate

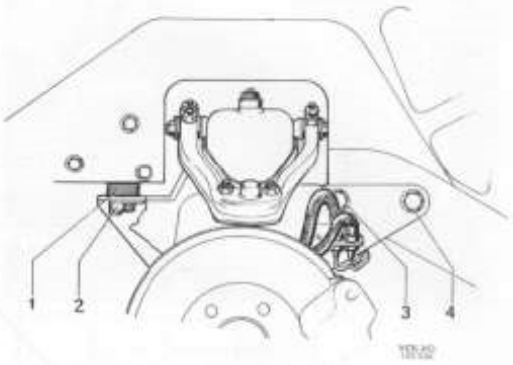

Fig. 6-8. Adjustment parts at side-member
1. Shims 3. Bolt
2. Bolt 4. Bolt

to a certain extent can be seen from the diagram in Fig. 6-9. Shims are stocked in thicknesses of 0.15—0.5—1.0—3.0 and 6.0 mm (0.006—0.020—0.039—0.120 and 0.240"). The caster angle is altered to the same extent either by

a. removing a shim at one the bolts
b. adding a shim to the other bolt
c. moving over half of the required shim thickness from one bolt to the other.

Adjustment should be in accordance with alternative c for the right caster.

After adjusting, tighten the bolts to a torque of 5.5—7.0 kpm (40—50 lb.ft.).

Method 2 (at side-member)

Raise the front end and place props under the body at the jack attachments. Release the attaching bolts (2, 3 and 4, Fig. 6-8). Add or deduct the number of shims required in order to get the proper caster. Shims for this purpose are available in thicknesses of 2 and 3 mm (0.08 and 0.120"). The diagram in Fig. 6-9 shows how much the caster is to be altered. The same alteration should be made on both sides to avoid extra tension in the front axle member. Tighten the bolts before making a new measurement.

CAMBER

The camber for each wheel should be within a tolerance range of 0° to +1/2°, that is, it should be min. 0° and max. 1/2° positive.

When adjusting bend the lock plate (3, Fig. 6-7) up and slacken the attaching bolts (2) so much that the shims (1) can be lifted up. Thereafter

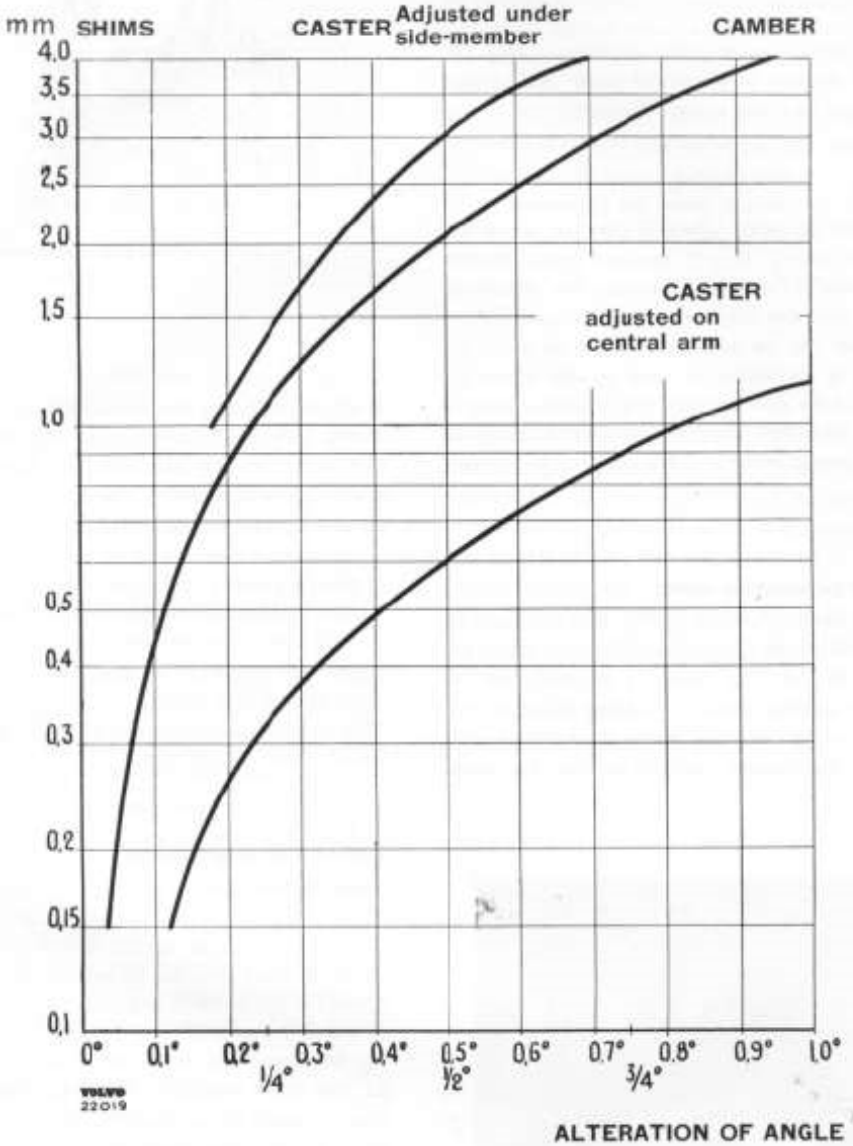

Fig. 69. Diagram for alteration of caster and camber

either increase or reduce the number of shims equally for both bolts. More positive camber is obtained by removing shims and negative camber by increasing the number of shims.

The shim thickness required to alter the angle to a certain extent is shown in the diagram in Fig. 6-9. Shims are stocked in thicknesses of 0.15—0.5—1.0—3.0 and 6.0 mm (0.006—0.020—0.039—0.120 and 0.240"). The total thickness of shims at each bolt may not exceed 12 mm (0.48"). The difference in thickness between the shims at the front and rear bolts may be max. 2.5 mm (0.1"). Note that an equal number of shims must be removed or added at both the bolts if the camber is not to be altered.

After adjusting tighten the bolts to a torque of 5.5—7.0 kpm (40—50 lb.ft.) and lock them.

In order to save time and labour adjust the caster and camber at the same time by removing or adding shims for the camber and altering the number of shims for the caster. For example, if the camber is increased 0.6° and the caster 1/4°, first remove 2.5 mm (0.1") in shims at both the bolts and move 0.15 mm (0.006") in shim thickness from the front to the rear bolt.

Fig. 6-10. Adjusting max. wheel lock

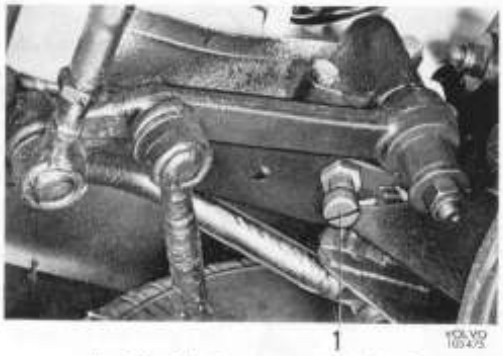

Fig. 6-11. Adjusting screw, max. wheel lock
1. Adjusting screw

ADJUSTING TOE-IN

The toe-in should be 0—4 mm (0—0.16"). Incorrect toe-in is adjusted by slackening the locknuts on the tie rod, after which the rod is turned in the required direction. The distance between the tyres at the front is reduced, that is to say, toe-in is increased by turning the tie-rod in the normal direction of rotation of the wheels. Tighten the locknut after adjustment to a torque of 7.5—9.0 kpm (55—65 lb.ft.).

ADJUSTING STEERING LIMITS

Turning of the wheels is limited by stop screws, at the pitman arm for left-hand driving and at the relay arm for right-hand driving, see Fig. 6-11.

Checking is done as follows:

1. Turn the left wheel for a left-hand turn as far as it goes. Check that the lock angle of the wheels is 39—40°. If it is not, then adjust to this value with the stop screw (Fig. 6-11) at the pitman arm.
2. Repeat this procedure with the right wheel and the stop screw on the relay arm.
   N.B. Check that the brake hoses are clear at full wheel lock.