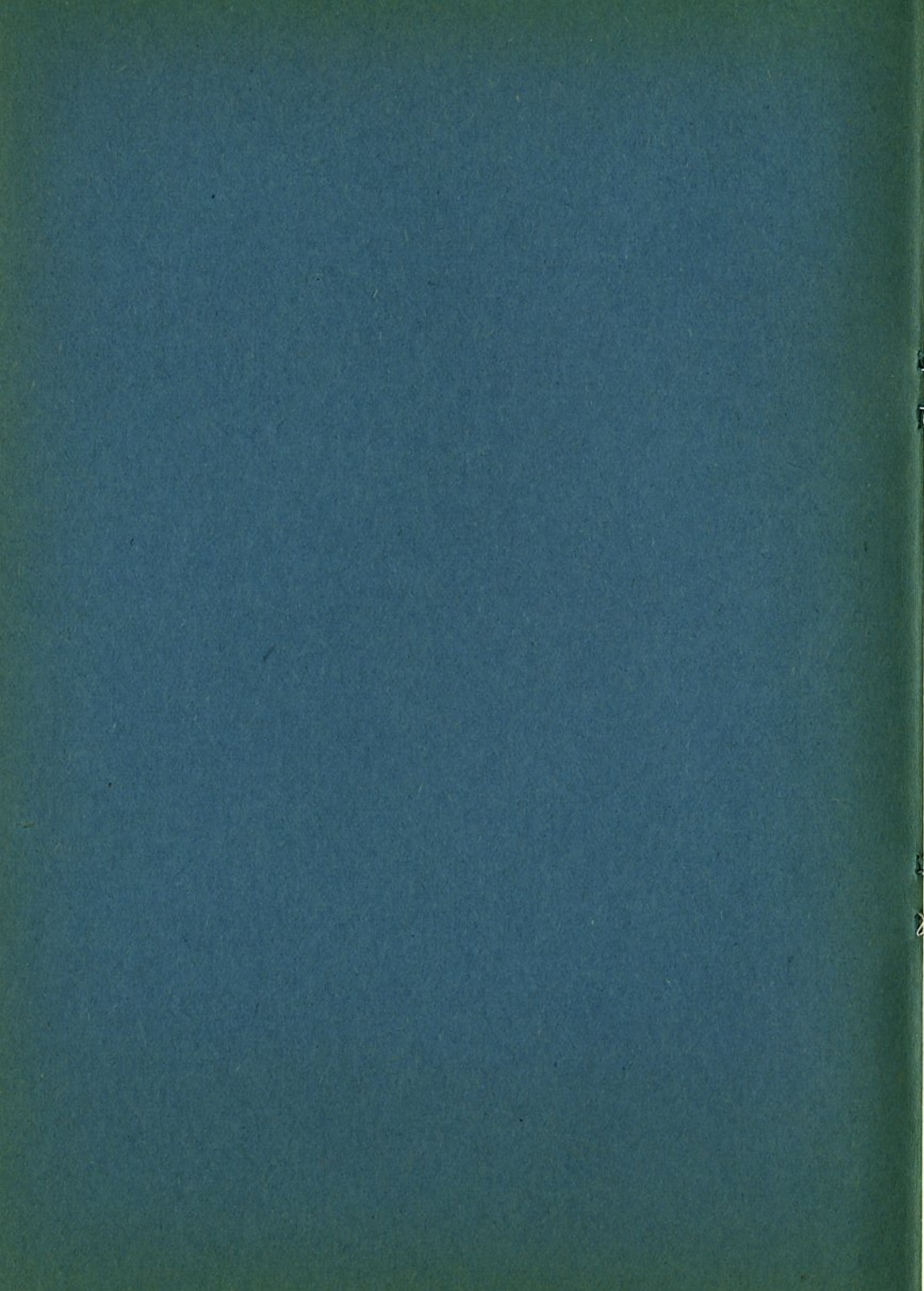


**LOOK
LISTEN
DO IT BETTER**



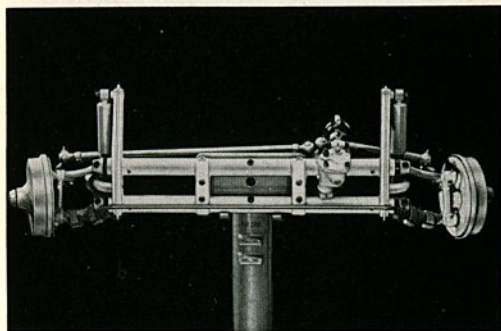
**Front Axle and Steering of the
VOLKSWAGEN 1200**

Slide Series № 5

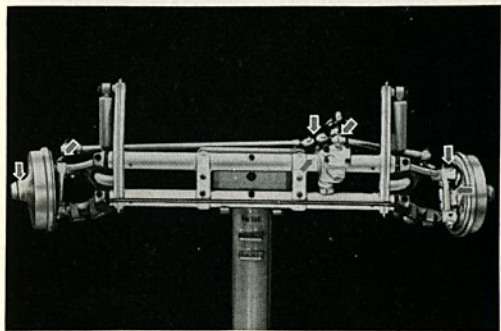


FRONT AXLE AND STEERING OF THE VOLKSWAGEN 1200

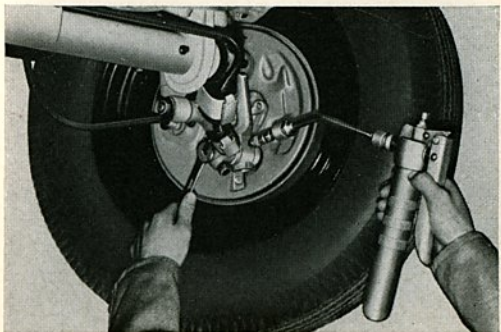
5/10 Front axle and steering are chiefly responsible for good roadholding and steering characteristics. Road-holding, steerability and suspension will be noticeably affected if the front axle and steering components are not carefully adjusted or excessive play and wear are present. Complaints arise and particular attention has to be paid to the steering troubles and their numerous origins.

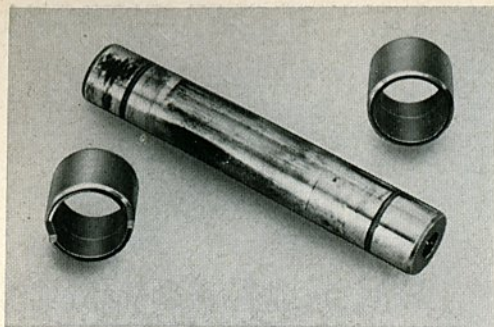


5/20 The picture shows a complete front axle. All parts shown with arrows can cause steering troubles, such as heavy steering, kick and shimmy and noises or encourage such faults. If the steering is hard to turn for example, the cause may be king pin binding. This can easily be determined by removing the tie rod from the steering knuckle arm and moving the wheel to and fro. The various causes for stiffness at this point call for a careful check of the front suspension.

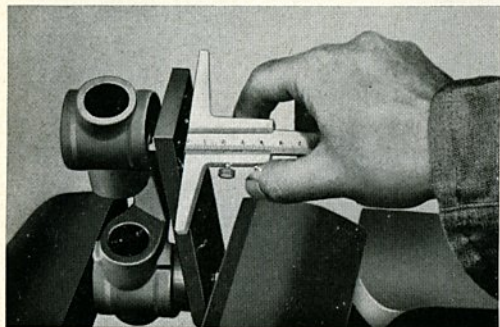


5/30 First of all try to counteract this stiffness by greasing. To do so, lift the car so that the front axle is unloaded. While greasing turn the torsion arm link pin to and fro to ensure that the new grease can penetrate better. If this measure has no result the steering knuckle and torsion arm link are to be removed and disassembled.

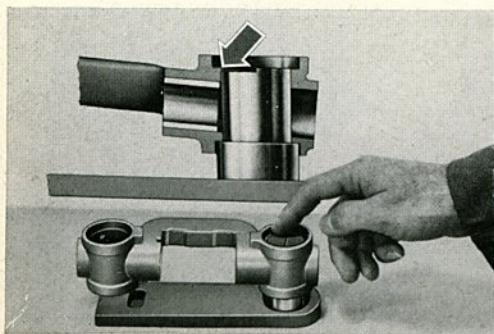




5/40 The king pins and bushes are removed in the Repair Press. If king pins and bushes are badly worn as shown in this picture, they should be replaced. Before installing them the front suspension should be thoroughly checked.

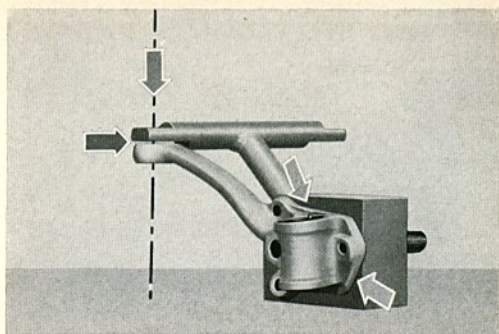


5/50 The offset of a new torsion arm link is 7.0 ± 0.2 mm which is measured with the prescribed gauge plate as shown here. The depth gauge reads 20.3 mm. A measurement of 20 mm from the back of the gauge to the inner shoulder of the torsion arm link corresponds to the correct offset of 7.0 mm. The offset in this case, is 7.3 mm which is 0.1 mm in excess of the permissible value. Despite this the torsion arm link can still be used. However, the deviation of this value from the correct offset must be considered when working out the torsion arm offset.

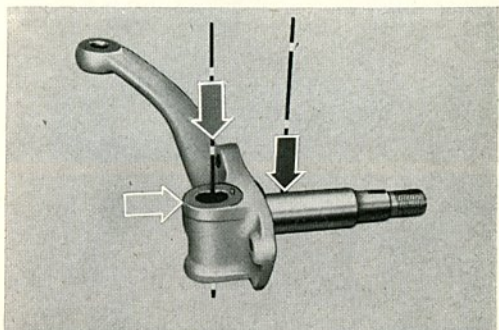


5/60 The torsion arm link pin shims are positioned at the inner shoulder. The contact surfaces wear due to friction. Check therefore that the bores for the torsion arm link pin bushes are sufficiently long. Both ends of the torsion arm link are inserted over the stud of the offset gauge the length of which corresponds to the shortest bore length for the torsion arm link pin bushes. Check whether the inner shoulder of the bore is above the face of the gauge stud. If this is not so, install a new torsion arm link.

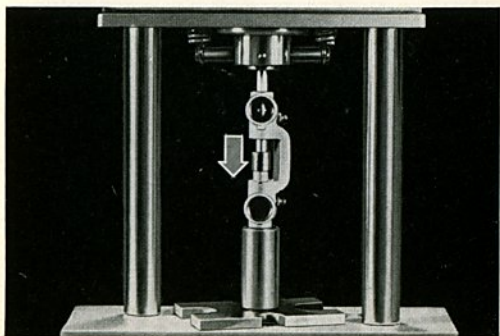
5/70 The steering knuckle arm can be bent by heavy blows to a wheel caused when driving over very uneven ground or striking sharp obstacles. When checking the accuracy of the steering knuckle, the face of the steering knuckle must be completely flush with the side of the gauge as shown by the two right-hand arrow. The left-hand arrow denotes the parallelism between gauge and eye, the vertical arrow the center line which indicates whether the steering knuckle arm bore aligns with the bore in the gauge.

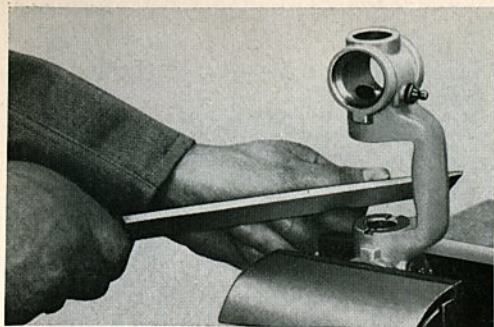


5/80 Here you see the other points on the steering knuckle which should be checked. The right-hand arrow: the seating surfaces for the outer and inner front wheel bearings, the center arrow: condition of king pin bores — and the left-hand arrow: contact surface for the thrust washer and tightness of the dowel pin. The two lines — namely the center line of the bore for the king pin and the line at right angles to the wheel spindle axis deviate approx. 5° from each other. This deviation gives the king pin inclination and the chamber of the wheel.



5/90 After checking and measuring, the king pin bushes are pressed into the torsion arm link on the Repair Press. Always press the bushes towards the outside of the torsion arm link as shown by the arrow.

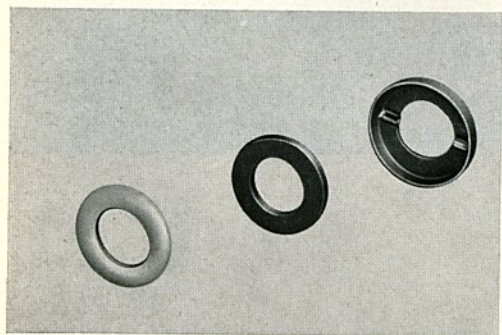




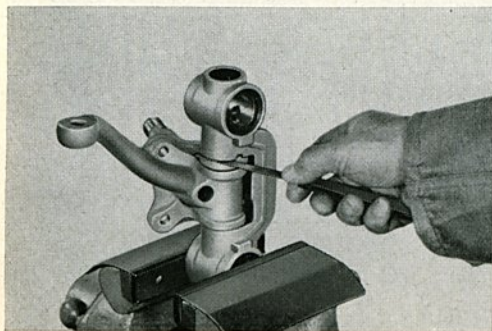
5/100 The cover is held in position at the top of the torsion arm link to prevent rotation. If new bushes have been installed, the upper bush has to be filed in accordance with the grooves in the steering knuckle. Remove all filings carefully.



5/110 The bushes are now reamed up to the correct dia. 18.034—18.016 mm with an adjustable reamer. The bushes must be free from scores and chatter marks. There is a danger when reaming split bronze bushes that the reamer will get blunt quicker.



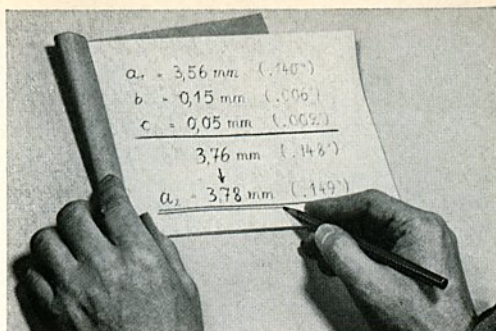
5/120 The thrust bearing, installed between the steering knuckle and the torsion arm link, consists of a thrust washer, plastic washer and a cover. Here you see the cover with two different synthetic washers which have been installed intermittently. The dark one should always be used during repairs instead of the lighter colored one. If the old washer shows no signs of wear it is better to reuse it as a new one can settle slightly during use.



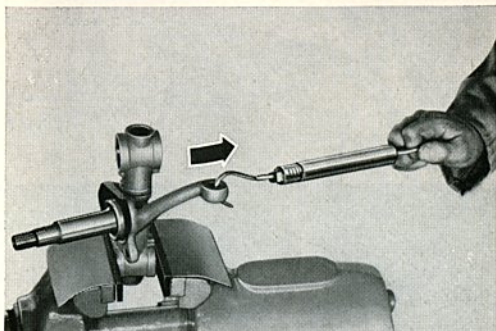
5/130 When assembling steering knuckle, thrust bearing and torsion arm link there should be no end-play. This factor is of great importance in cases of kick and shimmy. First of all take the thinnest thrust washer 3.56 mm when installing the thrust bearing and then measure the end-play with a feeler gauge. In this case it is 0.15 mm and the assembly should take place with a preload of 0.05 ± 0.02 mm.

5/140 The end-play should be eliminated by means of a thrust washer the thickness of which is determined as follows:

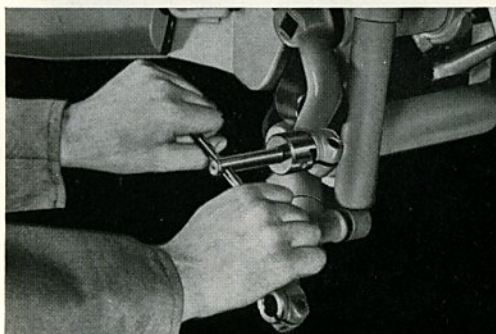
a_1 is the thickness of the thrust washer first installed, b the end-play, and c the amount of preload which gives a total of 3.76 mm. This amount must be eliminated by a thrust washer. Of the various thicknesses available, the nearest sized washer $a_2 = 3.78$ mm should be installed.



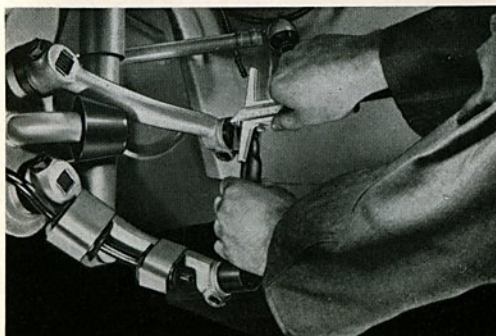
5/150 The king pin is a press fit in the steering knuckle. Heat the steering knuckle in an oil bath to 80° C (175° F) before pressing in the king pin. The king pin must move freely in the torsion arm link. You see here how the movement is checked by a spring balance. The force applied at the eye to move the steering knuckle arm should be between 5 and 7 kg (11 and 15 lbs.). The torsion arm link pin bushes are then pressed into the torsion arm link.

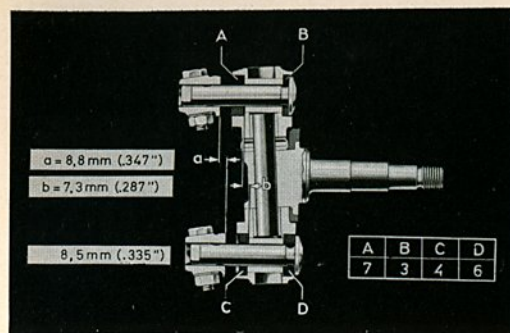


5/160 The contact faces of the torsion arm eyes should be checked for wear. If they are uneven they can be refaced by means of the cutter as shown on the picture.



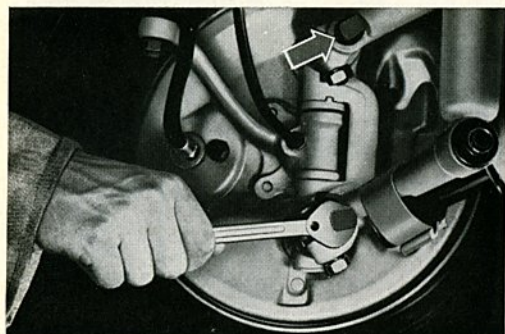
5/170 The offset between upper and lower torsion arms is then checked with the prescribed gauge and depth gauge. In this example the measurement is 18.8 mm. Taking the gauge thickness of 10.0 mm into consideration, the offset is 8.8 mm.



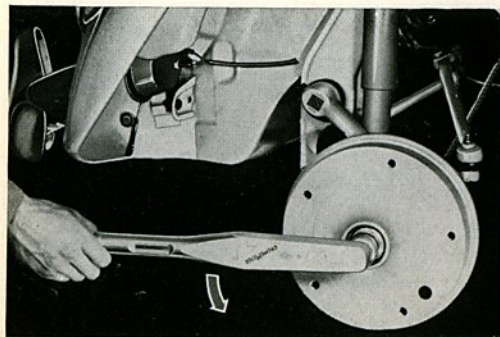


5/180 The arrangement of the shims at the torsion arm link pins is determined by the torsion arm offset. The offset, small *a*, is 8.8 mm as previously measured and is usually rounded off to 9.0 mm. The offset at the torsion arm link, small *b*, was 7.3 mm in our example. This measurement is, therefore, 0.1 mm larger than the permissible high limit and exceeds the nominal value by 0.3 mm. Such an excessive deviation should be considered when arranging the shims. This is done by subtracting the deviation 0.3 mm from small *a* = 8.8 mm. This gives a total offset of 8.5 mm. The number of shims for large A, B, C and D can be taken from the booklet "Without Guesswork". The result is seen in the right lower corner.

| A | B | C | D |
|---|---|---|---|
| 7 | 3 | 4 | 6 |

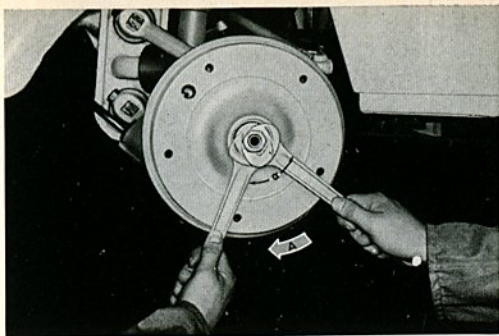


5/190 The torsion arm link pins should be carefully adjusted as follows: Fully tighten the torsion arm link pins and then back off 1/8 of a turn. Then retighten the link pins until the first resistance is felt.

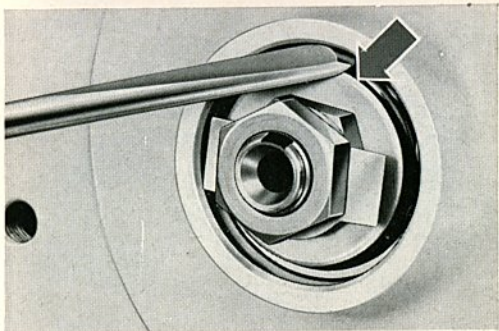


5/200 After installing the brake drum adjust the front wheel bearings. The picture shows how this can be done if a torque wrench suitable for 4 mkg (29 ft. lbs.) with a 27 mm socket is available. First tighten the inner nut to 4 mkg (29 ft. lbs.), then fit a new lock plate and loosely screw on outer nut.

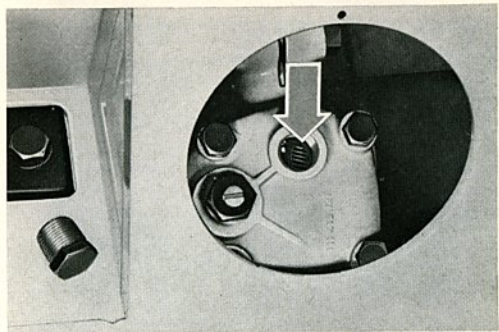
5/210 Now back off inner nut with a 27 mm open-end wrench the amount $a = 72^\circ$. This is done by moving the wrench in the loosening direction A from one brake drum hole to the next as shown here.



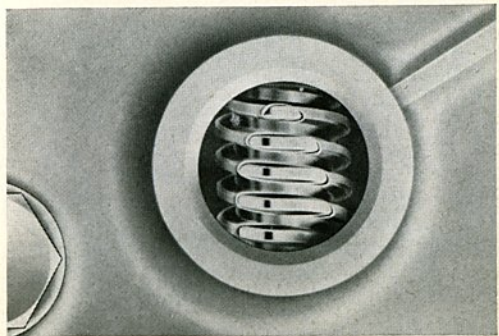
5/220 In this way the bearing play can be correctly adjusted. The bearings are correctly adjusted if the thrust washer can just be moved by a screwdriver. After installing the wheels check front axle tread and rectify if necessary.

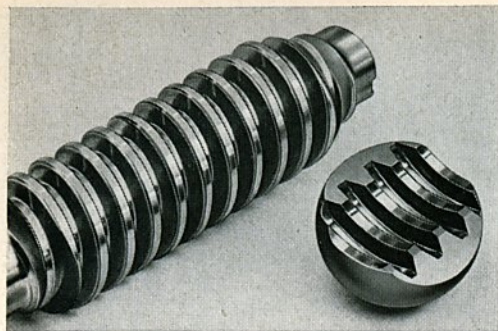


5/230 If the steering is heavy and does not self-center the oil level in the steering gear should be checked first. The wheels are then locked to the right so that the sector and sector shaft arm are at the lower end of the worm.

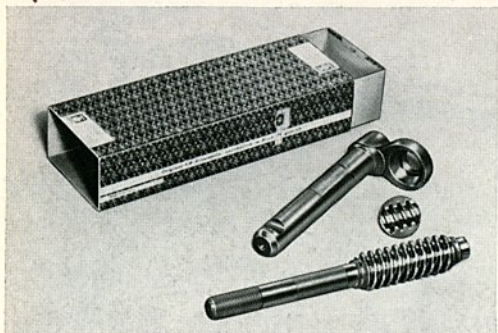


5/240 The oil level is correct if the root of the worm thread is just covered with oil as shown here. Then check the steering gear adjustment and rectify if necessary. If the steering trouble still exists, the steering gear must be removed and all components carefully examined.

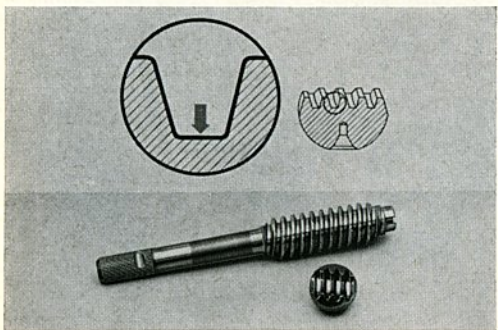




5/250 Correct steering operation can only be ensured if the surface condition of the worm, sector and sector shaft are perfect and tooth contact is good. In a correctly run-in steering gear the sector should bear at the roots and flanks as shown here. If it is not bearing on the flanks, the side play is excessive. The Sector can then tilt sideways in the worm and jam. Obviously you should check the surface condition of all steering gear components. If they are worn or show poor tooth contact they must be replaced.



5/260 A replacement is also necessary if the sector is badly worn in the recess of the sector shaft or the sector shaft has seized in the steering gear case. These three parts are supplied as a set only. The worm and sector must be replaced in pairs.

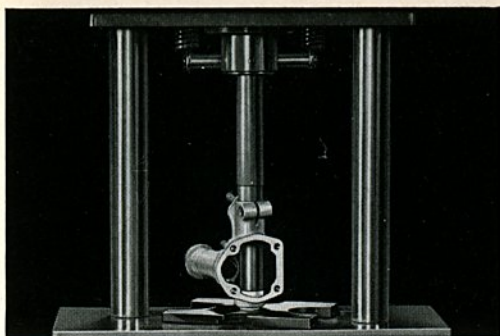


5/270 It is good practice to check tooth contact before installing a new worm and sector. With a new set, the sector should only bear on the roots of the worm as shown here. After some use the sector will settle and then bear on the flanks also.

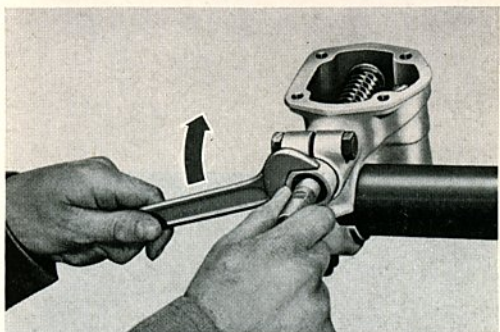


5/280 After installing a new steering set or a complete steering gear, the customer should be requested to come back to the workshop after 500 km (300 miles) to have the adjustment checked and rectified if necessary. This is necessary because the sector settles after some use and the radial play increases. This check is absolutely essential to ensure correct breaking-in and good steering over a long period.

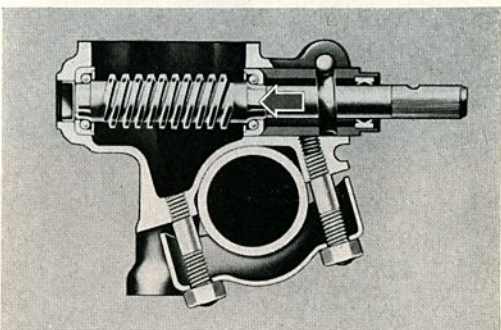
5/290 Foreign bodies can damage the ball bearing rings. Check the bearings for easy operation and replace them, if damaged. The lower thrust bearing must always be pressed into the steering gear case with the Repair Press and never hammered. The narrow end of the fitting tube must press on the outer ring only.



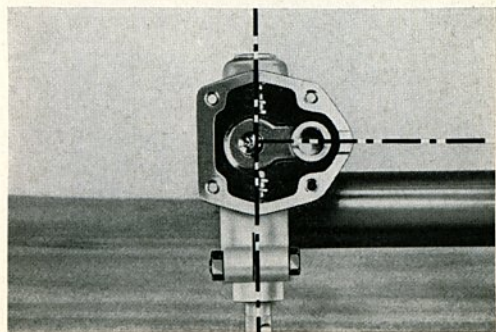
5/300 After installing the worm the upper bearing is pressed in. Remove sharp edge of outer ring before pressing in bearing in order to prevent metal being scraped off the wall of the bore and getting into the lower bearing. After installing the adjusting sleeve with seal, adjust end-play. Turn the steering worm to and fro and at the same time tighten the adjusting sleeve until no end-play can be felt and the worm can still be turned easily.

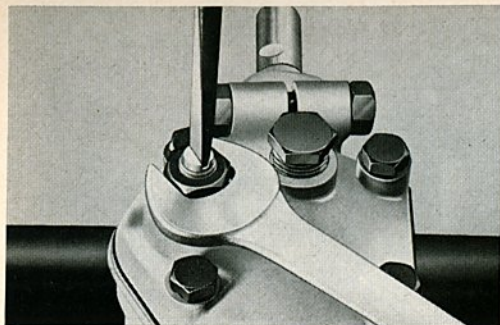


5/310 The adjusting sleeve presses against the upper bearing in the direction shown by the arrow. This pressure is also imposed on the lower bearing via the worm. If the adjusting sleeve is overtightened the bearings will be damaged and stiffness will result in the steering gear.

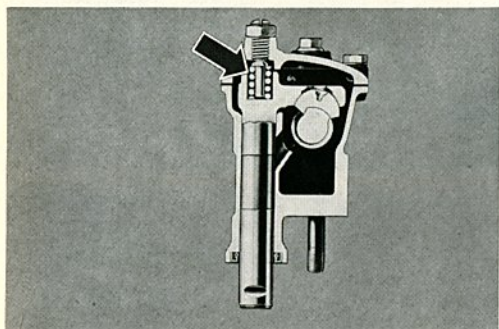


5/320 Remove burr at the sector shaft splines before installing it to avoid damaging the lip of the seal. When adjusting the radial play turn the worm so that the sector shaft arm is at right angles to the axis of the worm. With the steering gear installed the front wheels are then exactly in the straight ahead position.

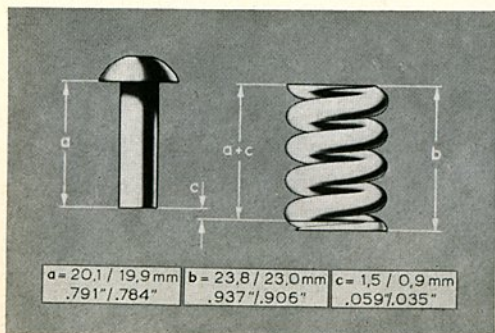




5/330 After installing the thrust spring and pin and tightening the cover, adjust the radial play. Tighten the adjusting screw as far as it will go and then back off approximately $\frac{1}{8}$ of a turn i. e. 45° . Hold the adjusting screw in this position and tighten the lock nut. On all accounts back off as prescribed to ensure that the correct play between thrust pin and sector shaft is obtained.

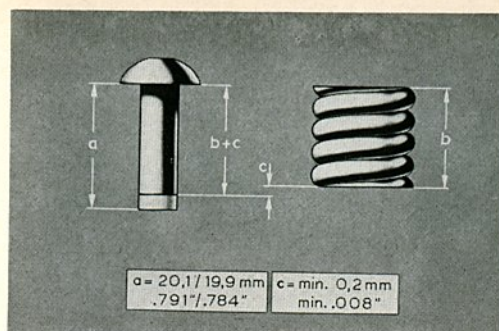


5/340 This picture shows the operation. The pin and spring, shown by the arrow, play a very important part. If the spring pressure is too high or too low, or if the length of the parts deviates from the correct measurements, incorrect play can result between worm, sector and sector shaft even with the adjusting screw properly set.

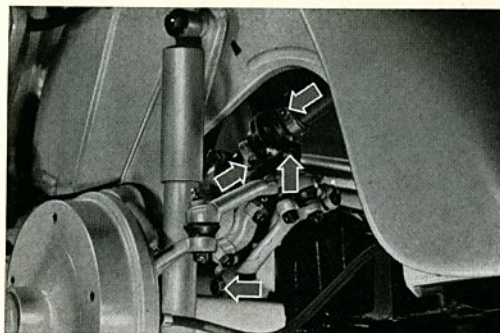


5/350 The spring pressure should be between 60 and 75 kg (132—165 lbs.), and if it is too high the sector will be pressed too hard on the worm and will cause heavy steering. In this case the spring can be shortened by grinding. Measure the length of the pin shaft a and the free length of the spring b . The correct measurements are shown on the picture. The spring can be ground down until it is still 1.5 to 0.9 mm longer than the pin shaft, measurement c . The length of the spring is $a + c$.

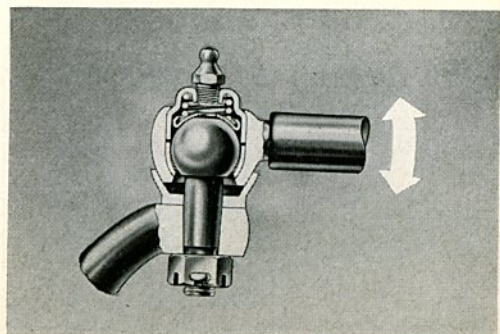
5/360 The spring pressure is more often too low. This causes the sector shaft to be lifted by road shocks against the insufficient spring pressure giving rise to steering noises and moreover affecting the characteristics of the steering gear. The picture shows how this can be remedied. Measure the length of the pin shaft a and the length of the fully compressed spring b . The pin can be ground down to the measurement $b + c$, whereby c is the minimum amount that the shaft must be longer than the fully compressed spring. The grinding down increases the spring pressure. A new spring can also be installed the pressure of which is at the upper limit. It is, however, not permitted to increase the pressure on the sector shaft by installing spring washers between the steering gear case and the drop arm.

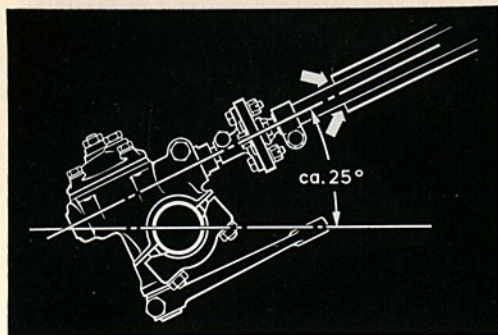


5/370 Many components should be checked when complaints arise, including the points shown here. Shown from top right are: steering column clamp, the screws holding the flange to the steering column coupling, the clamp bolt for the lower flange and the drop arm screw. Make sure that all nuts and bolts are properly tightened and secured.



5/380 Check tie rod ends for wear as any play here encourages kick and shimmy. This is done by holding the tie rods close to the ends and attempting to move them up and down as shown by the dual arrow. If the ball joints show signs of play, the tie rod or tie rod end has to be replaced.

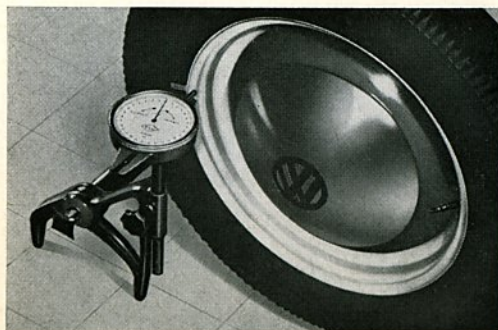




5/390 The angle of the steering worm, designed to be approximately 25°, plays an important part in cases of steering trouble. The position of the steering gear on the front axle tube is correct when the steering column is centrally located in the column tube, as shown by the arrows. In some cases it may be a help to slightly lower the rear of the steering gear on the axle tube. The drop arm and tie rods are consequently somewhat lowered. The column must always turn freely in the tube. The tread must be checked and corrected if necessary every time the position of the steering gear is altered. If an optical wheel alignment gauge is used it is advisable to check the difference in wheel angularity and the front wheel camber.

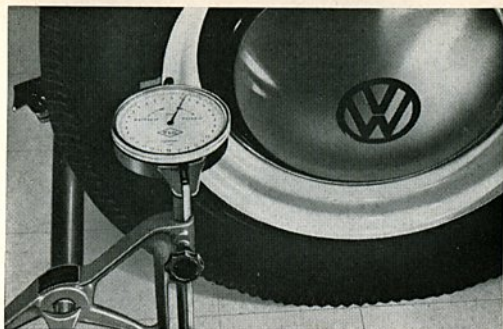


5/400 An incorrect or unfavourable adjustment of the front axle tread an inadmissible deviations from the prescribed values for the wheel position encourage kick and shimmy. When using an alignment gauge drive the vehicle forward on to a flat surface. Place the gauge in front of the vehicle so that the pins bear against the rim shoulders exactly level with the center of rotation of the wheels.

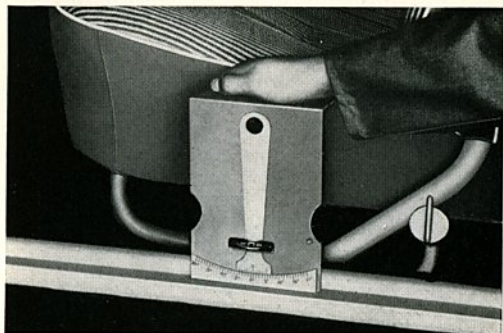


5/410 Mark the tires with chalk at the point of contact. Set the gauge dial to zero, remove the gauge and push the car forward by half a wheel turn.

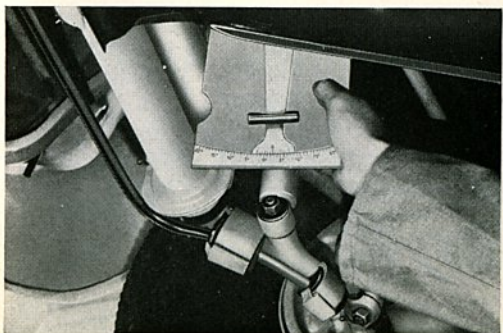
5/420 Now place the gauge behind the front wheels. The pins contact the rim shoulders level with the chalk marks. The gauge dial is at the right hand wheel and indicates the tread value.

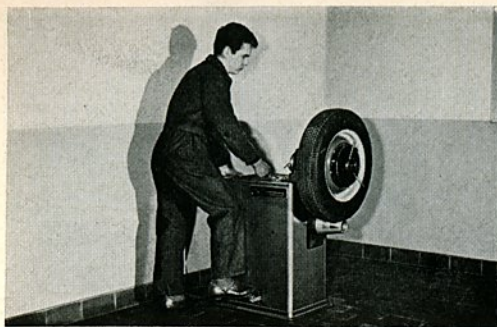


5/430 As you already know the front wheels are trailed and have a definite caster angle. Excessive caster can also encourage kick and shimmy. The inclination of the car towards the rear also plays a part. This inclination is measured at both door openings with a protractor and the mean value taken. With vehicle unloaded and spring plates correctly adjusted the inclination should be approximately 45' for vehicles produced up to July 1959 and 30' for those produced from August 1959. The inclination depends among other things, on the spring plate adjustment. If the adjustment angle is increased, the inclination decreases and vice versa.

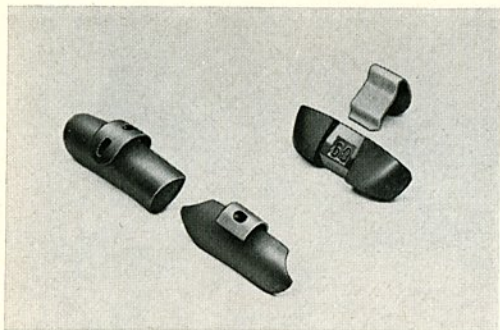


5/440 Measure the caster angle of the front axle beam as shown here before altering the caster of the wheels. The caster can be decreased by installing shims between the upper axle tube and the frame head mounting. After carrying out this measure the position of the steering gear should be corrected. Furthermore check that the steering self-centers sufficiently. Do not forget that incorrectly functioning suspension components can encourage kick and shimmy. Check the shock absorbers, the condition of the front torsion bars and the spring plate adjustment.

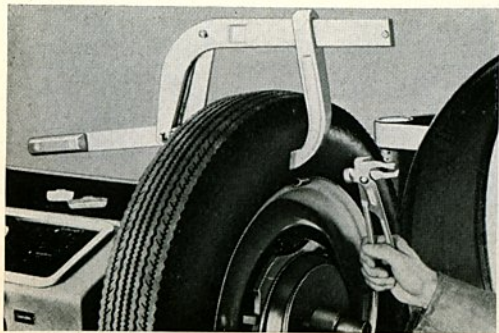




5/450 Finally check the wheels and tires. The maximum radial and lateral run-out must not exceed 1.5 mm. Any unbalance of wheels and tires is determined by a wheel balancer. The result shows the location and the weight required to balance the wheels.



5/460 There are various sizes and types of weights. Only weights with short retaining tongues — as shown below — may be used for tubeless tires as otherwise the seating between tire and rim can be affected. The weight with the long tongue — to the left of it — can only be used for tires with tubes. At the top right you see a third weight which is in two parts, is easy to fit and ensures a perfect seat of the tubeless tire and a tight fit on the rim.



5/470 Here you see the tire walls being pressed in with a clamp and the weight being attached. Take care that the tongue is not bent back too far when installing, as otherwise the weight may work loose when driving.

5/480 The road test carried out on a winding and uneven road shows the result of your work. A systematic check is necessary to counteract kick and shimmy. Usually the presence of numerous faults in the front axle and steering components complicates matters. The actual sequence of operations depends on the type and extent of the complaint. It is often necessary to go into many of the possibilities which have been mentioned here. Careful and skilled work ensure successful completion of the job.



