

STEERING BOX

OPERATION

With the steering in a straight ahead position, fluid supplied by the pump flows through an extended groove in the side of the piston and is then fed through a hole in the piston to an identical groove on the opposite side to allow compensation for lateral pressure. These ex-

tended grooves are connected with chambers on both sides of the control valve.

Fluid reaching the chambers is forced through the distribution grooves to the centre of the valve and then to the return flow line.

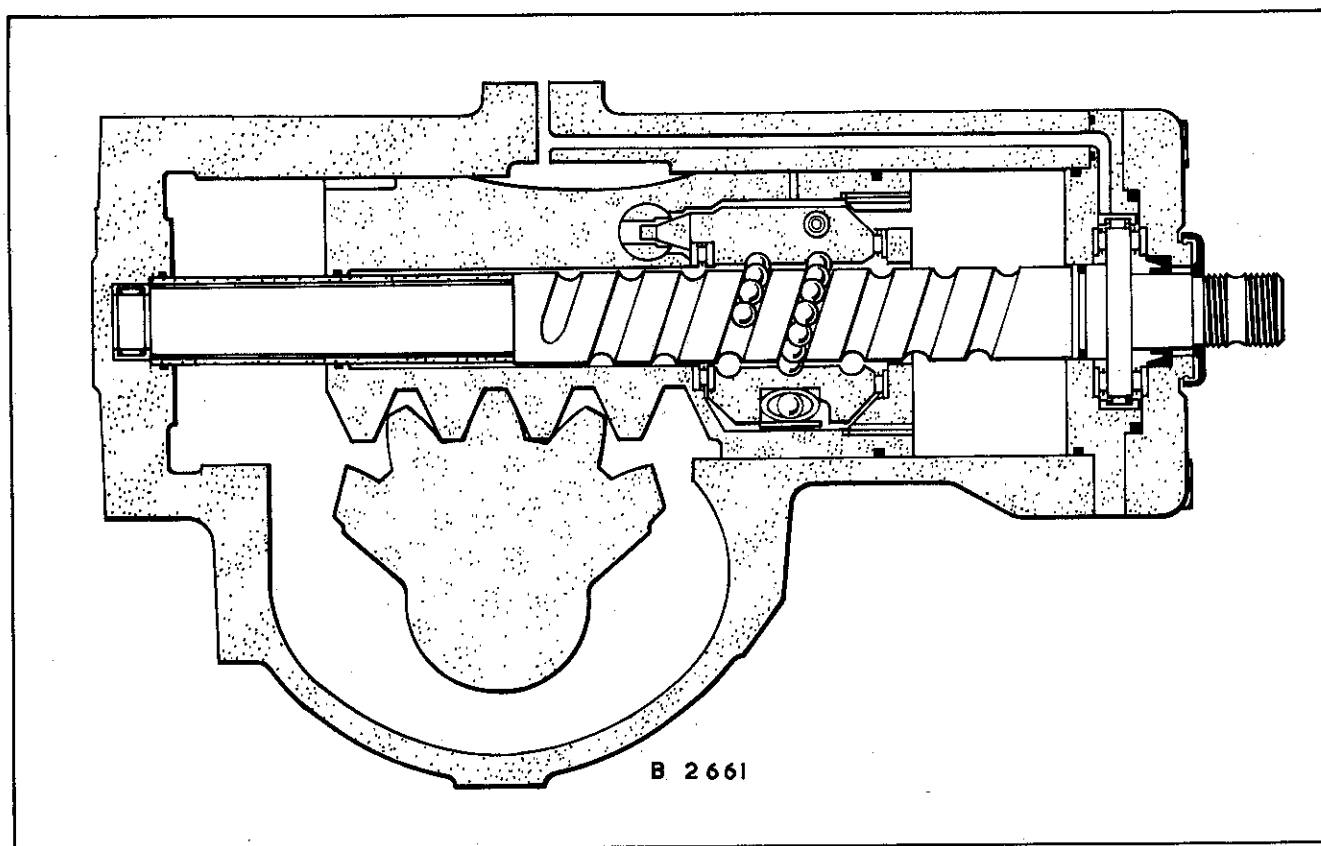


Fig. 1 Sectional view of steering box

Under these fluid flow conditions, pressure is equal on both sides of the piston, there is no variation in the path of the vehicle and the whole system is in equilibrium.

The control valve is normally maintained in a neutral position by a reaction spring. When the steering wheel is turned, its movement is conveyed through the worm shaft and balls to the steering nut, which compresses the reaction

spring and causes the push-rod to displace the control valve. Depending upon the direction of rotation of the steering wheel, the fluid will be fed under pressure to one of the control valve piston sides.

Figs. 2, 3 and 4 show the control valve and fluid flow in diagrammatic form.

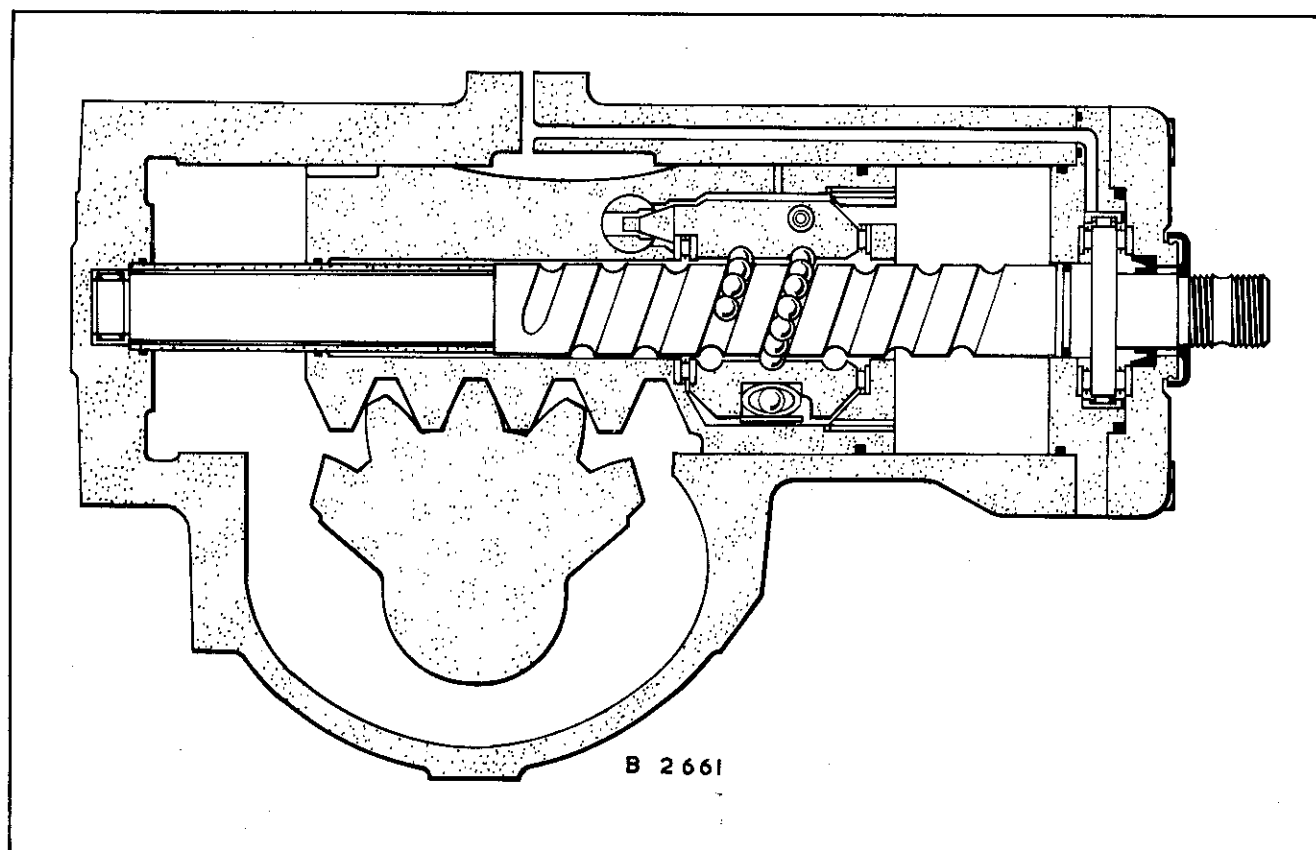


Fig. 2 Control valve in neutral position, system in equilibrium

The control valve embodies two reaction sides which tend to oppose the valve leaving its neutral position due to the pressure of the fluid. Consequently, the effort required at the steering wheel is proportional to the load acting on the wheels, a phenomenon known as 'Hydraulic Reaction'.

Hydraulic Reaction

As the hydraulic pressure starts to overcome the initial load of the return spring the fluid provides the total pressure required to turn the wheels. This would cause the driver to lose the feed-back from the wheels, which would be an unsatisfactory situation. To avoid this situation, pistons are provided at the ends of the control valve. These pistons are floating, but axial movement is prevented by stabilizing squares. The fluid under pressure acts on only one of the chambers formed between the reaction piston and the

internal face of the valve to oppose a resistance to displacement, therefore adding its power to that of the return spring. Consequently the effort used by the driver is proportional to that transmitted from the road wheels.

Hydraulic Limiting Device

To avoid overloads in the steering stops and linkages and internal damage to the steering box, the power assistance is arranged to cut-off as the piston approaches the end of its stroke. This is achieved by the provision of milled grooves in the steering box housing arranged so that the piston normally covers them. As it approaches the end of its stroke they are uncovered, thus providing a direct connection between the low pressure chamber and the return, consequently reducing the inner pressure to approximately 25 Bar (37 lb. sq.in).

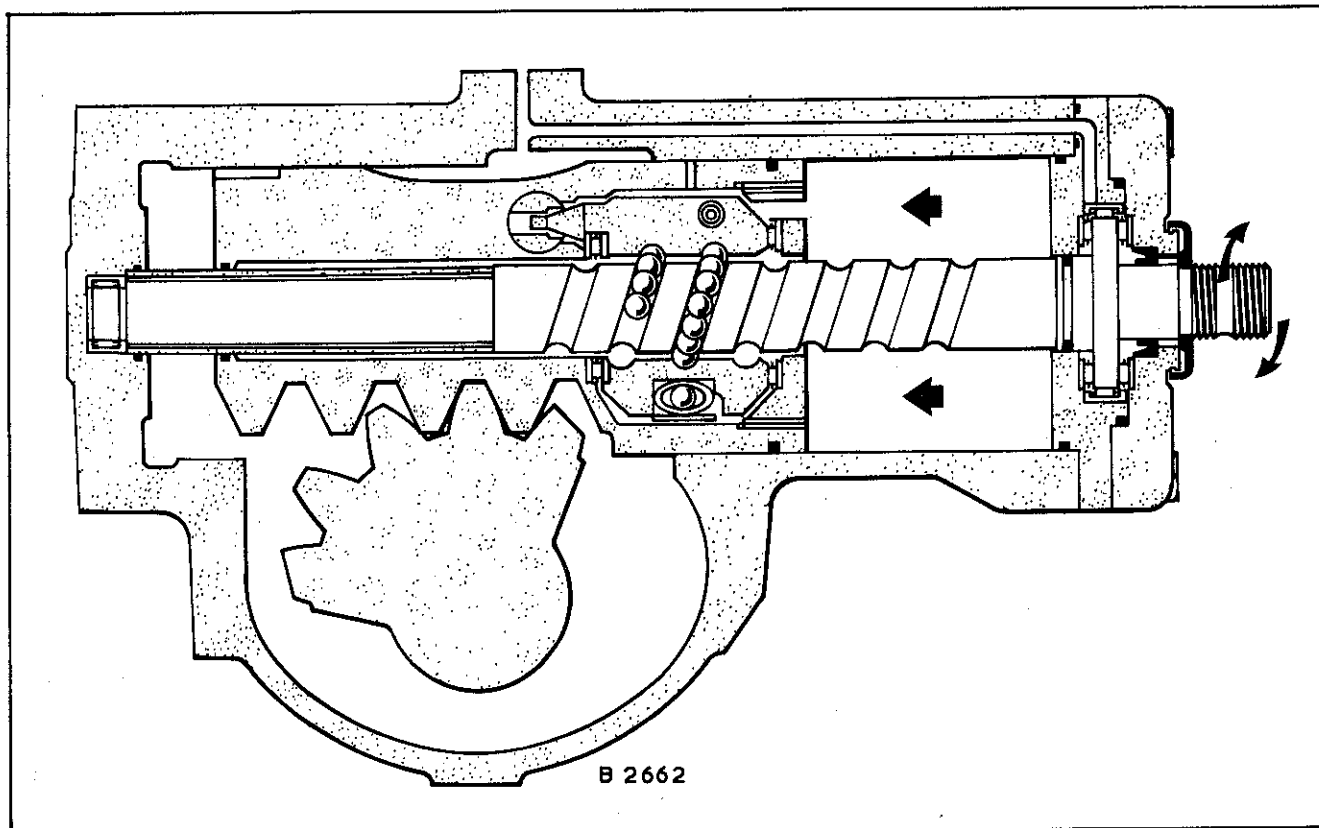


Fig. 3 Valve in working position, pressure in right hand chamber

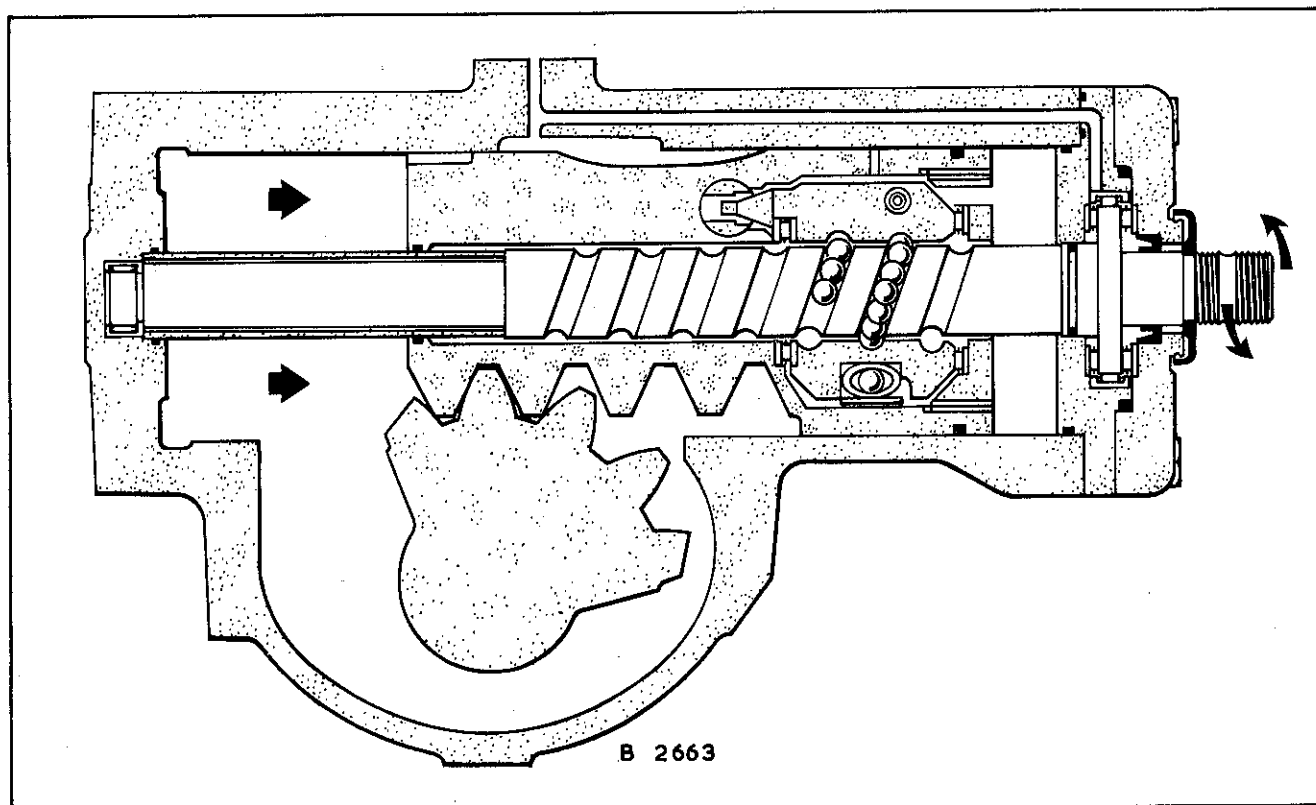


Fig. 4 Valve in working position, pressure in left hand chamber

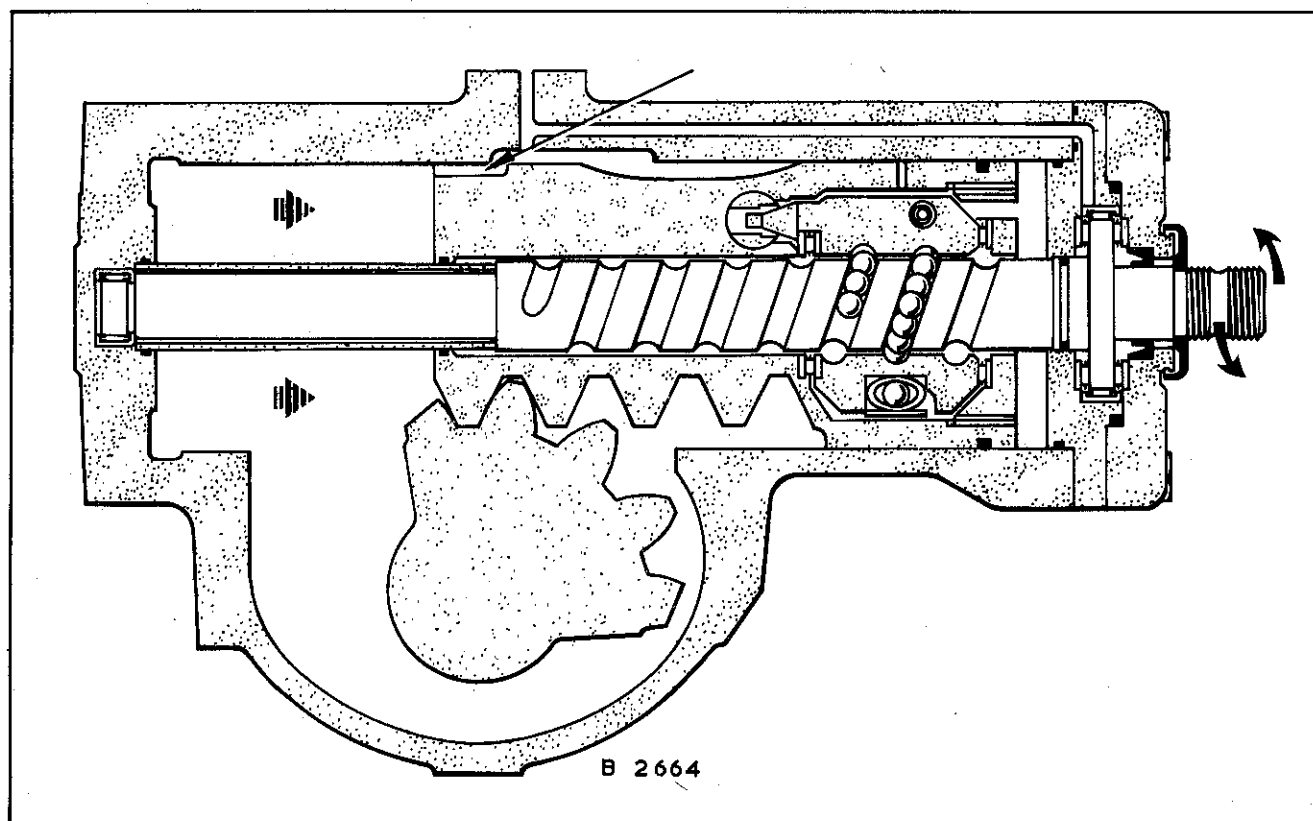


Fig. 5 Limiting groove uncovered, fluid pressure greatly reduced

STEERING BOX

To Remove

Disconnect battery.

Apply parking brake and chock the rear wheels.

Raise front of vehicle until both front wheels are clear of the ground.

Support the vehicle using suitable equipment to ensure safety of workshop personnel.

Place a suitable receptacle beneath the steering box to catch the fluid when the pipes are disconnected.

Unscrew the union of each pipe from the steering box and allow fluid to drain.

Further fluid will drain from the steering box if the steering is turned from lock to lock several

times. Continue until fluid ceases to flow.

Remove the split pin and securing nut from the side steering rod to drop arm ball joint.

Using Tool 18G 1133 (Ball joint separator) release the ball joint from the drop arm.

Remove the steering column (Refer to Sub-section L100).

Remove the engine sound insulation panel immediately to the rear of the steering box to allow access to steering box securing bolts.

Support the steering box and remove the three bolts securing it to the mounting bracket. Alternatively, remove the four nuts and bolts securing the mounting bracket to the chassis side member and remove the steering box and bracket as a unit. The bracket may then be removed on the bench.

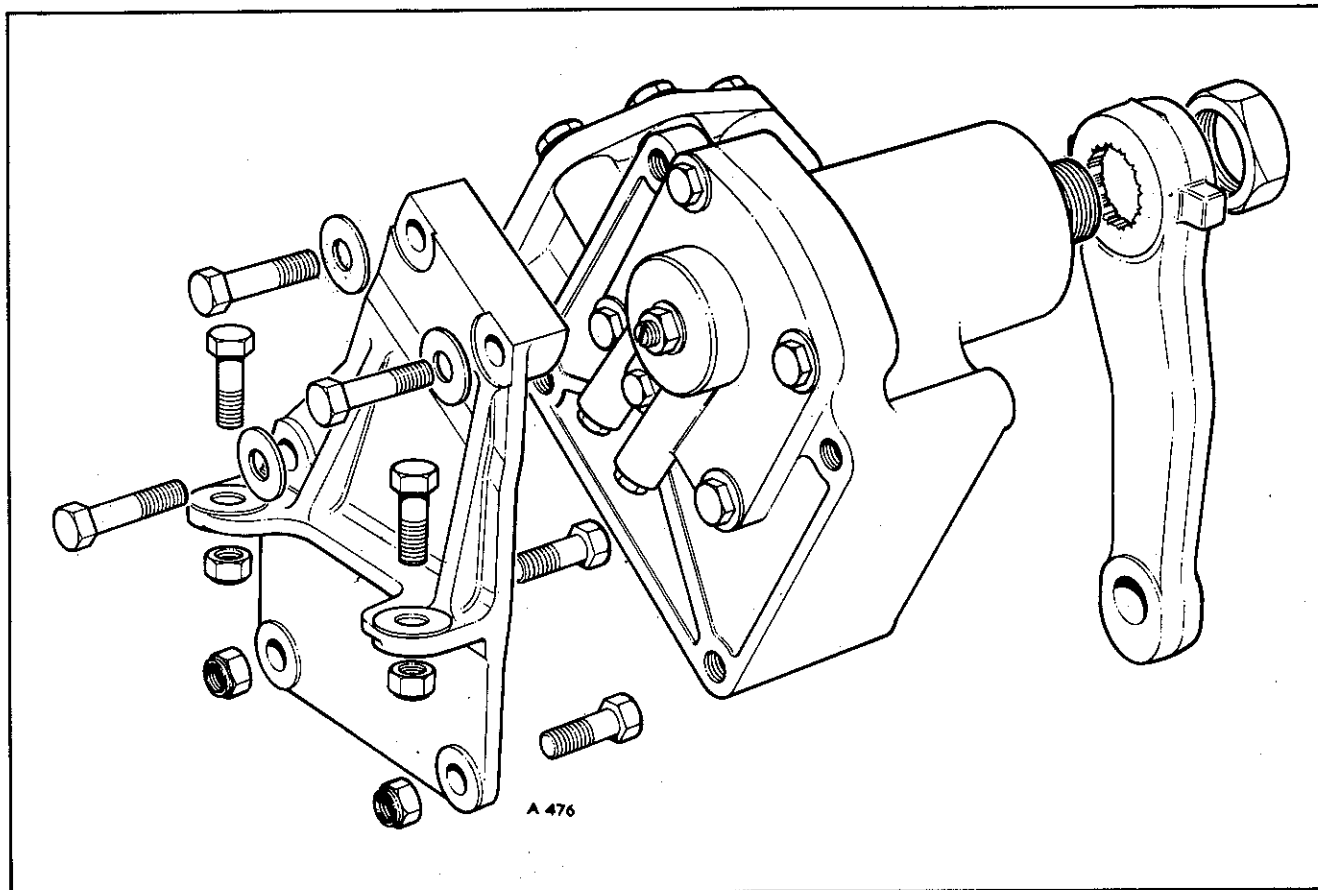


Fig. 6 *Steering Box and Mounting Bracket*

If a replacement steering box is to be fitted it will be necessary to remove the universal joint assembly from the input shaft and to remove the drop arm.

Release the universal joint by removing the pinch bolt and nut and removing the joint from the splines of the input shaft.

With the steering box securely mounted in a vice remove the drop arm as follows:

Obtain a suitable tube to fit over the drop arm and position it so that the drop arm is prevented from moving when the securing nut is unscrewed. The internal mechanism must NOT be allowed to take the torque reaction as the nut is loosened.

If the drop arm is not clearly marked to assist refitting, mark it at this stage, ensuring that the mark aligns with the scribed line on the end of the cross shaft.

Knock back the tab washer and remove the nut securing the drop arm.

Position Tool RG 59A (Adjustable drop arm remover) and tighten the centre bolt to release the drop arm from the shaft.

To Refit

Refitting is a reversal of the removal instructions.

Bleed the system (Refer to Sub-section L330).

Adjust the steering stops (Refer to STEERING STOPS — this section).

To Overhaul

To enable an operator to correctly overhaul the steering box and to accurately set the various pressure adjustments, a considerable amount of experience and fair amount of special tooling is required. It is therefore recommended that when the unit requires attention, it is returned ZF or one of their appointed agents.

CROSS SHAFT ADJUSTMENT

The adjustment of the cross shaft does *not* follow the generally accepted method applied to manual steering boxes i.e. Turn the adjuster until all end movement is eliminated, then slacken 1/12 of a turn.

If the above method is used the steering of the vehicle will be adversely effected.

It is stressed that the cross shaft adjustment should not be deliberately altered. If the setting is accidentally disturbed the following method will permit it to be reset with reasonable accuracy. It should be understood however that this adjustment will not cure any other fault in the steering box or compensate for worn steering linkages.

Apply parking brake and chock rear wheels.

Raise the vehicle until both front wheels are clear of the ground.

Place suitable supports below the axle to ensure safe access below the vehicle.

Locate the centre point of the steering (road wheels straight ahead).

Mark the T.D.C. point of the steering wheel and another suitable surface so that the two may be observed and aligned by sight from the driving position. Self-adhesive tape is useful for this purpose.

Detach the cover from the centre of the steering wheel.

Obtain a torque wrench of the dial reading type calibrated in Ncm or lbf in and having a range of 0 — 330 Ncm (0 — 30 lbf in) approximately and a socket to fit the steering wheel centre nut.

Read the following instructions *before* commencing adjustment of the cross shaft.

Refer to Fig. 7 and key, turn the steering with the torque wrench towards full right lock noting the reading as it approaches and passes point 'C' on the diagram. Point 'C' is approximately half a turn prior to full lock.

Repeat the operation for the left lock noting the reading obtained. If the readings are of different values take an average of the two and note the figure for reference.

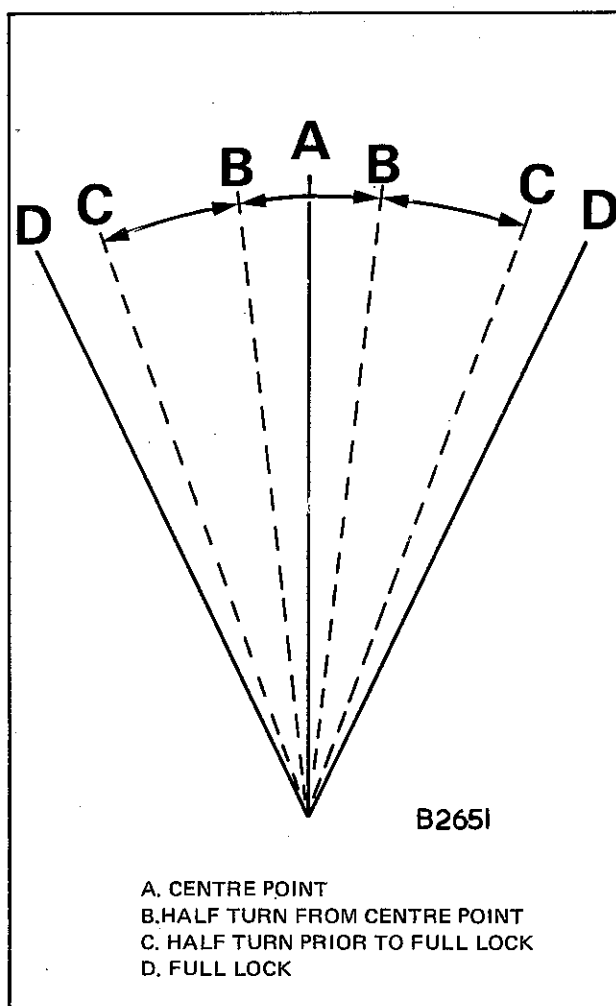


Fig. 7 Steering wheel positions for obtaining torque figures

Steering Box

Turn the steering to the 'Straight Ahead' position (Point 'A'). Rock the steering approximately half a turn either side of the 'Straight Ahead' position (Points B to B on the diagram). The reading should start to increase as the steering leaves point 'B' reaching a peak as it passes point 'A' and decreasing as point 'B' is approached on the opposite lock. The aim is to obtain an increase over the reading obtained at point 'C' of 40 – 50 Ncm (3,54 – 4,42 lbf in) as the steering passes through the 'Straight Ahead' position.

Setting the torque to a higher figure will not improve the steering characteristics but will result in accelerated wear of the steering box.

It will be necessary to temporarily tighten the lock-nut following each adjustment to ensure that erroneous readings are not obtained.

Note: Disconnection of the side steering rod (drag link) may assist in cases where it proves difficult to obtain steady or consistent torque readings.

When the position of the adjuster has been finalised, tighten the locknut to a torque of 90Nm (66 lbf ft) ensuring that the adjuster is not accidentally disturbed.

DROP ARM

To Remove

Turn the steering onto full right lock (Full left lock on L.H.D. vehicles).

Knock back the tab washer securing the drop arm nut.

Unscrew and remove the drop arm nut.

Remove the split pin and nut from the drop arm to side steering rod ball joint.

Position Tool 18G 1133 (Ball joint separator) and separate the ball joint assembly from the drop arm. Rest the side steering rod and ball joint on the front road spring.

Turn the steering wheel until the steering box reaches the limit of its travel on the opposite lock.

Check that the drop arm is marked in such a way that it can be refitted in its original position. A line is already provided on the end of the cross shaft and it is suggested that the mark is aligned with this.

Position Tool R59A (Adjustable drop arm remover) and tighten the centre bolt to release the drop arm from the cross shaft.

To Refit

Refitting is a reversal of the removal procedure.

Adjust steering stops (Refer to STEERING STOPS – this section).

STEERING STOPS

To avoid serious damage to the steering box, steering linkage or pump, the system is designed so that power assistance ceases just before the steering box reaches the limit of its travel. The remaining travel can still be used up to the point that the steering stops make contact but without the benefit of power assistance. It is **essential** that power assistance ceases before the steering stops make contact.

Preliminary Checks

Position the steering 'Straight Ahead'.

Check the 'Toe-in' of the road wheels and adjust if necessary.

Remove split pin and nut securing the side steering rod ball joint to the drop arm. Use Tool 18G 1133 (Ball joint separator) to remove the ball joint assembly from the drop arm.

Turn the steering to full right lock. Slowly turn the steering to full left lock counting the number of revolutions and part revolutions of the steering wheel required. Turn back the steering exactly half the number of revolutions previously counted. The steering box should now be half way through its travel.

Steering Box

Check that the drop arm is correctly positioned relative to the steering box. The drop arm should be positioned 4° (2° on RB75) to the rear of a vertical line passing through the centre of its pivot, with the steering box half way through its travel.

Check the distance between the ball joint centres of the side steering rod against DATA figure. If it is necessary to adjust the length of the rod refer to Sub-section L200.

Refit the side steering rod to the drop arm.

Safety

If an assistant is used during the adjustment operation ensure that each step of the procedure is fully understood and precautions are taken to ensure that the assistant is clear of any steering gear before turning the steering wheel. Remember, very high forces are generated at the road wheels for a relatively small effort at the steering wheel.

Adjustment

Slacken the lock-nut and screw the right hand stop towards the brake back plate.

Turn the steering wheel until the steering box reaches the limit of its travel on right lock. If the steering stop contacts the forged stop on the axle beam, screw the stop further towards the brake back plate until it fails to make contact, but the steering box is at the limit of its travel.

Note: Do not use undue force when checking that the steering box has reached the limit of its travel as this could cause internal damage.

With the steering wheel held on full lock, adjust the steering stop until it contacts the forged stop on the axle beam.

Release the steering wheel and screw out the steering stop a further **two turns**. Hold in this position and tighten the lock-nut.

Repeat the procedure for the left hand stop.

The above operations will ensure that:

- a) Power assistance ceases before the steering stops make contact.
- b) The steering stops make contact before the steering box reaches the limit of its travel.
- c) That the steering stops prevent undue stress being transmitted through the steering linkage to the steering box should the vehicle be 'kerbed' on full lock.

Check that there is adequate clearance between the tyres, steering linkage and road springs on both left and right steering lock.