SECTION H

REAR AXLE AND SUSPENSION

Section No. H.1. Lubrication

Section No. H.2. Axle unit

Section No. H.3. Axle shafts

Section No. H.4. Hubs

Section No. H.5. Bevel pinion and differential

Section No. H.6. Crown wheel and pinion

Section No. H.7. Spring removal

Section No. H.8. Shock absorbers

Section No. H.9. Fault diagnosis

Section No. H.10. Modified shock absorbers and mountings

Section H.1

LUBRICATION

For the lubrication of the hypoid axle use lubricants only from approved sources, as tabulated in Section P. Do not, under any circumstances mix various brands of hypoid lubricant. If there is any doubt as to the oil previously used, drain and flush the axle with a little new hypoid oil before finally filling up. Do not use paraffin as a flushing medium. On a new car the oil should be drained and the axle refilled at 500 miles (800 km.) **and subsequently every 6,000 miles (9600 km.), failure to do this will eventually lead to axle break-down.**

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

Section H.2

AXLE UNIT

To Remove and Replace

(1) Raise up the vehicle by placing a jack under the differential housing. Place supports under the rear spring body anchorage.

(2) The down pipe, silencer and exhaust pipe should be withdrawn from the car as described in Section D.

(3) Keeping the jack in position release the check strap by unscrewing the nut and bolt at its body connection.

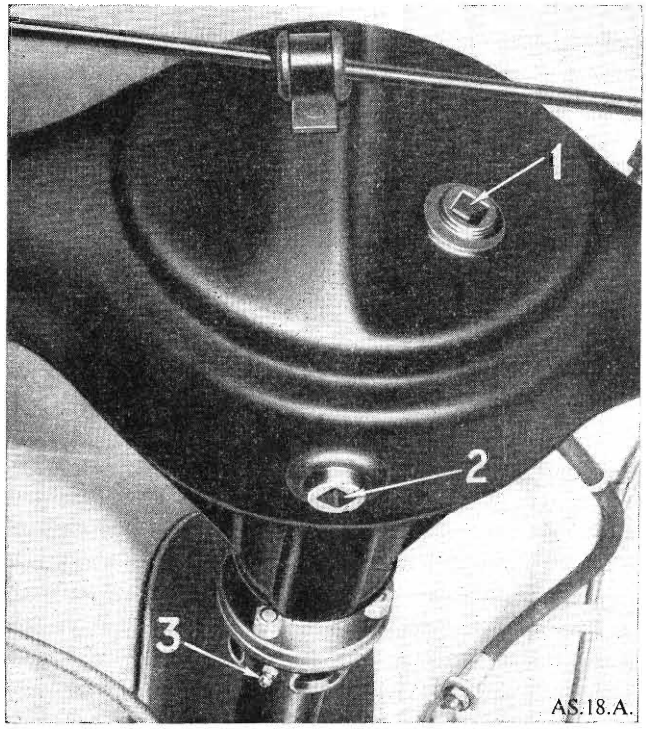


Fig. H.1. Rear axle.
1. *Filler plug.* 2. *Drain plug.* 3. *Propeller shaft universal nipple.*

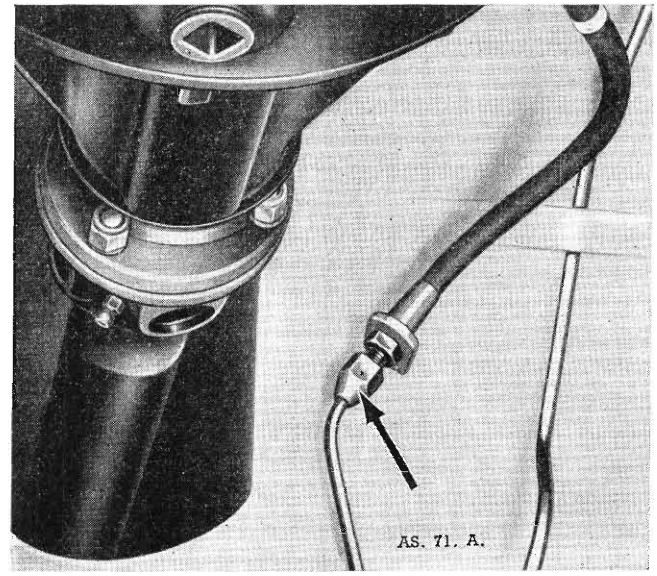


Fig. H.2. Showing the position of the brake hydraulic pipe union which must be disconnected when removing the back axle.

(4) Release the shock absorber arm from its connecting linkage.

(5) Disconnect the suspension upper link from the rear axle bracket by unscrewing the nut and bolt and tapping the bolt from its housing.

(6) Disconnect the handbrake cable at the cable adjustment (Fig. L.5).

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

(8) Disconnect the hydraulic brake pipe at the main union just forward of the differential housing (Fig. H.2).

(9) After ascertaining that the weight of the axle is fully on the jack, unscrew and remove the shackle pins.

(10) Lower the axle and withdraw it from the car.

The replacement of the rear axle is a reversal of the removal procedure with attention to the following:

If, for any reason, it has been necessary to remove the suspension upper link and at the same time the rear axle has been withdrawn from the car, do not tighten the shackle pins until the upper link is mounted in position.

Section H.3

AXLE SHAFTS

To Remove and Replace

(1) Loosen the wheel nuts of the wheel concerned before jacking up the car.

(2) Remove the wheels after further unscrewing the wheel nuts.

(3) Take out the drum locating screw, using a screwdriver.

(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.

(5) Remove the axle shaft retaining screw and draw out the axle shaft by gripping the flange outside the hub. It should slide easily but if it is tight on the studs it may need gently prising with a screwdriver inserted between the flange and the hub. Should the paper washer be damaged it must be renewed when reassembling.

(6) Replacement is a reversal of the above operations.

Section H.4

HUBS

To Remove and Replace

(1) Remove the drum and axle shaft as described above.

(2) Knock back the tab of the locking washer and unscrew the nut with Service Tool 18G 152.

(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 146.

The bearing and oil seal will be withdrawn with the hub. (Fig. H.4).

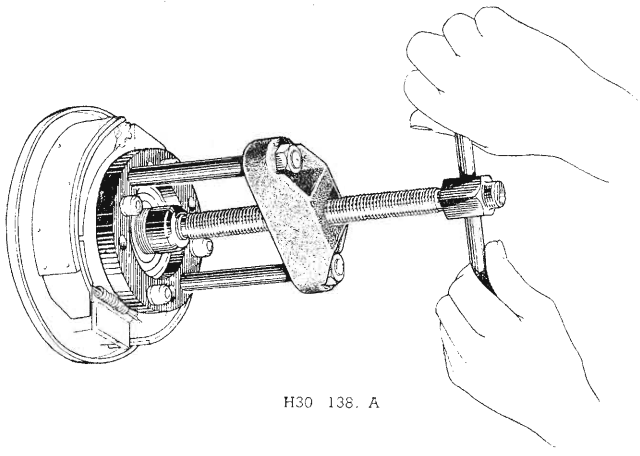


Fig. H.3. Withdrawing the rear hub using tool 18G 146.

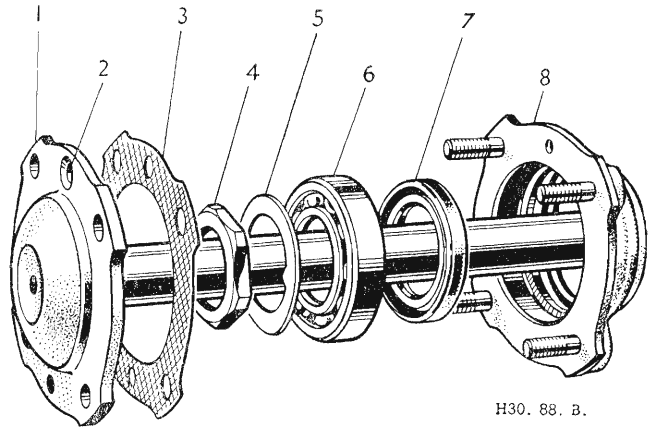


Fig. H.4. Rear hub assembly exploded.

1. *Differential shaft flange.*
2. *Fixing screw countersunk hole.*
3. *Joint washer.*
4. *Hub securing nut.*
5. *Lockwasher.*
6. *Hub bearing.*
7. *Oil seal.*
8. *Hub casing.*

Hub Assembly

The hub bearing is non-adjustable and is replaceable in one operation, by pressing it into place.

It is essential when fitting the differential shaft that the paper joint washer between its flange and the hub is compressed before the abutment shoulder of the shaft pulls up against the bearing races. If, in an emergency, a paper joint washer is hand made, ensure that it is about ·010 in. (·254 mm.) thick. An oil leak will invariably result if this washer is too thin.

If the oil seal has been removed, it must be drifted into position with Tool 18G 134 and adaptor 18G 134Q (lip towards the bearing) before the bearing is inserted.

The hub is then drifted on to the axle casing with Service Tool 18G 134 and adaptor 18G 134Q followed by a new lockwasher, whose peg must register in its location, and nut.

When the nut has been tightened, bend the lockwasher against one of its flats so locking it.

Assemble the axle shaft, brake drum and wheel as previously described (Section H.3).

During reassembly the hubs should be packed with fresh grease although they receive some lubricant from the axle during normal running.

Section H.5

BEVEL PINION AND DIFFERENTIAL

Removing and Refitting Bevel Pinion Oil Seal

(1) Mark the propeller shaft and the pinion driving flanges so that they may be replaced in the same relative position. Disconnect the propeller shaft.

(2) Unscrew the nut in the centre of the driving flange. Remove the nut and washer and withdraw the flange and pressed-on end cover from the pinion shaft.

(3) Extract the oil seal from the casing.
(4) Press a new oil seal into the casing with the edge of the sealing ring facing inwards.
(5) Replace the driving flange end cover, taking care not to damage the edge of the oil seal. Tighten the nut with a torque wrench to a reading of 140 lb. ft. (19·36 kg. m.).
(6) Reconnect the propeller shaft, taking care to fit the two flanges with the locating marks in alignment.

Removing and Replacing the Differential Pinions

(1) Drain the oil from the axle casing, and remove the axle shafts.
(2) Mark the propeller shaft and pinion shaft driving flanges so that they may be replaced in the same relative positions; unscrew the nuts and bolts and separate the joint.
(3) Unscrew the nuts securing the bevel pinion and gear carrier casing to the axle banjo; withdraw the casing complete with the pinion shaft and differential assembly.
(4) Make sure that the differential bearing housing caps are marked so that they can be replaced in their original positions, then remove the four nuts and spring washers. Withdraw the bearing caps and differential assembly.
(5) Tap out the dowel pin locating the differential pinion shaft. The diameter of the pin is $\frac{1}{8}$ in. (3·17 mm.). The pinions and thrust washers can then be removed from the cage.
(6) Examine the pinions and thrust washers and renew as required.
(7) Replace the pinions, thrust washers and pinion shaft in the differential cage and insert the dowel pin. Peen over the entry hole.
(8) Refill the axle with oil to Ref. B (page P.1).

Removing the Differential Bearings and the Crown Wheel

(1) Remove the differential bearings from the differential cage using Service Tool 18G 47C and adaptors 18G 47M. Note that the word 'Thrust' is stamped on the thrust face of each bearing and that shims are fitted between the inner ring of each bearing and the differential cage.
(2) Knock back the tabs of the locking washers, unscrew the nuts from the bolts securing the crown wheel to the differential, and remove the crown wheel.
(3) Examine the crown wheel teeth. **If a new crown wheel is needed, a mated pair—pinion and crown wheel—must be fitted (see Section H.6).**

Removing the Pinion

(1) Remove the differential assembly. Unscrew the nut; remove the spring washer, the driving flange and the pressed end cover.
(2) Drive the pinion shaft towards the rear; it will carry with it the inner race and the rollers of the rear bearing, leaving the outer race and the complete front bearing in position.
(3) The inner race of the front bearing may be removed with the fingers after removal of the oil seal, and the outer races may be withdrawn with Service Tool 18G 264 with adaptors 18G 264D and 18G 264E.
(4) Slide off the pinion sleeve and shims; withdraw the rear bearing inner race from the pinion shaft, using Service Tool 18G 285, noting the spacing washer against the pinion head.

NOTE.—If it proves necessary to fit a new crown wheel and pinion or new bearings, the axle assembly must be set up as detailed in Section H.6.

Section H.6

CROWN WHEEL AND PINION

Replacing Crown Wheel and Pinion

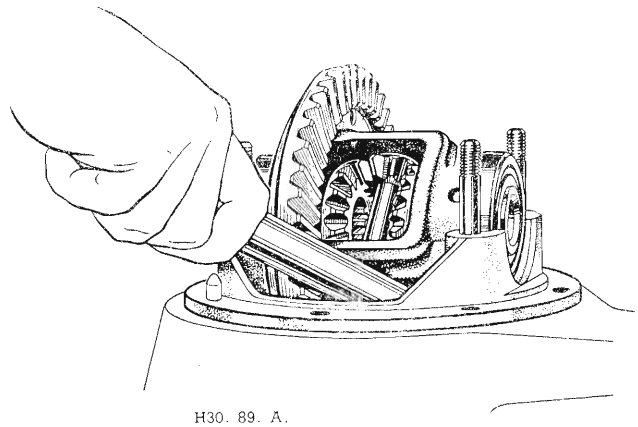
Fitting a new crown wheel and pinion involves four distinct operations:

(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, four special tools are required; the bevel pinion and differential setting gauge, Service Tool 18G 191B, the pinion bearing outer race remover and replacer, Service Tool 18G 264 with adaptors 18G 264D and 18G 264E, the pinnion inner race remover and replacer, 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.
(2) Smooth off the pinion head with an oil stone, but do not erase the markings that are etched on the pinion head.
(3) Fit a washer of known thickness to the pinion



H30. 89. A.

Fig. H.5. Showing the method of levering out the differential unit.



Fig. H.6. Rear axle exploded.

Caption to Fig. H.6.

1. *Axle breather.*
2. *Gear carrier stud.*
3. *Axle case.*
4. *Differential bearing cap nut and washer.*
5. *Differential bearing cap.*
6. *Drain plug.*
7. *Gear carrier joint washer.*
8. *Spring washer.*
9. *Gear carrier.*
10. *Gear carrier and washer.*
11. *Differential bearing packing shims.*
12. *Differential wheel.*
13. *Differential pinion shaft.*
14. *Differential shaft peg.*
15. *Differential pinion.*
16. *Pinion thrust washer.*
17. *Wheel stud.*
18. *Backplate bolt, nut and washer.*
19. *Hub casing.*
20. *Hub oil seal.*
21. *Hub bearing.*
22. *Hub lockwasher.*
23. *Hub securing nut.*
24. *Differential shaft screw.*
25. *Differential shaft.*
26. *Joint washer.*
27. *Differential bearing.*
28. *Crown wheel setscrew.*
29. *Lockwasher.*
30. *Differential cage.*
31. *Crown wheel.*
32. *Bevel pinion.*
33. *Bevel pinion rear bearing.*
34. *Pinion bearing distance piece.*
35. *Bevel pinion shims.*
36. *Bevel pinion front bearing.*
37. *Oil seal.*
38. *Oil seal housing.*
39. *Bevel pinion flange.*
40. *Bevel pinion spring washer.*
41. *Bevel pinion nut.*

head. 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 bearing to the pinion shaft using Service Tool 18G 285 and position the pinion in the gear carrier without the shims, distance tube 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 8 to 10 lb. in. (·092 to ·115 kg. m.) is obtained.

(6) Adjust the dial indicator to zero on the machined step 'A' 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 and 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.

(8) 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 minus** add the clock reading to the pinion head marking, the resulting sum being minus. **Reduce** the washer thickness by this amount.

Example:	Clock reading	—·002 in.
	Pinion marking	—·005 in.
	Variation from nominal ..	—·007 in.

Reduce 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.

(*c*) **If the clock reading is plus and numerically greater** than the pinion head marking, **increase** the washer thickness by the difference.

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

Increase the washer thickness by this amount.



Fig. H.7. Checking differential bearing width with Service Tool 18G 191B

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. Proceed 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.

Adjusting Pinion Bearing Pre-load

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

(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 13 lb. in. (·15 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 shimming must be decreased.

Adjusting the Differential Bearing Pre-load

The differential bearings must be pre-loaded and this is done by 'pinching' them to the extent of ·002 in. on each bearing, the 'pinch' being obtained by varying the thickness of the shims fitted between each bearing inner ring and the differential cage. The shim thickness is calculated as shown below.

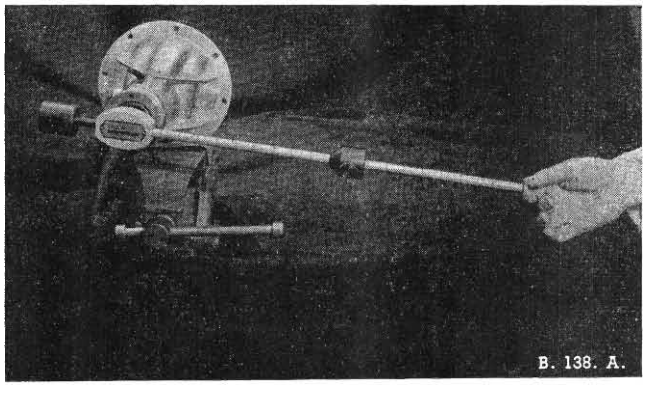


Fig. H.8. Checking the bevel pinion bearing pre-load (Service Tool 18G 207).

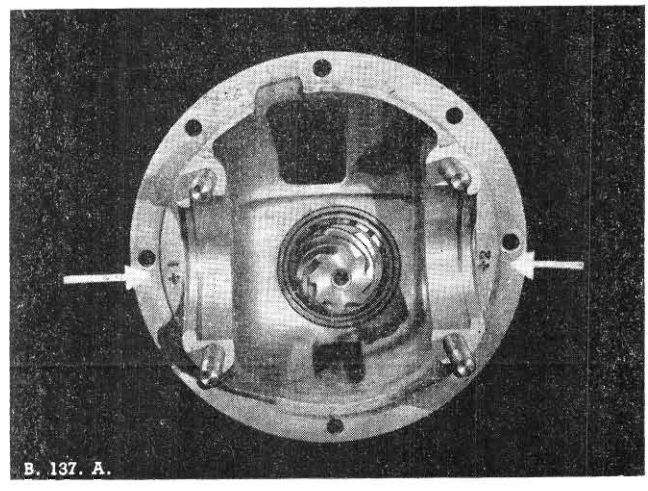


Fig. H.9. Illustrating the machining variations for the differential bearing housings as marked by the factory inspector.

In making the necessary calculations, machining tolerances 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. H.11, 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 shim thickness:

Left-hand side:

Formula: A+D—C+·002 in. (·05 mm.)

Substitute the dimensional variations for the letters in the formula. The result is the thickness of the shims 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 shim thickness. If

the bearing width is under standard, that amount must be added to the shim thickness, and *vice versa.*

To Check Bearing Width

(1) Rest the bearing on the small surface plate of Tool 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 'A' 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 shims at this side; a **positive** reading, the thickness to be **subtracted.**

Right-hand side:

Formula: B—D+·006 in. (·15 mm.)

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

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

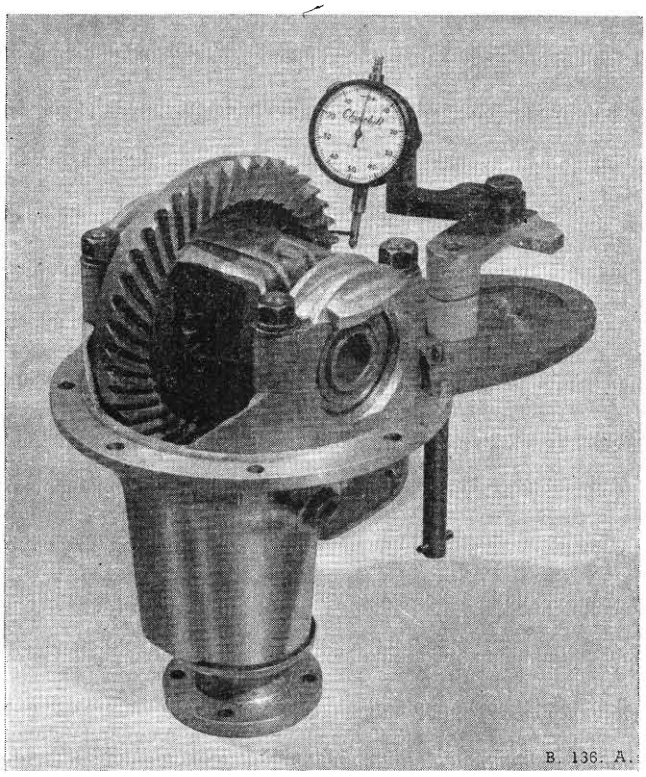


*Fig. H.*10. *Checking crown wheel to pinion backlash (Service Tool* 18*G* 191*B*).

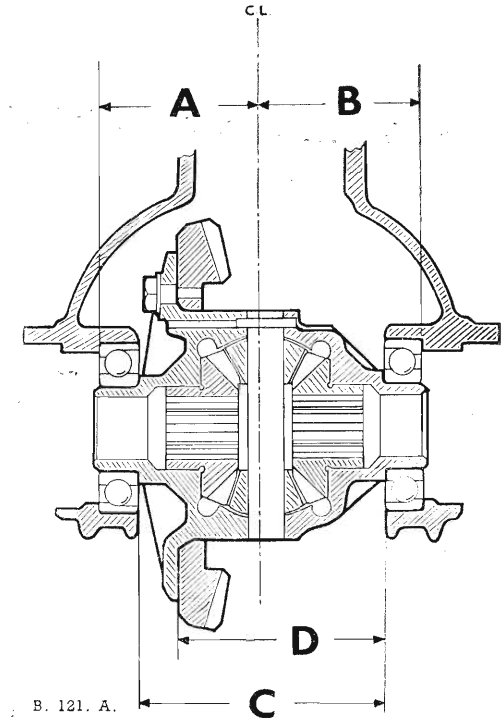


*Fig. H.*11. *Illustrates the points from which the calculations must be made to determine the shim thickness for the bearings on each side of the carrier.*

If, for example, the mark is +2, then shims to the value of ·002 in. (·05 mm.) must be transferred from the left-hand side (the crown wheel side) to the right-hand side. If the marking is —2, then shims to the value of ·002 in. (·05 mm.) must be moved from the right-hand side to the left-hand side.

Adjusting Backlash

(1) Assemble the bearings (thrust faces outwards) and shims of calculated thickness to the differential cage.

(2) Bolt the crown wheel to the differential cage, but do not knock over the locating 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.

(4) The maximum permissible run out is ·002 in. (·05 mm.) and any greater irregularity must be corrected. Detach the crown wheel and examine the joint faces on the flange of the differential case and crown wheel for any particles of dirt.

(5) When the parts are thoroughly cleaned the crown wheel should run true.

(6) Tighten the bolts to the correct torque wrench reading and knock over the locking tabs.

(7) Refit the differential to the gear carrier. Tighten the bearing cap nuts to a torque wrench reading of 65 lb. ft. (8·99 kg. m.).

(8) Mount the dial indicator on the magnet bracket so that an accurate measurement of the backlash can be taken. The recommended backlash is etched on the crown wheel.

(9) Vary the backlash by decreasing the thickness of the shims at one side and increasing the thickness of the shims at the other side by the same amount, thus moving the crown wheel into or out of mesh as required. The total thickness of the shims must not be changed.

(10) The minimum backlash allowed in any circumstances is ·004 in. (·102 mm.) and the maximum is ·007 in. (·178 mm.).

(11) A movement of ·002 in. (·05 mm.) shim thickness from one side of the differential to the other will produce a variation in backlash of approximately ·002 in. (·05 mm.). Thus it should be possible to set up the differential, even though the backlash is incorrect, by removing the bearings on one occasion only.

Section H.7

SPRING REMOVAL

To remove a rear spring proceed as detailed under 'Axle Unit' Section H.2 items 1 to 10.

The spring can now be removed simply by extracting the two set bolts which pass upwards at the forward end of the spring into caged nuts on the upper leaf. The 'U' bolt must also be removed when the spring can be pulled out of its mounting.

Section H.8

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.

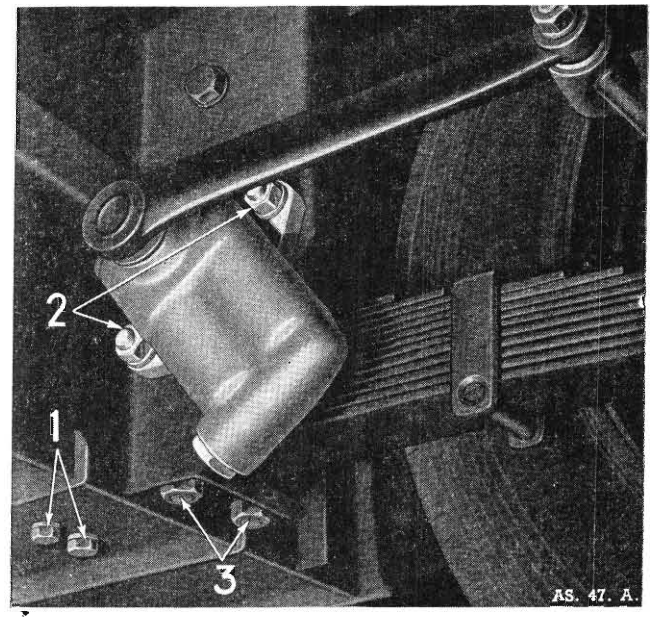


Fig. H.12. Rear spring mounting.
1. *Spring securing set bolts.* 2. *Shock absorber nuts.*
3. *'U' bolt nuts.*

When checking the fluid level every 6,000 miles (9600 km.) 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 chamber.

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 and is deficient in various other ways.

Removing Shock Absorbers

Remove the nut and spring washer that secures the shock absorber lever to the link arm between lever and axle. Withdraw the two fixing bolts from the shock absorber body and body frame, then remove the shock absorber, threading the lever over the link arm bolt.

Refitting Shock Absorbers

Shock absorbers may be replaced by simply reversing the removal procedure. However, when handling shock absorbers that have been removed from their mountings, it is important to keep the assemblies upright as far as possible, otherwise air may enter the working chamber and cause erratic resistance.

Shock Absorber Arm Rubber Bushes

The rubber bushes integral with both ends of the shock absorber to axle connecting links cannot be renewed. When these bushes are worn renew the arm.

Section H.9 FAULT DIAGNOSIS

Symptom	No.	Possible Fault
(a) Noisy Axle (i) On drive	1	Insufficient crown wheel/pinion backlash
(ii) On coast	2	Excessive crown wheel/pinion backlash
(iii) On drive and coast	3	Insufficient lubricant
	4	Chipped, broken or scored teeth
	5	Damaged or worn bearings
(b) Broken Crown Wheel and Pinion Teeth	1	Excessive loads
	2	Clutch snatch
	3	Incorrect backlash adjustment
	4	Incorrect differential bearing adjustment (preload)
(c) Broken or Scored Differential Gear Teeth		In (a), check 3
		In (b), check 2
	1	Misaligned or bent differential shafts
	2	Badly worn differential wheel and pinion thrust washers
(d) Differential Shaft Breakage		In (b), check 1 and 2
(e) Overheating		In (a), check 1 and 3
	1	Bearings adjusted too tightly
(f) Oil Leaks	1	Damaged gear carrier flange
	2	Damaged or broken joint washers
	3	Worn or damaged oil seals

Section H.10

MODIFIED SHOCK ABSORBERS AND MOUNTINGS

From Car No. AN5/4333 intermittent to 4507 (a mark of red paint on the shock absorber mounting brackets identifies the first 200 modified cars) and 4508 onwards modified shock absorbers (Part Nos. AHA5311-2) and body mounting brackets (Part Nos. AHA5305-6) are fitted. The mounting brackets, which previously supported only the forward ends of the upper suspension arms, now also accommodate the shock absorber fixing bolts. The shock absorbers are positioned at a different angle from the horizontal, having shorter arms and longer links. This has involved changes to the shock absorber link attachment brackets welded on to the axle casing. The Part Number of the axle casing is now ATA7419.

These modified components are **not** interchangeable with those previously used.

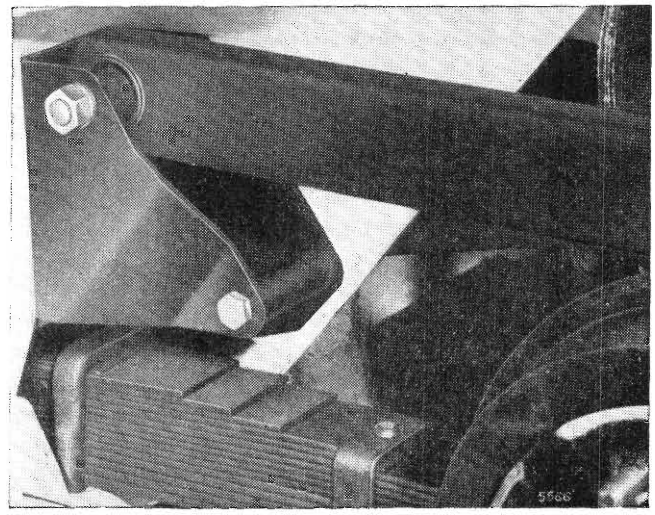


Fig. H.13. Modified suspension body mounting bracket.