SECTION J

REAR AXLE AND SUSPENSION

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Section J.1

LUBRICATION

For the lubrication of the hypoid axle use lubricants only from approved sources, as tabulated in Section Q. Do not, in any circumstances mix brands of hypoid lubricant. If there is any doubt as to the oil previously used, drain and flush the axle before finally filling up with new hypoid oil. Do not use paraffin as a flushing medium.

The filler plug is situated on the rear side of the axle, and the drain plug in the bottom of the banjo casing.

Fig. J.1. Rear axle.
1. Drain plug. 2. Filler plug. 3. Propeller shaft universal nipple

Section J.2

AXLE UNIT

To Remove and Replace

1. Loosen the wheel nuts or hub caps, then jack-up the car and place supports under frame members just forward of the rear springs front anchorages. Take off both wheels after removing the wheel nuts or hub caps.

2. Working from under the car, unscrew the four self-locking nuts and remove the bolts (U.N.F.) securing the propeller shaft flange to axle pinion flange.

3. Disconnect the handbrake cable from the axle. This is accomplished by unscrewing it from its link to the brake balance lever, and unscrewing the nut holding its outer casing to the axle.

4. The hydraulic brake pipe at the rear axle is detached from the flexible pipe at the union just forward of the right hand shock absorber.

5. Unscrew the nuts securing the shock absorber links to the axle mounting brackets. Do not attempt to remove the links as this operation will prove much easier when freeing the axle.

6. Remove the self-locking nuts from the spring clips ("U" bolts) which secure the axle to the springs. Observe that a fibre pad is situated between the axle and spring.

7. Disconnect the tiebar at its axle anchorage by unscrewing its securing nuts.

8. With the axle free, the connecting links from the shock absorbers should be detached.

9. Remove the rubber block fixed between the axle and the left hand chassis frame. It is not necessary to detach the corresponding block on the right hand chassis frame.

10. The complete axle should be removed from the right-hand side of the car. Take care not to damage other components, particularly the petrol pump.

11. Installing the axle is the reverse of the above operations.

On re-assembling, it is advisable to jack-up the springs to meet the axle thus locating the spring centre bolt properly. Remember to fit the fibre pad.

When assembly is complete adjust the handbrake if required and bleed the hydraulic brake system all round.

Section J.3

AXLE SHAFTS

To Remove and Replace

1. Loosen the wheel nuts or hub cap of the wheel concerned before jacking-up the car.

2. Remove the wheels after further unscrewing the wheel nuts or hub caps.

3. Take out the two drum locating screws, using a screwdriver.

Note.—If wire wheels are fitted it will be necessary to remove the five self-locking nuts, which secure the rear hub extension, to gain access to the two drum locating screws.

4. The drum can be tapped off the hub and brake linings, provided the handbrake is released and the brake shoes are not adjusted so closely as to bind on the drum.

Should the brake linings hold the drum when the handbrake is released, it will be found necessary to slacken the brake shoe adjuster a few notches.

J.1
(5) Remove the axle shaft retaining screw and withdraw the axle shaft. Should the paper washer be damaged it must be renewed when re-assembling.

(6) Replacement is the reversal of the above operations, but ensure that the bearing spacer is in position. Adjust the rear brakes, and if hand brake adjustment is necessary refer to Section M.1.

Section J.4

HUBS

To Remove and Replace

(1) Remove the drum, axle shaft and bearing spacer.

(2) Knock back the tab of the locking washer and unscrew the nut with Service Tool 18G 258.

(3) Tilt the lock washer to disengage the key from the slot in the threaded portion of the axle casing; remove the washer.

(4) The hub can then be withdrawn with a suitable extractor such as Service Tool 18G 220 with adaptors 'A', 'D' and 'E'. The bearing and oil seal will be withdrawn with the hub.

(5) Fit a new oil seal using Service Tool 18G 134 and adaptor 18G 134AQ.

(6) The bearing is not adjustable and is replaced in one straightforward operation.

When re-assembling it is essential that the outer face of the bearing spacer should protrude from -001 in. (-025 mm.) to -004 in. (-1 mm.) beyond the outer face of the hub and the paper washer, when the bearing is pressed into position. This ensures that the bearing is gripped between the abutment shoulder in the hub and the driving flange of the axle shaft.

Section J.5

REMOVING AND REPLACING THE PINION OIL SEAL AND THE DIFFERENTIAL PINIONS

Pinion Oil Seal

Removal

(1) Mark the propeller shaft and pinion shaft driving flanges so that they can be replaced in the same relative positions, and disconnect the propeller shaft, carefully supporting it.
REAR AXLE AND SUSPENSION

(2) Using Service Tool 18G 34A to prevent the pinion flange from turning, remove the nut and spring washer. Withdraw the flange and pressed end-cover from the pinion shaft using Service Tool 18G2.
(3) Extract the oil seal from the casing.

Replacement
(1) Press a new seal into the casing with the sealing edge facing inwards.
(2) Replace the driving flange and end-cover, taking care not to damage the edge of the oil seal, and tighten the nut with a torque wrench to a reading of 140 lb. ft. (19.4 kg.m.)
(3) Reconnect the propeller shaft, taking care to fit the two flanges with the locating marks in alignment.

Differential Pinions
Removal
(1) Drain the oil from the axle.
(2) Remove the axle shafts as detailed in Section J.3.
(3) Mark the propeller shaft and pinion driving flanges so that they can be replaced in the same relative positions, and disconnect the propeller shaft.
(4) Remove the twelve nuts and spring washers securing the gear carrier to the axle case, and withdraw the complete carrier assembly.
(5) Having marked the differential bearing housing caps so that they can be replaced in their original positions, remove the four nuts and spring washers. Withdraw the bearing caps and the differential cage from the carrier. Note the thickness of the spacer collars fitted between the outer ring of each bearing and the differential carrier.
(6) Tap out the dowel pin locating the differential pinion shaft. The diameter of the pin is ½ in. (4.8 mm.) and it must be tapped out from the crown wheel side of the differential cage as the hole into which it fits has a smaller diameter at the crown wheel end to prevent the pin passing right through. It may be necessary to clean out the metal peened over the entry hole with a ½ in. drill in order to facilitate removal of the dowel pin.
(7) Drive out the differential pinion shaft and remove the pinions and thrust washers from the differential cage.

Replacement
Examine the pinions and thrust washers for wear and renew as required. Reassembly is a reversal of the above procedure. Care must be taken to peen over the dowel pin entry hole in order to retain the dowel pin securely in position. Refill the axle with oil to Ref. B (page Q.1).

NOTE.—If it proves necessary to fit any new parts other than those detailed in this section the axle assembly must be set up as in Section J.7.

Section J.6
DISMANTLING THE AXLE

Remove the differential carrier from the axle case as detailed in ‘Differential Pinions’ of Section J.5. It is strongly recommended that operators should make use of the Service Tools that are available. These tools have been specially designed to render easy operation and to prevent damage to the parts concerned.

Crown Wheel and Bearing Removal
(1) Remove the bearing caps, having marked them so that they can be replaced in their original positions. Lever out the differential cage and bearings. Note the spacer collars fitted between the outer ring of each bearing and the differential carrier.
(2) Remove the lockplates and bolts, and take off the crown wheel.
(3) The ball races should be a tight fit on each end of the differential cage and if found to be loose, a new cage will be needed. Service Tool 18G 47C and adaptor 18G 47R should be used to remove the bearings.

Bevel Pinion and Bearing Extraction
(1) Using wrench 18G 34A to keep the bevel pinion flange from turning, remove the nut and spring washer. Withdraw the flange using extractor 18G 2.
(2) Drive out the bevel pinion rearwards through the carrier using a soft metal drift. The pinion will take the inner race and rollers of the rear bearing, distance piece and shims leaving the front bearing and oil seal in the carrier. Extractor 18G12A with adaptor 12F or Service Tool 18G 285 can be used to draw the rear inner race and rollers off the bevel pinion. Retain the pinion head washer.

J.3
Fig. 3.3. The rear axle exploded.

1. Breather.
2. Filler plug.
3. Axle casing.
5. Drain plug.
6. Cup carrier stud.
8. Differential wheel thrust washer.
11. Pinion thrust washer.
12. Pinion shaft securing pin.
13. Lockwasher.
15. Differential bearing cap.
16. Bearing collar.

17. Differential bearing.
20. Pinion.
22. Pinion rear bearing.
23. Distance piece.
27. Pinion front bearing.
28. Oil seal.
29. Oil seal housing.
30. Pinion flange.
31. Flange nut and washer.
32. Shims.
(3) Remove the oil seal from the gear carrier and extract the front pinion bearing inner race and rollers with the fingers. The outer races of both bearings can be withdrawn with Service Tool 18G 264 using adaptors 18G 264D and 18G 264H.

Section J.7
ASSEMBLING AND SETTING THE CROWN WHEEL AND PINION

Apart from fitting parts as detailed in Section J.3, J.4 and J.5 it is not permissible to fit any new parts (e.g. crown wheel and pinion, pinion bearings, differential bearings etc.) to the axle assembly without working through the procedure given in this section. Furthermore, if a new crown wheel or a new pinion is needed, a mated pair—crown wheel and pinion—must be fitted.

Replacing and Adjustment

Fitting a new crown wheel and pinion involves four distinct operations:

1. Setting the position of the pinion.
2. Adjusting the pinion bearing pre-load.
3. Adjusting the differential bearing pre-load.
4. Adjusting the backlash between the gears.

To carry out these operations correctly, the following special tools are required; the bevel pinion setting and differential bearing gauge, Service Tool 18G 191B, the pinion bearing outer race remover and replacer, Service Tool 18G 264 with adaptors 18G 264D and 18G 264H, Service Tool 18G 285 and the pre-load checking tool, Service Tool 18G 207.

Setting the Pinion Position

(1) Fit the bearing outer races to the gear carrier, using Service Tool 18G 264 with adaptors 18G 264D and 18G 264H.

(2) Smooth off the pinion head with an oil stone, but do not erase any figures that are etched on the pinion head.

(3) Refit the pinion head washer; if the original washer is damaged or not available, select a washer from the middle of the range of thicknesses.

(4) Fit the inner race of the rear bearings to the pinion shaft using Service Tool 18G 285 and position the pinion in the gear carrier without the shims, bearing spacer and oil seal. Fit the inner race of the front bearing.

(5) Refit the universal joint driving flange and tighten the nut gradually until a pre-load figure of 13 to 15 lb. in. (15 to 173 kg. m.) is obtained.

(6) Adjust the dial indicator to zero on the machined step 'C' of the setting block (Service Tool 18G 191B).

(7) Remove the keep disc from the base of the magnet; clean the pinion head and place the magnet and dial indicator in position. Move the indicator arm until the foot of the gauge rests on the centre of the differential bearing bore at
one side and tighten the knurled locking screw. Obtain the maximum depth reading and note any variation from the zero setting.

Repeat the check in the opposite bearing bore. Add the two variations together and divide by two to obtain a mean reading.

Take into account any variation in pinion head thickness. This will be shown as an unbracketed figure etched on the pinion head and will always be minus (−). If no unbracketed figure is shown, the pinion head is of nominal thickness.

Using the mean clock gauge reading obtained and the unbracketed pinion head figure (if any), the following calculation can be made:

(a) If the clock reading is plus and numerically greater than the pinion head marking, increase the washer thickness by this amount.

Example:
Clock reading ... ... ... +008 in.
Pinion marking ... ... ... −003 in.
Variation from nominal ... ... +005 in.

Increase the washer thickness by this amount.

(b) If the clock reading is plus and numerically less than the pinion head marking, reduce the washer thickness by the difference.

Example:
Pinion marking ... ... ... −005 in.
Clock reading ... ... ... +003 in.
Variation from nominal ... ... −002 in.

Reduce the washer thickness by this amount.

The only cases where no alterations are required to the washer thickness are when the clock reading is plus and numerically equal to the unbracketed pinion head marking, or when the clock reading is zero and there is no unbracketed marking on the pinion head.

(9) Allowance must finally be made for the mounting distance marked on the pinion head in a rectangular bracket. Proceeds as follows:

If the marking is a plus figure, reduce the washer thickness by an equal amount.

If the marking is a minus figure, increase the washer thickness by an equal amount.

A tolerance of +001 in. is allowed in the thickness of the washer finally fitted.

Fit a washer of this thickness to the pinion with the chamfer towards the pinion head.

**Adjusting Pinion Bearing Pre-load**

(1) Assemble the pinion, bearings, bearing spacer and shims to the gear carrier; fit the oil seal and driving flange.

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Fig. J.6. Illustrating the machining tolerances for the differential bearing housings as marked by the factory inspector.
(2) Tighten the flange nut gradually to a torque wrench reading of 140 lb. ft. (19.4 kg.m.), checking the pre-load at intervals to ensure that it does not exceed 18 lb. in. (2-49 kg.m.), i.e. 3 lb. in. greater than the previous figure as the oil seal is now fitted.

(3) If the pre-load is too great more shims must be added, and if too small the thickness of the Shim must be decreased.

Adjusting Differential Bearing Pre-load

Units marked with variations. The differential bearings must be pre-loaded and this is done by “pinching” them to the extent of 0.002 in. on each bearing, the “pinch” being obtained by varying the thickness of the bearing distance collar fitted between each bearing outer ring and the register in the differential carrier. The collar thickness is calculated as shown below.

In making the necessary calculations, machining variations, and variations in bearing width must be taken into account. Machining variations are stamped on the component; bearing width variations must be measured.

The dimensions involved in pre-loading the differential bearings are illustrated in fig. J.8, and it is emphasised that it is the variation from nominal on each dimension which is important and referred to in the formula used.

The dimensions are:—

(1) From the centre line of the differential to the bearing register on the left-hand side of the gear carrier.

Variation: stamped on the carrier.

(2) From the centre line of the differential to the bearing register on the right-hand side of the carrier.

Variation: stamped on the carrier.

(3) From the bearing register on one side of the differential cage to the register on the opposite side.

Variation: stamped on the cage.

(4) From the rear face of the crown wheel to the bearing register on the opposite side.

Variation stamped on the cage.

To calculate the collar thickness:—

Left-hand side:

Formula: A + D - C + 1.515 in. (40-10 mm.).

Substitute the dimensional variations for the letters in the formula. The result is the thickness of the collar required at the left-hand side to compensate for machining variations and to give the necessary pinch, with bearings of standard width. The width of the bearing must now be checked and any variation from standard added to or subtracted from the collar thickness. If the bearing width is under standard, that amount must be added to the collar thickness, and vice versa.

Fig. J.8. Illustrates the points from which the calculations must be made to determine the collar thickness for the bearings on each side of the carrier.

Fig. J.9. Checking differential bearing width with Service Tool No. 10G1918B.
Rear Axle and Suspension

Fig. J.10. Checking crown wheel to pinion backlash (Service Tool No. 18G 191B).

Table of Washer and Shim Thickness

<table>
<thead>
<tr>
<th>Pinion head washer thickness</th>
<th>...</th>
<th>0.208 in. to 0.222 in. in steps of 0.002 in.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pinion bearing pre-load shims</td>
<td>...</td>
<td>0.004 in. to 0.012 in. in steps of 0.002 in., plus 0.020 in. and 0.030 in.</td>
</tr>
<tr>
<td>Crown wheel bearing collars</td>
<td>...</td>
<td>0.175 in. to 0.193 in. in steps of 0.002 in.</td>
</tr>
<tr>
<td>Pinion bearing pre-load</td>
<td>...</td>
<td>13 to 15 lb. in. without oil seal; 16 to 18 lb. in. with oil seal.</td>
</tr>
<tr>
<td>Crown wheel bearing pinch</td>
<td>...</td>
<td>0.002 in. each side.</td>
</tr>
</tbody>
</table>

To Check Bearing Width

1. Rest the bearing on the small surface plate of Tool No. 18G 191B with the inner race over the recess and the thrust face downwards.
2. Place the magnet on the surface plate and set the dial indicator to zero on the step marked "C" of the small gauge-block; this is the width of a standard bearing. Transfer the indicator to the plain surface of the bearing inner race and, holding the race down against the balls, note the reading on the dial. A negative reading shows the additional thickness to be added to the collar at this side; a positive reading, the thickness to be subtracted.

Right-hand side:

Formula: B = D - 0.1825 in. (4.634 mm).

The procedure is the same as that for the left-hand side.

When a framed number is marked on the crown wheel, e.g. +2, it must be taken into account before assembling the collars to the differential carrier. This mark assists in relating the crown wheel with the pinion.

If, for example, the mark is +2 then the spacer thickness must be increased on the right-hand side by 0.002 in. (0.05 mm.) and decreased on the left-hand side (crown wheel side) by the same amount. If the marking is -2, the spacer thickness must be decreased on the right-hand side and increased on the left-hand side by the same amount.

Units not marked with variations: Some early models are fitted with differentials bearing no markings except the correct backlash for that particular pair of gears. The differential in such a case can be set as follows:

1. Fit the differential to the carrier with a distance collar at each side.
   By trial and error select collars of thicknesses such that the differential with bearings and collars just fits into the carrier without slack and without pinching the bearings.
2. Remove the unit and add 0.002 in. to the thickness of the collar at each side to give the required pre-load.
3. Fit the unit to the carrier and bolt up.
4. Check and adjust the backlash as detailed below.

Adjusting Backlash

1. Assemble the bearings "Thrust" side outwards to the differential cage.
2. Bolt the crown wheel to the differential cage, but do not knock over the locking tabs. Tighten the nuts to a torque wrench reading of 60 lb. ft. (8.3 kg. m.).
3. Mount the assembly on two "V" blocks and check the amount of run out of the crown wheel as it is rotated, by means of a suitably mounted dial indicator.
Section J.8  REAR SPRINGS

Description

The road springs are of the semi-elliptical type. The rear ends pivot in shackles to allow for variation in the effective lengths of the springs as they are flexed on load or rebound. The front ends of the springs are mounted in rigid brackets on the chassis longitudinal members. Driving and braking forces are transmitted from the axles to the chassis by this end of the springs.

Two rubber buffers attached to the axle limit any excessive upward or bump movement of the axle.

The rear spring dampers are of the lever, hydraulic type and are mounted to brackets on the chassis longitudinal members. The levers are attached to brackets on the axle. A filler plug is located in the top plate of each rear damper.

Maintenance

(1) Examine and tighten, if necessary the spring "U" bolts.

(2) Examine the oil level in the rear spring dampers and top up if necessary.

(3) Clean the springs and wipe them with an oily rag.

(4) Examine the springs for fractures and the bushes for wear.

To Remove

(1) Jack up the car on that side from which the spring is to be removed.

(2) Pack up the chassis rear cross member with suitable supports, placing the supports as near to the spring rear anchorage as possible.

(3) Place a screw jack under the centre of the spring to relieve the tension.

(4) Remove the respective wheel.

(5) Using a box spanner release the four self-locking nuts from the "U" bolts which secure the spring to the axle tube.

(6) Detach the nut and spring washer on the inside of the upper rear shackle, and the locknut, spring washer and nut on the inside of the lower rear shackle.

(7) Remove the shackle inside connecting link and extract the top and bottom shackle pins, together with the outside link.

(8) At the forward end of the spring detach the anchor pin by removing the nut and spring washer on the inside of the pin and drive the pin clear.

(9) Remove the supporting jack from under the spring to withdraw the latter from the car.
Rear Axle and Suspension

To Dismantle
(1) Grip the spring in a vice jaws against the top and bottom leaves, adjacent to the centre bolt.
(2) Unscrew the clips.
(3) Unscrew the nut from the centre pin and withdraw the pin.
(4) Open the vice when the spring leaves, together with the zinc interleaving will separate.
(5) Examine the zinc interleaves for signs of failure or cracks.

To Reassemble
(1) Replace the spring in a vice.
(2) Utilising a rod of similar diameter to the clamping bolt and having a tapered end, position the leaves so that the clamping bolt can be readily replaced without risk of damage to the thread.
(3) Replace the clamping bolt and secure by its nut and spring washer.
(4) Refit the leaf clips renewing their pins if necessary.

Section J.9
SHOCK ABSORBERS

General Description
The shock absorbers are of the hydraulic double acting piston type. All the working parts are submerged in oil. They are carefully set before dispatch and cannot be adjusted without special equipment. Any attempt to dismantle them will seriously affect their operation and performance. Should adjustment or repair be necessary they must be returned to their makers.

Maintenance
The maintenance of the hydraulic shock absorbers should include a periodical examination of their anchorages to the body frame and axle brackets. The fixing bolts and nuts must be tightened as necessary.

The cheese-headed screws securing the cover-plates must be kept fully tightened to prevent leakage of the fluid.

When checking the fluid level all road dirt must be carefully cleared away from the vicinity of the filler plugs before the plugs are removed. This is most important as it is absolutely vital that no dirt or foreign matter should enter the operating chamfer.

The correct fluid level is just below the filler plug threads.

The use of Armstrong Super (thin) Shock Absorber Oil is recommended. When this is not available any good quality mineral oil to Specification S.A.E. 20/20 W is acceptable. This alternative is not suitable for low temperature operation.

To Remove
(1) Remove the nut and spring washer that secure the shock absorber lever to the link arm.
(2) Withdraw the two fixing setpins from the shock absorber body and chassis bracket.
(3) Remove the shock absorber, threading the lever over the link arm bolt.

To Replace
The replacement of a rear shock absorber is a reversal of the removal procedure. Ensure that the link is above the arm when refitting the unit to the chassis and axle. When handling shock absorbers that have been removed from the chassis, it is important to keep the assemblies upright otherwise air may enter the working chamber and so cause erratic resistance.

Connecting Link Bushes
The rubber bushes integral with both ends of the connecting link which joins the shock absorber to the rear axle cannot be renewed. When these bushes are worn the arm must be renewed complete.

Section J.10
TIE-ROD ASSEMBLY

A tie-rod that is mounted in rubber bushes between a bracket welded to the axle casing and a bracket welded to the chassis frame prevents lateral motion between the axle and the frame.

To renew the rubber bushes, remove the self-locking nuts, washers and outer bushes from the ends of the tie-rod, free the rear axle as described in Section J.2 paras. (1) to (7) and remove the rod. Then remove the inner rubber bushes.

Replacement of the tie-rod is a reversal of this procedure.