SECTION HH

THE REAR AXLE

(SECOND TYPE)

General Description.

Lubrication.

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Section No. HH.2 The hubs.

Section No. HH.3 The bevel pinion oil seal.

Section No. HH.4 The differential.

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GENERAL DESCRIPTION

The second type rear axle fitted from Car No. RMH.2982 is of the three-quarter-floating type, incorporating hypoid final reduction gears. The axle shafts, pinion and differential assemblies can be withdrawn without removing the axle from the vehicle.

The rear axle wheel bearing outer races are located in the hubs; the inner races are mounted on the axle tube and secured by nuts and lock washers. Wheel studs in the hubs pass through the brake-drums and axle shaft driving flanges. The brake-drums are located on the hub flanges by two countersunk screws in each.

The differential and pinion shaft bearings are pre-loaded, the amount of pre-load being adjustable by shims. The position of the pinion in relation to the crown wheel is determined by a spacing washer. The backlash between the gears is adjustable by shims.

Suspension is by coil springs, radius arms, anti-sway bar and telescopic shock absorbers.

LUBRICATION

The axle is filled or topped up through the combined filler and level plug in the rear of the axle casing.

It is of the utmost importance that only hypoid oils of the approved grades and manufacture be used if satisfactory service is to be obtained from the hypoid gears.

Inspect the oil level every 1,000 miles (1600 km.) and top up as necessary to the level of the filler opening with oil to Ref. B.

After the first 500 miles (800 km.) and subsequently every 6,000 miles (10000 km.) drain off the old oil and refill with new.

The hub bearings are lubricated from the axle and no provision is made for any other attention.

Section HH.1

BRAKE-DRUMS AND AXLE SHAFTS

To remove

Jack up the axle.

Remove the wheel.

Release the hand brake.

Unscrew and remove the two countersunk Phillips screws locating the drum and tap it from the hub. It may be necessary to slacken off the brake adjustment slightly if the shoes hold the drum.

Unscrew the countersunk Phillips locating screw in the axle shaft driving flange.

Withdraw the axle shaft by gripping the flange or carefully prising it with a screwdriver. If the latter method is used the paper washer may be damaged and must be renewed when reassembling.

To replace

Reverse the above sequence of operations. Make sure that the bearing spacer is in position.

Section HH.2

THE HUBS

To remove

Remove the drum and axle shaft as detailed in Section HH.1.

Remove the bearing spacer.

Knock back the tab of the locking washer and unscrew the nut with a suitable spanner.

Note that the left-hand bearing hub nut has a left-hand thread.

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

The hub can then be withdrawn with a suitable puller such as Special Tool No. AJA.5019 with AJA.5021 and AJE.5004. The bearing and oil seal will be withdrawn with the hub.

To refit

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

When reassembling it is essential that the outer face of the bearing spacer should protrude from ·001 in. (·025 mm.) to ·004 in. (·091 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 HH.3

THE BEVEL PINION OIL SEAL

To renew

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

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.

Extract the oil seal from the casing.

Press a new oil seal into the casing with the edge of the sealing ring facing inwards.

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 1,680 lb. in. (19·36 kg. m.).

Reconnect the propeller shaft, taking care to fit the two flanges with the locating marks in alignment.

Section HH.4

THE DIFFERENTIAL

To remove

Drain the oil from the axle casing.

Remove the axle shafts as detailed in Section HH.1

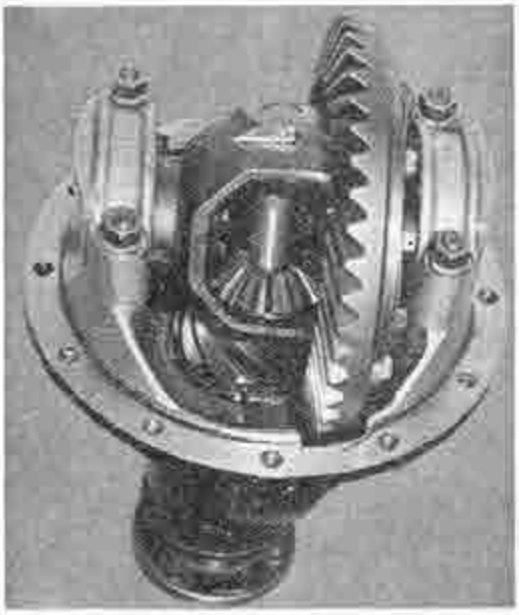


Fig. HH.1.
The differential and carrier assembly.

Mark the propeller shaft and pinion shaft driving flanges so that they may be replaced in the same relative positions; unscrew the self-locking nuts and disconnect the joint.

Unscrew the ten nuts securing the bevel pinion and gear carrier casing to the axle banjo; withdraw the casing complete with the pinion shaft and differential assembly.

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.

Remove the differential bearings from the differential case. Note that the word " Thrust " is stamped on the thrust face of each bearing.

Knock back the tabs of the locking washers, unscrew the bolts securing the crown wheel to the differential, and remove the crown wheel.

Tap out the dowel pin locating the differential pinion shaft. The diameter of the pin is $\frac{3}{16}$ in. (4·8 mm.) and it must be tapped out from the crown wheel side as the hole into which it fits has a slightly smaller diameter at the crown wheel end to prevent the pin from passing right through. The metal around the entry hole is peened over after the pin has been inserted. The pinions and thrust washers can then be removed from the case.

Examination and assembly

Examine the pinions and thrust washers and renew as required.

Examine the crown wheel teeth. If a new crown wheel is needed, a mated pair—pinion and crown wheel—must be fitted. (See Section HH.6 for adjustment procedure.)

Replace the pinions, thrust washers and pinion shaft in the differential casing and insert the dowel pin. Peen over the entry hole.

Bolt the crown wheel to the differential cage, but do not knock over the locating tabs. Tighten the bolts to a torque wrench reading of 720 lb. in. (8·3 kg. m.).

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.

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 cage and crown wheel for any particles of dirt.

When the parts are thoroughly cleaned it is unlikely that the crown wheel will not run true.

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

Fit the differential bearings with the thrust faces outwards.

Section HH.5

THE PINION SHAFT

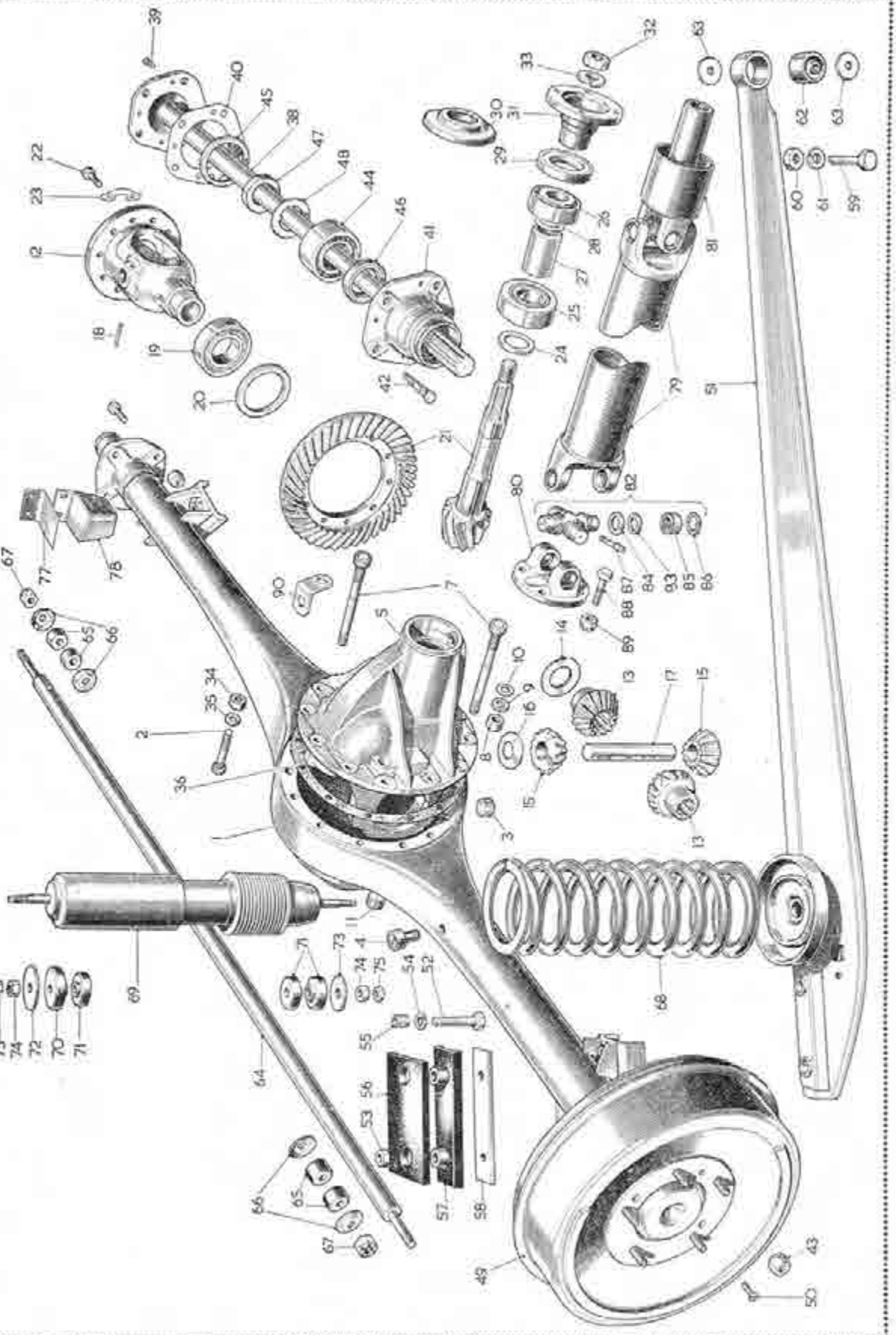
Remove the differential assembly as detailed in Section HH.4.

Unscrew the nut, remove the spring washer, the driving flange and the pressed end cover.

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.

The inner race of the front bearing may be removed with the fingers after removal of the oil seal, and the outer race may be withdrawn with special tool No. 301587.

THE REAR AXLE (Second Type) AND SUSPENSION COMPONENTS



KEY TO THE REAR AXLE AND SUSPENSION COMPONENTS

No.	Description
1.	Case assembly.
2.	Bolt—differential carrier to case.
3.	Plug—oil drain.
4.	Breather—rear axle.
5.	Carrier assembly—gear.
7.	Bolt—bearing cap.
8.	Nut—cap stud and bolt.
9.	Washer—spring—cap stud and bolt.
10.	Washer—plain—cap stud and bolt.
11.	Plug—oil filler.
12.	Cage—differential.
13.	Gear—differential.
14.	Washer—gear.
15.	Pinion—differential.
16.	Washer—pinion.
17.	Pin—pinion.
18.	Pin—locking—pinion pin.
19.	Bearing—differential.
20.	Collar—bearing distance.
21.	Wheel and pinion—crown.
22.	Bolt—crown wheel to cage.
23.	Washer—bolt locking.
24.	Washer—pinion head.
25.	Bearing—inner—pinion.
26.	Bearing—outer—pinion.
27.	Spacer—pinion bearing.
28.	Shim—pinion bearing.
29.	Seal—oil—pinion.
30.	Cover—dust.
31.	Flange—universal joint.
32.	Nut—flange to pinion.
33.	Washer—spring—flange nut.
34.	Nut—differential carrier to case.
35.	Washer—spring—carrier nut.
36.	Joint—carrier to case.
38.	Shaft—axle.
39.	Screw—shaft to hub.
40.	Joint—shaft to hub.
41.	Hub assembly.
42.	Stud—road wheel.
43.	Nut—wheel stud.
44.	Bearing—hub.
45.	Distance-piece—bearing.
46.	Seal—oil.
47.	Nut—bearing.
48.	Lock washer—bearing nut.
49.	Drum—brake.
50.	Screw—drum to hub.
51.	Arm—R/H—rear axle radius.
52.	Bolt—short—arm to axle.
53.	Nut—arm bolt.
54.	Washer—spring—arm bolt.
55.	Distance-piece—arm to axle.
56.	Rubber—upper—arm to axle.
57.	Rubber—lower—arm to axle.
58.	Plate—clamp—arm to axle.
59.	Bolt—arm to frame.
60.	Nut—arm bolt.
61.	Washer—spring—arm bolt.
62.	Bush—arm to frame.
63.	Washer—fibre—arm bush.
64.	Rod assembly—anti-sway.
65.	Bush—rod to axle and frame.
66.	Washer—cup—rod.
67.	Nut—rod.
68.	Spring—rear.
69.	Absorber assembly—rear.
70.	Bush—large—absorber.
71.	Bush—small—absorber.
72.	Washer—upper—absorber.
73.	Washer—lower—absorber.
74.	Nut—absorber to radius arm and frame
75.	Locknut—absorber nut.
77.	Packing—bump rubber.
78.	Rubber—bump.
79.	Shaft—tubular.
80.	Yoke—flange.
81.	Yoke—sleeve.
82.	Journal assembly.
83.	Gasket.
84.	Retainer—gasket.
85.	Bearing assembly—needle.
86.	Circlip—bearing.
87.	Lubricator—journal.
88.	Bolt—shaft to rear axle.
89.	Nut—shaft bolt.
90.	Bracket—rear hose.

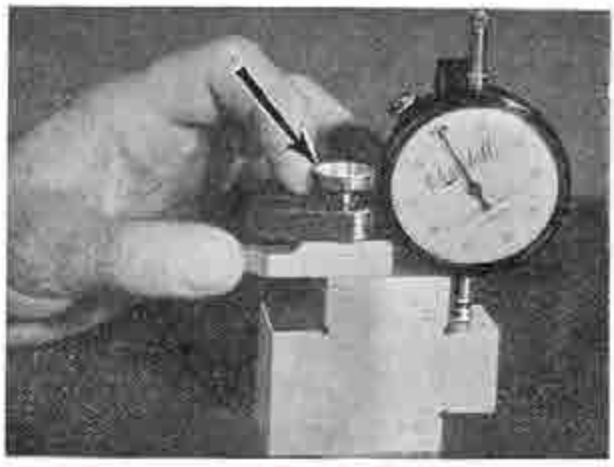


Fig. HH.2.
Setting the gauge to zero on the special block for determination of the pinion position. The arrow indicates the knurled nut.

Slide off the pinion sleeve and shims; withdraw the rear bearing inner race from the pinion shaft with the special tool, noting the spacing washer against the pinion head.

Assembly and adjustment procedures are detailed in Section HH.6.

Fig. HH.3.
The tool in position on the pinion, with the gauge indicating a variation from the standard setting.

Section HH.6

REPLACING THE 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 (pinch).
4. Adjusting the backlash between the gears.

To carry out these operations correctly, three special tools are required: the bevel pinion setting gauge, Part No. AJA.4004, the pinion bearing outer race remover and replacer, Part No. 301224, and the pre-load checking tool, Part No. 68839, with adaptor, Part No. AJH.5138.

1. SETTING THE PINION POSITION

(*a*) Fit the bearing outer rings to the gear carrier.

(*b*) Smooth off the pinion head with an oil stone, but do not erase the variation in pinion head thickness that may be etched on the pinion head.

(*c*) 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: say, ·214 in. or ·216 in.

(*d*) Fit the inner ring of the rear bearing to the pinion shaft and position the pinion in the gear carrier without the shims, distance tube and oil seal. Fit the inner ring of the front bearing.

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

(*f*) Adjust the dial indicator to zero on the machined step " C " of the setting block.

(*g*) Remove the keep disc from the base of the magnet; clean the pinion head and place the magnet and dial indicator in position (Fig. HH.3). 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.

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(*h*) *With a standard pinion head (no variation marked)*

If the mean reading is within +·001 in. (·025 mm.) of the zero setting, the washer thickness is correct.

A positive mean reading indicates that the washer is not thick enough, and a negative mean reading indicates that it is too thick.

Example

Thickness of washer fitted ...	·214 in.
Mean reading	+·003 in.
Mounting distance	+·005 in.
Thickness of washer required ...	**·212 in.**

(*i*) *With a non-standard pinion head (variation marked)*

In addition to the procedure detailed above, allowance must also be made for the variation in thickness of the pinion head: a positive (+) dimension must be subtracted from the thickness obtained above, and a negative (—) dimension added.

Using the same example and assuming a pinion head of non-standard thickness:—

Example

Thickness of washer fitted ...	·214 in.
Mean reading	+·003 in.
Total	**·217 in.**
Marked variation in pinion head	+·002 in.
Mounting distance	+·005 in.
Thickness of washer required ...	**·210 in.**

Fig. HH.4.

To measure variations in bearing thickness, first zero the gauge to the appropriate portion of the gauge block. Here the dial is set for the " A " type axle.

Fig. HH.5.

With the gauge set to zero, place the bearing on the surface plate with the outer thrust ring face down, and take a reading while the indicator foot contacts the inner ring.

Note.—*The mounting distance is the number enclosed in a box and etched on the pinion head. The figure must be subtracted from the washer thickness if it is a plus figure and added if a minus figure.*

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

2. ADJUSTING PINION BEARING PRE-LOAD

Assemble the pinion shaft bearings, distance tube, and shims to the gear carrier; fit the oil seal and driving flange. Tighten the flange nut gradually to a torque wrench reading of 1,680 lb. in. (19·4 kg. m.), checking the pre-load at intervals to ensure that it does not exceed 18 lb. in. (·207 kg. m.), i.e. 3 lb. in. (·035 kg. m.), greater than the previous figure as the oil seal is now fitted.

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

3. ADJUSTING THE DIFFERENTIAL BEARING PRE-LOAD

Units marked with tolerances

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 bearing distance collar

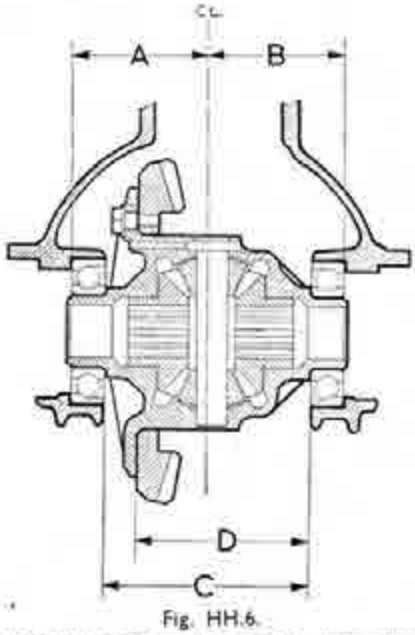

Fig. HH.6.
The dimensions referred to in the instructions for differential setting.

fitted between each bearing outer ring and the register in the axle housing. The collar thickness is calculated as shown below.

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

The dimensions involved in pre-loading the differential bearings are illustrated in Fig. HH.6, and it is emphasised that it is the tolerance on each dimension which is important and referred to in the formula used.

The dimensions are:—

(A) From the centre line of the differential to the bearing register on the left-hand side of the gear carrier.
Tolerance: stamped on the carrier.

(B) From the centre line of the differential to the bearing register on the right-hand side of the carrier.
Tolerance: stamped on the carrier.

(C) From the bearing register on one side of the differential cage to the register on the opposite side.
Tolerance: stamped on the cage.

(D) From the rear face of the crown wheel to the bearing register on the opposite side.
Tolerance: stamped on the cage.

To calculate the collar thickness:—

Left-hand side

Formula: A+D−C+·1815 in. (4·610 mm.).

Substitute the dimensional tolerances for the letters in the formula. The result is the thickness of the collar required at the left-hand side to compensate for machining tolerances 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.

To check bearing width, rest the bearing on the small surface plate of tool No. AJA.4004 with the inner race over the recess and the thrust face downwards.

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+·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 back of the crown wheel, e.g. +2, it must be taken into account before assembling the collar and bearings to the differential cage. This mark assists in relating the crown wheel with the pinion.

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.

Units not marked with tolerances

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:—

(*a*) 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.

(*b*) Remove the unit and add ·002 in. to the thickness of the collar at each side to give the required pre-load.

(*c*) Fit the unit to the carrier and bolt up.

(*d*) Check and adjust the backlash as detailed in 4 below.

4. ADJUSTING BACKLASH

Assemble the bearing and collars as calculated to the differential cage and fit the differential to the gear carrier. Replace the bearing caps and tighten the nuts. Bolt the special tool surface plate to the gear carrier flange and mount the clock gauge on the magnet bracket in such a way that an accurate backlash

TABLE OF WASHER AND SHIM THICKNESS

Pinion head washer thicknesses	·208 in. to ·222 in. in steps of ·002 in.
Pinion bearing pre-load shims	·004 in. to ·012 in. in steps of ·002 in., plus ·020 in. and ·030 in.
Crown wheel bearing collars	·175 in. to ·193 in. in steps of ·002 in.
Pinion bearing pre-load ...	13 to 15 lb. in. without oil seal; 16 to 18 lb. in. with oil seal.
Crown wheel bearing pinch	·002 in. each side.

figure may be obtained. (See Fig. HH.7.) The minimum backlash allowed in any circumstances is ·005 in. (·127 mm.) and the maximum is ·007 in. (·178 mm.).

Note.—To ensure adequate clearance when fitting a crown wheel and pinion to earlier axles it may be found necessary to use a pair of gears on which the crown wheel is unmarked.

Section HH.7

REPLACING THE PINION BEARINGS

Remove the bearings as detailed in Section HH.5.

Refit the pinion with its bearings and shims as detailed in Section HH.6, 1 and 2. It is necessary to check and reset the pinion position and bearing pre-load owing to the variation in width of the pinion bearings.

Section HH.8

REPLACING THE DIFFERENTIAL BEARINGS

Remove the differential assembly as detailed in Section HH.4.

Replace the bearings.

Check the bearing pinch and backlash between the gears and reset as detailed in Section HH.6, 3 and 4.

Section HH.9

REMOVING THE AXLE

Using jacks under the axle, raise the car and support it with blocks under the chassis side-members. Mark the two halves of the universal joint and disconnect : **do not remove the jacks until this has been done.**

Remove the road wheels and position a trolley jack under the centre of the axle.

Withdraw the clevis pins from the hand brake cables at the back-plates.

Fig. HH.7.
Measuring backlash between crown wheel and pinion

Disconnect the flexible brake hose at the bracket on the body.

Unscrew the two bolts at each end securing the axle to the radius arms.

Extract the split pin and remove the nut from the right-hand end of the anti-sway bar. Pull the axle to the right to free the anti-sway bar from the bracket.

Wheel the axle away on the trolley jack.

To replace, reverse the above sequence of operations.

Bleed the brakes.

Section HH.10

REAR HUB OIL SEAL

On the rear axles fitted to later cars a modified rear hub is introduced with an additional oil seal. The hub assembly has a groove machined in the face into which a rubber sealing ring is fitted, as shown in Fig. HH.8.

The oil seal may only be fitted to earlier axles together with the modified hub.

This change commences at Car No. 5433.

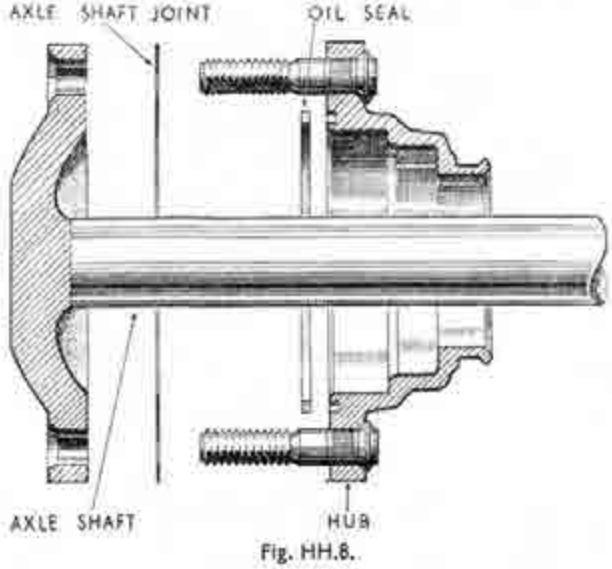

Fig. HH.8.

The position of the hub oil seal is clearly shown in this illustration.

Section HH.11

REMOVING THE AXLE (LATER MODELS)

Jack up the vehicle and support it with stands below the frame side-member. Position a trolley jack under the centre of the axle.

Remove the road wheels.

Withdraw the clevis pins from the hand brake cables at the back-plates.

Mark the propeller shaft coupling flanges, and disconnect the shaft from the driving flange. Support the rear end of the propeller shaft.

Disconnect the flexible brake hose at the bracket on the body.

Remove the nuts from the 'U' bolts and the rear shackle pins, remove the shackle pins and lower the rear ends of the springs to the ground.

Withdraw the axle from the car.

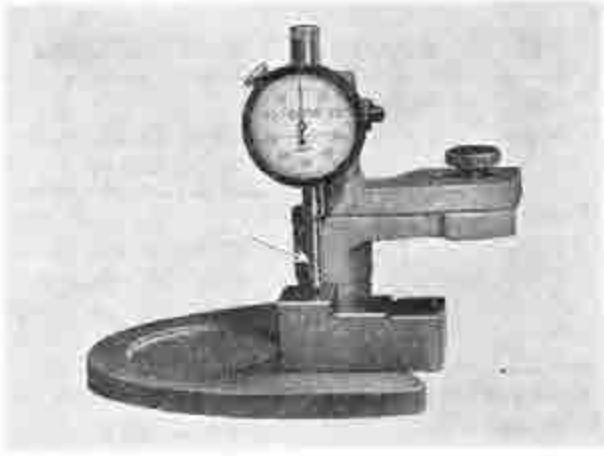

Fig. HH.9.

Setting the later type dial gauge to zero on the stepped gauge block for determination of the pinion position. The arrow indicates the extension to the contact post.

Section HH.12

BEVEL PINION AND DIFFERENTIAL BEARING SETTING GAUGE

In a recent modification to the bevel pinion and differential bearing setting gauge, Part No. 18G191B, a stepped gauge block and a small dial gauge, with a ½-in. (12·7 mm.) extension to the contact foot replaces the original cut-out block and large dial gauge.

When in use this new block should be placed on the surface plate, together with the dial gauge and magnet assembly (with the keep disc removed), and the gauge set to zero on the appropriate step for the standardised 'C' type axle.