

## **SECTION H**

### **THE REAR AXLE**

General description.

Lubrication.

- |                 |                                                        |
|-----------------|--------------------------------------------------------|
| Section No. H.1 | Removing and replacing a hub extension and axle shaft. |
| Section No. H.2 | Removing and replacing a hub.                          |
| Section No. H.3 | Renewing the bevel pinion oil seal.                    |
| Section No. H.4 | Removing the differential pinions.                     |
| Section No. H.5 | Replacing the differential pinions.                    |
| Section No. H.6 | Dismantling the crown wheel and pinion.                |
| Section No. H.7 | Assembling and setting the crown wheel and pinion.     |
| Section No. H.8 | Removing and refitting the axle.                       |
| End of Section  | Service tools.                                         |

## THE REAR AXLE COMPONENTS

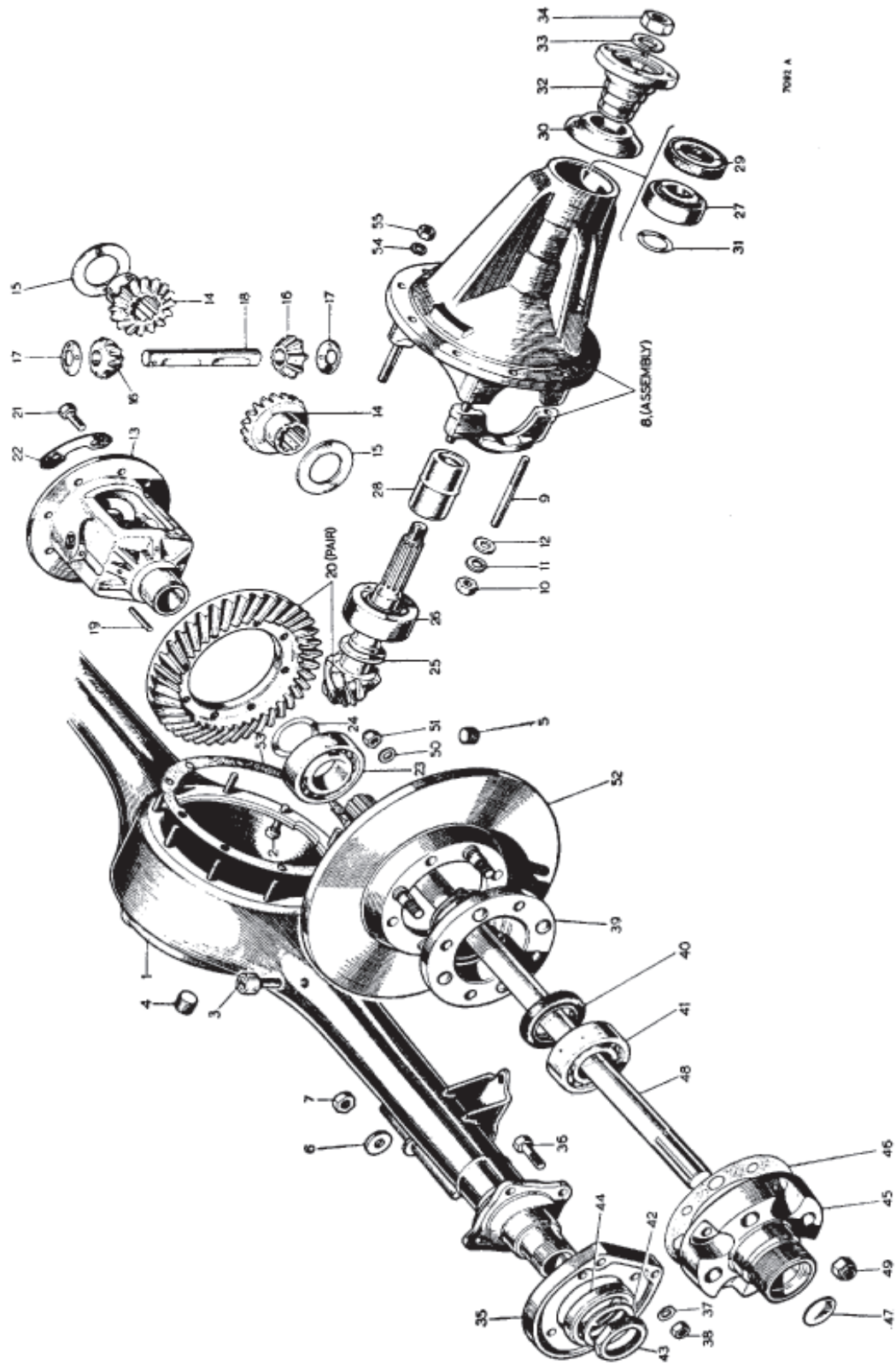
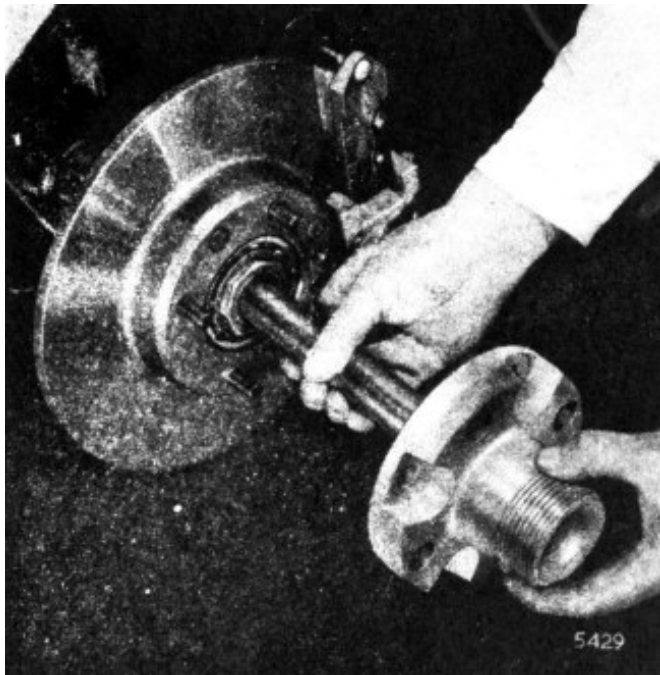


FIGURE A

### KEY TO THE REAR AXLE COMPONENTS

<i>No.</i>	<i>Description</i>	<i>No.</i>	<i>Description</i>	<i>No.</i>	<i>Description</i>
1.	Axle centre case.	20.	Crown wheel and pinion.	38.	Nut.
2.	Serrated bolt.	21.	Bolt.	39.	Wheel bearing housing.
3.	Breather.	22.	Lock washer.	40.	Oil seal.
4.	Filler plug.	23.	Differential bearing.	41.	Rear wheel bearing.
5.	Drain plug.	24.	Packing washer.	42.	Tab washer.
6.	Plain washer.	25.	Pinion head washer.	43.	Locknut.
7.	Nut.	26.	Pinion bearing.	44.	Dust cover.
8.	Gear carrier.	27.	Pinion bearing (outer).	45.	Hub extension.
9.	Stud.	28.	Pinion bearing spacer.	46.	Joint washer.
10.	Nut.	29.	Oil seal.	47.	Welch plug.
11.	Spring washer.	30.	Dust cover.	48.	Axle shaft.
12.	Washer.	31.	Pinion bearing shim.	49.	Pinnacle nut.
13.	Differential case.	32.	Flange.	50.	Plain washer.
14.	Differential wheel.	33.	Spring washer.	51.	Pinnacle nut.
15.	Thrust washer.	34.	Nut.	52.	Rear brake disc.
16.	Differential pinion.	35.	Adaptor plate.	53.	Differential joint.
17.	Thrust washer.	36.	Bolt.	54.	Spring washer.
18.	Pinion centre.	37.	Spring washer.	55.	Nut.
19.	Peg.				



*Fig. H.1*

*Unscrew and remove the four self-locking nuts to withdraw the hub extension*

#### GENERAL DESCRIPTION

The rear axle 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.

The differential and pinion shaft bearings are preloaded, the amount of preload 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 semi-elliptic leaf springs, rubber-mounted, and the shackles are fitted with rubber bushes of the flexing type.

#### LUBRICATION

The axle is filled or topped up with oil through the filler plug in the rear cover by means of an oil gun with a special adaptor.

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.

H.4

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 capacity of the axle is 2½ pints (3.3 U.S. pints, 1.56 litres).

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

### Section H.1

#### REMOVING AND REPLACING A HUB EXTENSION AND AXLE SHAFT

Jack up the car and place blocks under the spring as close as possible to the axle.

Remove the wheel.

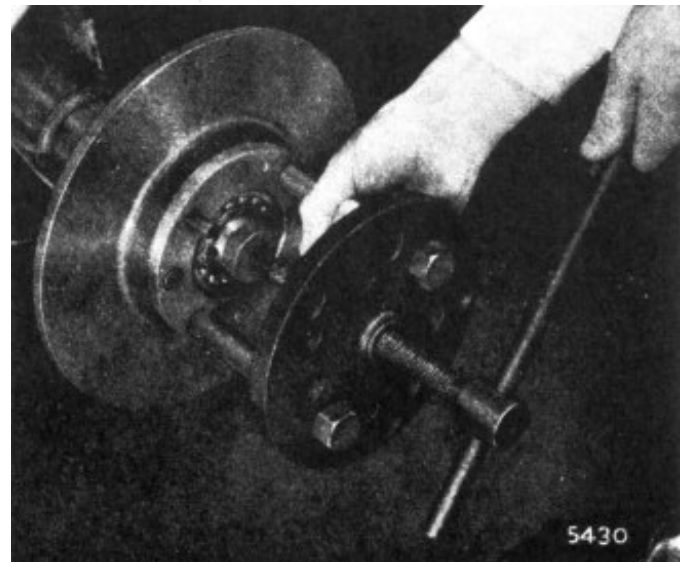
Release the hand brake.

Unscrew and remove the four self-locking nuts securing the hub extension driving flange to the hub.

Withdraw the hub extension and axle shaft by gripping the driving flange or the winged hub nut, which may be temporarily refitted for this purpose.

Remove the welch plug and apply pressure to the end of the axle shaft with a hand press to remove the hub extension from the spline on the shaft.

To replace the shaft and driving flange reverse the above sequence of operations. If the welch plug has been distorted on removal a new one should be fitted.



*Fig. H.2*

*Using hub remover 18G304 with adaptors 18G304B and thrust pad 18G304J*

## Section H.2

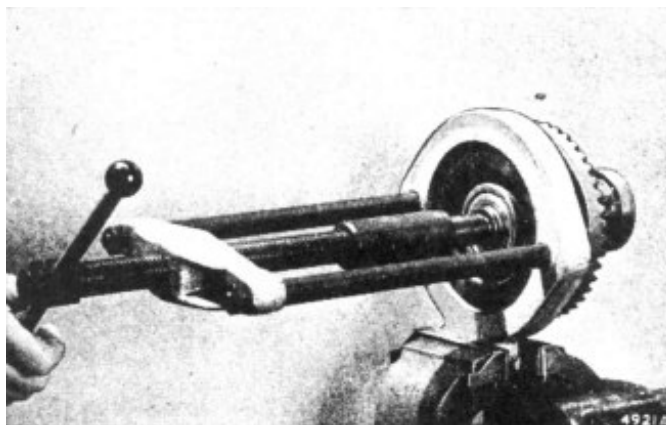
### REMOVING AND REPLACING A HUB

Remove the hub extension and axle shaft as detailed in Section H.1. Remove the wheel brake unit by the method described in Section M.7.

Knock back the tab of the hub nut locking washer, unscrew the nut using spanner 18G152, and pull off the washer. The left-hand hub bearing nut has a left-hand thread and is turned in a clockwise direction to unscrew.

The hub and brake disc assembly can then be withdrawn, using rear hub remover 18G304 together with adaptors 18G304B and thrust pad 18G304J. The bearing and oil seal will be withdrawn with the hub.

The bearing is not adjustable and is replaced in one straightforward operation. Replace the hub and drift it into position with replacer 18G134 and adaptor 18G134P. The remainder is a reversal of the above sequence of operations.



*Fig. H.3*

*Using service tool 18G47C and adaptors 18G47T to remove the differential bearings*

## Section H.3

### RENEWING THE BEVEL PINION OIL SEAL

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

Unscrew the nut in the centre of the driving flange using bevel pinion flange wrench 18G34A to prevent the flange from turning. 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 (service tool 18G372) to a reading of 140 lb. ft. (19.4 kg. m.).

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

## Section H.4

### REMOVING THE DIFFERENTIAL PINIONS

Drain the oil from the axle casing.

Remove the axle shafts as detailed in Section H.1.

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 10 nuts securing the bevel pinion and gear carrier to the axle casing; withdraw the gear

carrier complete with the pinion shaft and differential assembly.

Tap out the dowel pin locating the differential pinion shaft. The diameter of the pin is  $\frac{3}{8}$  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. It may be necessary to clean out the metal peened over the entry hole with a  $\frac{3}{8}$  in. (4.8 mm.) drill in order to facilitate removal of the dowel pin. Drive out the differential pinion shaft. The pinions and thrust washers can then be removed from the cage.

## Section H.5

### REPLACING THE DIFFERENTIAL PINIONS

Examine the pinions and thrust washers and renew as required.

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

Reassembly is now a reversal of the instructions given in Section H.4. Refill the axle with fresh oil to Ref. B (page P.2).

If it proves necessary to fit any new parts other than those detailed in Sections H.2, H.3, or H.5 the axle assembly must be set up as in Section H.7.

## Section H.6

### DISMANTLING THE CROWN WHEEL AND PINION

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

Make sure that the differential bearing housing caps

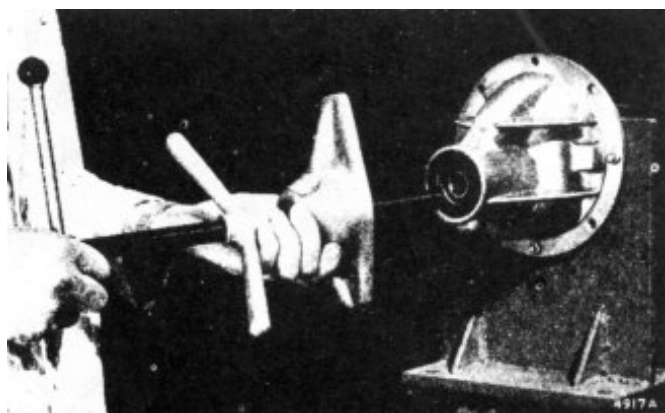


Fig. H.4

*Both front and rear bearing outer races may be removed, using service tool 18G264 with adaptors 18G264E and 18G264F*

are marked so that they can be replaced in their original positions, then remove the four nuts and spring and plain washers. Withdraw the bearing caps and differential assembly.

Remove the differential bearings from the differential cage, using the differential bearing remover 18G47C together with the adaptors 18G47T.

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.

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

Unscrew the pinion nut, using a bevel pinion flange wrench (service tool 18G34A) to prevent the flange from turning during this operation.

Remove the spring washer, the driving flange, and the pressed-on 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, and the outer race of both the front and rear bearings removed with the special bevel pinion bearing outer race remover (service tool 18G264) together with the adaptors 18G264E and 18G264F. (See Fig. H.4).

Slide off the pinion sleeve and shims; withdraw the rear bearing inner race from the pinion shaft with service tool 18G285, noting the spacing washer against the pinion head.

Assembly and adjustment procedure are detailed in Section H.7.

## Section H.7

### ASSEMBLING AND SETTING THE CROWN WHEEL AND PINION

Apart from the fitting of components as detailed in Sections H.2, H.3, and H.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.**

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

- (1) Setting the position of the pinion.
- (2) Adjusting the pinion bearing preload.
- (3) Setting the crown wheel position.
- (4) Adjusting the backlash between the gears.

The following special service tools are required to enable these operations to be carried out correctly:

- Bevel pinion and differential setting gauge.
- Bevel pinion inner race remover and replacer.
- Bevel pinion outer race remover and replacer.
- Bevel pinion preload gauge.

#### 1. SETTING THE PINION POSITION

- (1) Fit the bearing outer races to the gear carrier, using the special pinion race replacing tool.
- (2) Smooth off the pinion head with an oil-stone but do not erase any markings that may be etched on the pinion head.

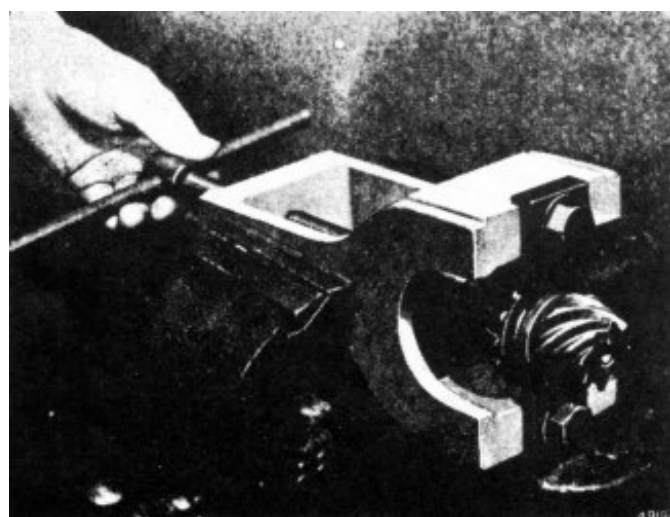


Fig. H.5

*Using service tool 18G285 to remove the bevel pinion bearing inner race*

- (3) Assemble the pinion and rear bearing with a washer of known thickness behind the pinion head.
- (4) Position the pinion in the gear carrier without the shims, bearing spacer, and oil seal.
- (5) Fit the inner ring of the front bearing and the universal joint driving flange and tighten the nut gradually until a bearing preload of 10 to 12 lb. in. (.12 to .14 kg. m.) is obtained.
- (6) Remove the keep disc from the base of the magnet. Adjust the dial indicator to zero on the machined step 'B' of the setting block.
- (7) Clean the pinion head and place the magnet and dial indicator in position (Fig. H.7). 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.

- (8) Take into consideration 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

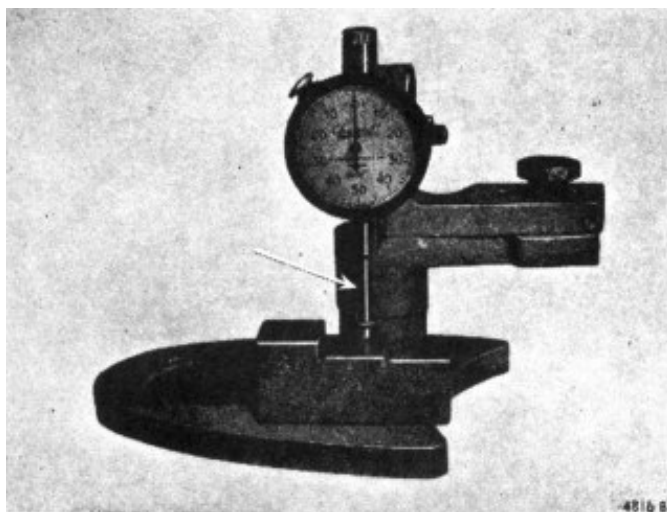


Fig. H.6

Setting the gauge to zero on the special block for determination of the pinion position. The arrow indicates the extension to the contact foot

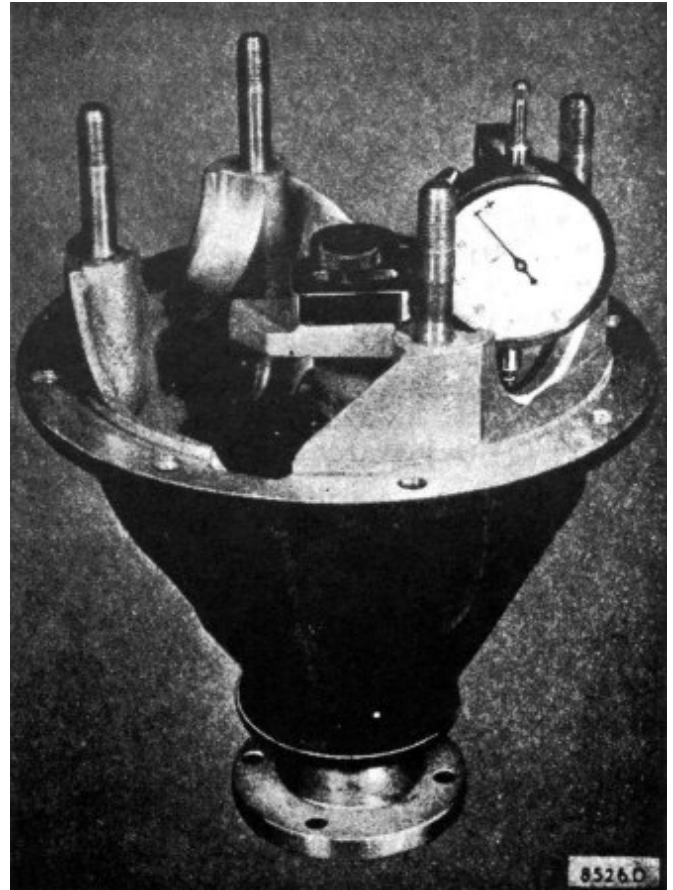


Fig. H.7

The gauge in position on the pinion with the dial indicating a variation from the standard setting

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 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 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.

Table of washer and shim thicknesses	
Pinion head washer thickness	·112 to ·126 in. in steps of ·002 in.
Pinion bearing preload shims	·004 to ·012 in. in steps of ·002 in., plus ·020 in. and ·030 in.
Crown wheel bearing shims	·002 in., ·003 in., ·004 in., ·006 in. and ·010 in.
Pinion bearing preload	.. 10 to 12 lb. in. without oil seal; 13 to 15 lb. in. with oil seal
Crown wheel bearing pinch	·002 in. each side

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 marking, or when the clock reading is zero and there is no unbracketed marking on the pinion head.

- (9) Allowance should then finally be made for the mounting distance marked on the pinion head in a rectangular bracket 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 the appropriate washer to the pinion head.

### 2. ADJUSTING PINION BEARING PRELOAD

Assemble the pinion, pinion bearings, bearing spacer, and shims to the gear carrier; fit the oil seal and driving flange. Shims to a thickness of ·008 to ·011 in. (·2 to ·28 mm.) should be used as a starting-point for adjustment of the bearing preload.

Tighten the driving flange nut gradually with a torque wrench to 140 lb. ft. (19·4 kg. m.) and check the preload on the bearings during tightening to ensure that it does not exceed 13 to 15 lb. in. (·150 to ·173 kg. m.), i.e. 3 lb. in. (·034 kg. m.) greater than the recommended figure, since the oil seal is now fitted. If the preload is too great more shims must be added. If the preload is too small when the nut is tightened correctly the shim thickness must be reduced.

### 3. SETTING THE CROWN WHEEL POSITION

- (1) Before fitting the crown wheel and differential assembly to the gear carrier it is necessary to calculate the shim thickness required behind each bearing to give the required pinch. To facilitate the calculation machining variations are indicated by stamped numbers on the carrier adjacent to the bearing bores. The dimensions to be considered are shown in Fig. H.8, (A) being the distance from the centre-line to the bearing register of the carrier on the left-hand side and (B) the distance from the centre-line to the bearing register of the carrier on the right-hand side. The (C) dimension is from the bearing register on one side of the cage to the register on the other side, while the (D) dimension is from the rear face of the crown wheel to the bearing register on the opposite side. Any variation from nominal on the (A) dimension will be found

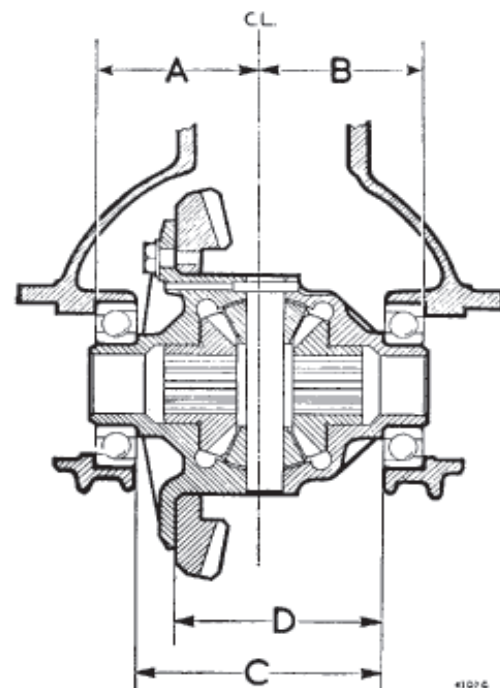


Fig. H.8

The dimensions referred to in the instructions for differential setting



stamped on the carrier adjacent to the bearing bore, and similarly with the (B) dimension. The variations from nominal on the (C) and (D) dimensions are stamped on the machined face of the differential cage.

It is possible to calculate the shim thickness required on the **left-hand side** by the use of the following formula:

$$A + D - C + .007 \text{ in.}$$

Substituting the actual variations shown, this formula gives the shim thickness required to compensate for the variations in machining plus the extra .002 in. (.05 mm.) to give the necessary bearing pinch. In addition, allowance must be made for variations in bearing thickness in the following manner.

Rest the bearing, with the inner race over the recess and the outer ring thrust face downwards, on the small surface plate of tool 18G191B. Drop the magnet onto the surface plate and set the clock gauge to zero on the small gauge block on the step marked 'B'. (See Fig. H.9.) This is the

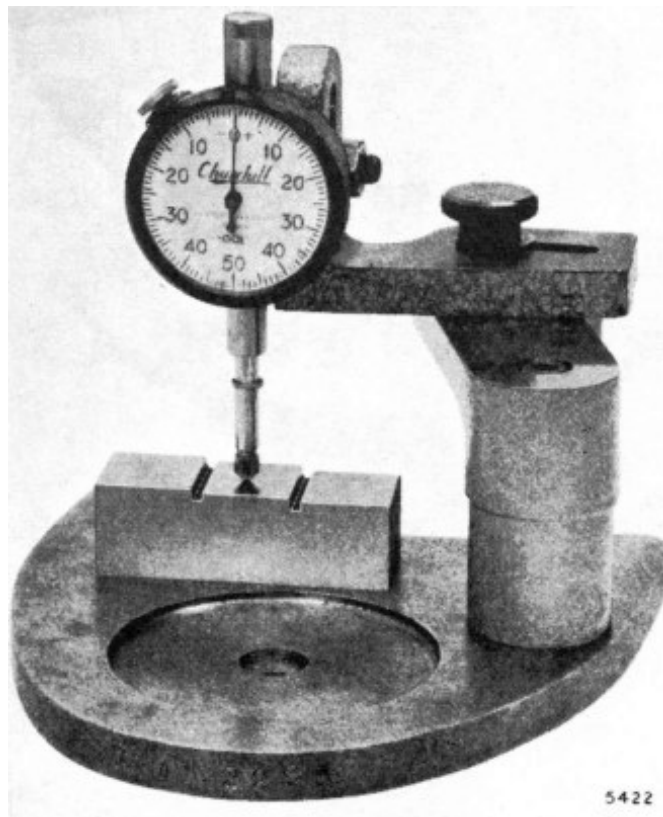


Fig. H.9

To measure variations in bearing thickness first zero the gauge on the portion of the gauge block marked 'B' for the 'MGA' axles

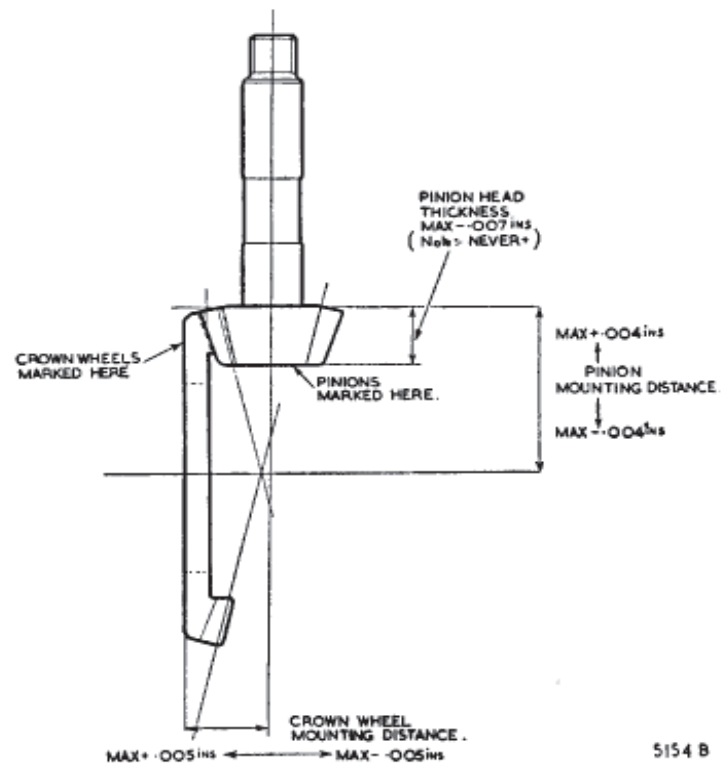


Fig. H.10

Crown wheel and pinion markings

thickness of the standard bearing. Swing over the indicator until it rests on the plain surface of the inner race and, holding the inner race down against the balls, take a reading (Fig. H.11). Normally the bearing will be standard to  $-.003$  in., though in some cases the tolerance may be from standard to  $-.005$  in. A negative variation shown by this test indicates the additional thickness of shimming to be added to that side of the differential.

The formula for the **right-hand side** is:

$$B - D + .006 \text{ in.}$$

and here again final allowance must be made for variation in bearing thickness.

- (2) When a framed number is marked on the back of the crown wheel, e.g.  $\boxed{+2}$ , 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.

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.

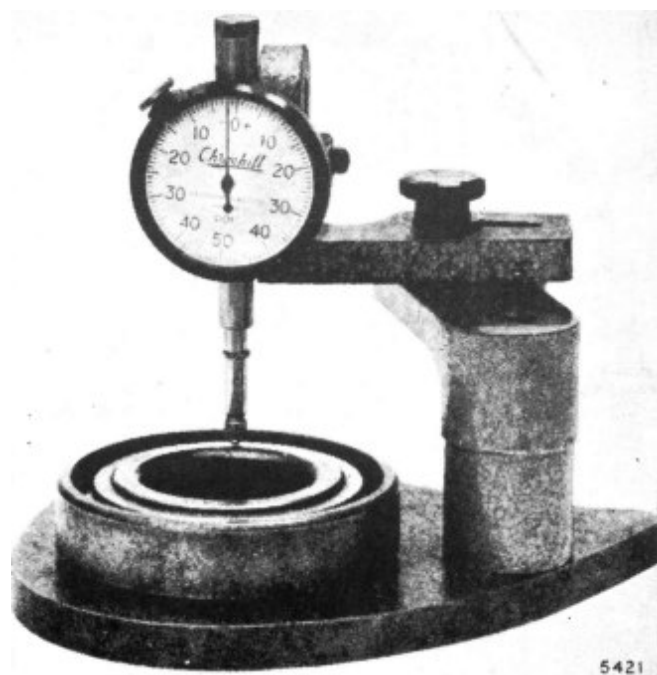


Fig. H.11

Checking the variation in bearing thickness

#### 4. ADJUSTING THE BACKLASH

- (1) Assemble the bearings (thrust side outwards) and shims as calculated 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.).

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.

- (3) Fit the differential to the gear carrier. Replace the bearing caps and tighten the nuts to a torque wrench reading of 65 lb. ft. (8.99 kg. m.). 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 figure may be obtained. (See Fig. H.12). The minimum backlash allowed in any circumstances is .005 in.

(.127 mm.) and the maximum is .007 in. (.178 mm.).

The correct figure for the backlash to be used with any particular crown wheel and pinion is etched on the rear face of the crown wheel concerned and must be adhered to strictly.

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.

Great care must be taken to ensure absolute cleanliness during the above operations, as any discrepancies resulting from dirty assembly would affect the setting position of the crown wheel or pinion.



Fig. H.12

Measuring the crown wheel backlash

## Section H.8

### REMOVING AND REFITTING THE AXLE

Raise the rear of the car.

Mark the propeller shaft coupling flanges so that they may be replaced in the original relative positions. Remove the four bolts and self-locking nuts and release the rear end of the propeller shaft from the axle. Remove the nuts and spring and flat washers securing each end of each check strap to the anchor pins and remove the check straps.

Remove the split pin and clevis pin securing the brake cables to each brake operating lever. Remove the small nut and Phillips recessed-head screw securing the hand brake cable clip to the axle casing. Remove the self-locking nut and large flat washer securing the brake balance lever to the pivot on the axle casing.

Remove the nut and spring washer securing the lower end of each damper link to the rear spring clamp plate.

Unscrew the brake fluid supply pipe union and release the flexible pipe from the battery box support bracket.

Release the exhaust pipe from the exhaust manifold and the three supporting brackets and remove the exhaust pipe assembly.

Remove the nut and spring washer from the spring front anchor pin.

Support the axle casing and remove the rear shackle plates, brackets, and rubbers. Lower the axle support until the axle and spring assembly rests on the road wheels. Withdraw the front anchor pins and roll the assembly from beneath the car.

Uncouple the propeller shaft at the rear flange by unscrewing the four self-locking coupling nuts and bolts. Support the tail end of the propeller shaft.

Remove the rear shackle nuts and bolts.

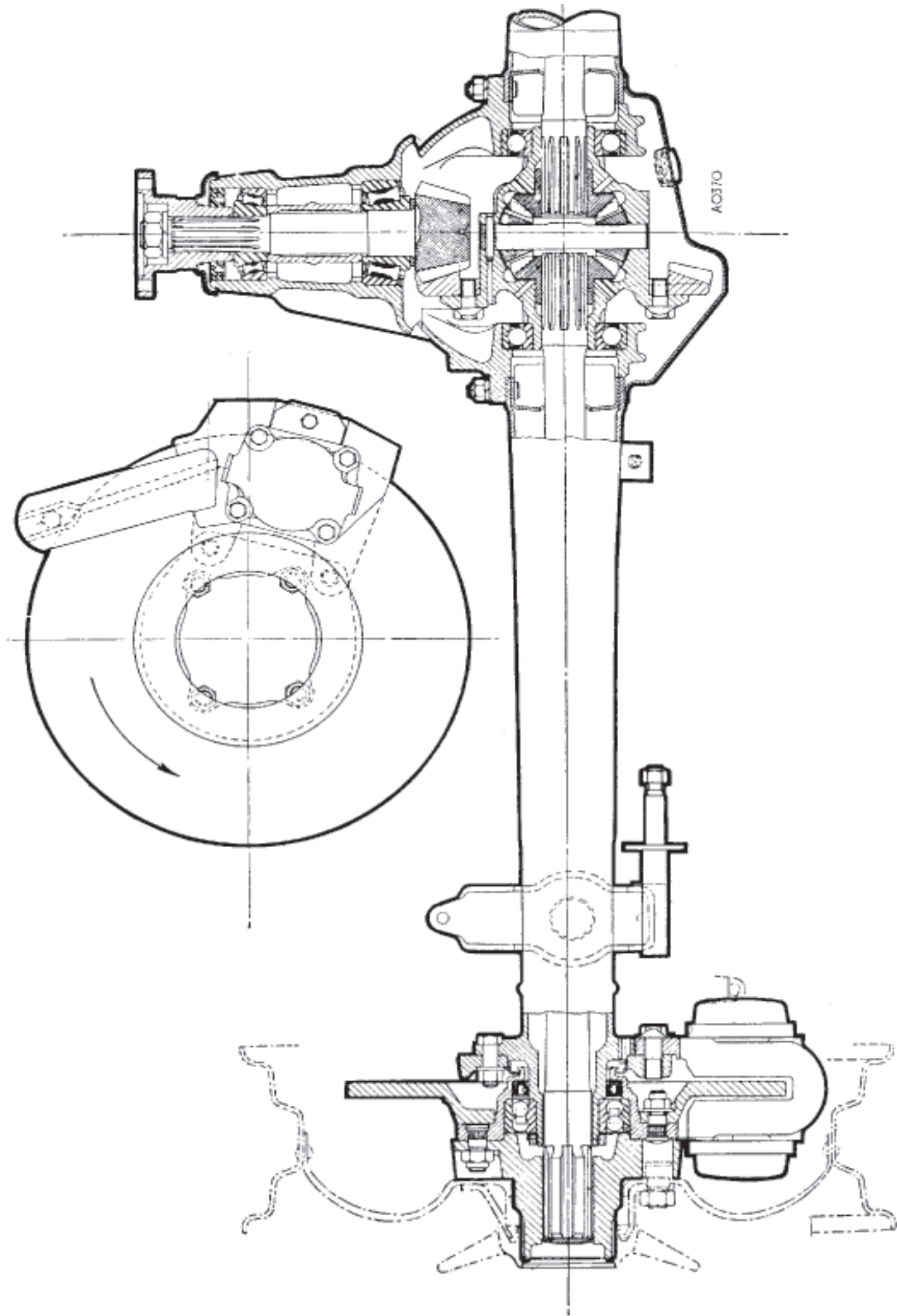
Remove the spring front anchorage bolts after removing the retaining nuts and spring washers.

The axle is now free to be withdrawn on the stand rearwards from the car.

Replacement is the reverse of the above sequence of operations.

*(See pages H.13 onwards for service tools.)*

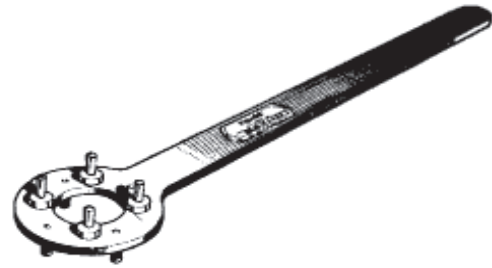
THE REAR AXLE IN SECTION



## SERVICE TOOLS

### 18G34A. Bevel Pinion Flange Wrench

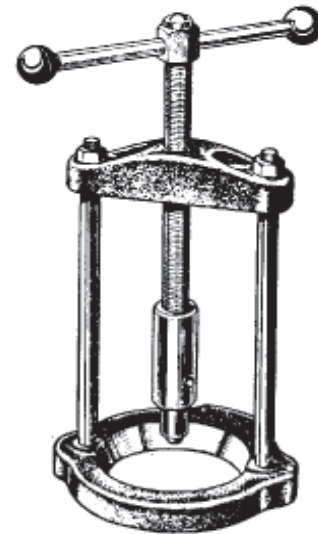
This wrench prevents the rotation of the bevel pinion flange when releasing or tightening the flange securing nut. The pegs of the holding wrench fit into the bolt holes of the flange.



18G34A

### 18G47C. Differential Bearing Remover (basic tool)

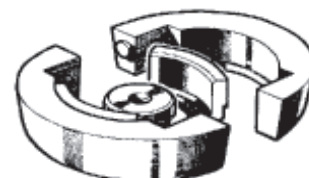
This standardized basic tool used in conjunction with adaptors 18G47T permits easy and safe withdrawal of the differential bearings.



18G47C

### 18G47T. Differential Bearing Remover—Adaptors

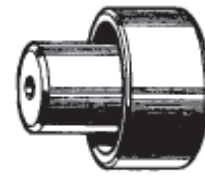
For use with basic tool 18G47C.



18G47T

**18G134P. Rear Hub Bearing Remover, Differential Bearing Replacer, and Rear Hub Assembly Replacer Adaptor**

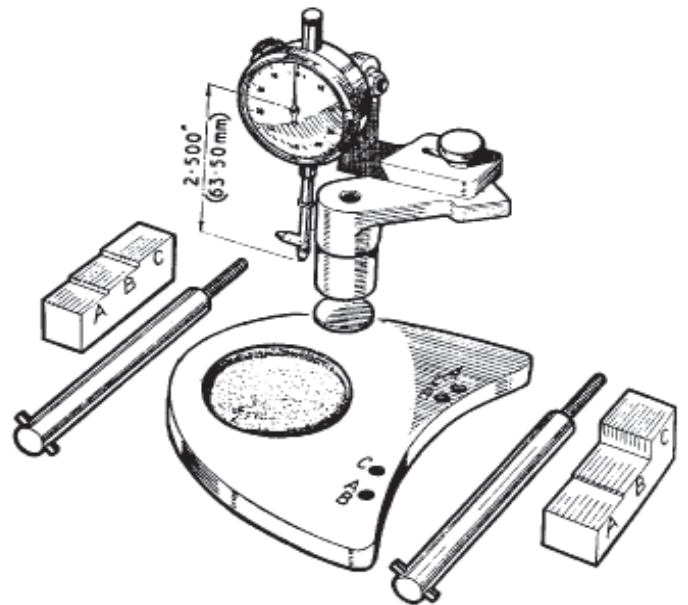
Use with handle 18G134.



**18G134P**

**18G191B. Bevel Pinion and Differential Bearing Setting Gauge.**

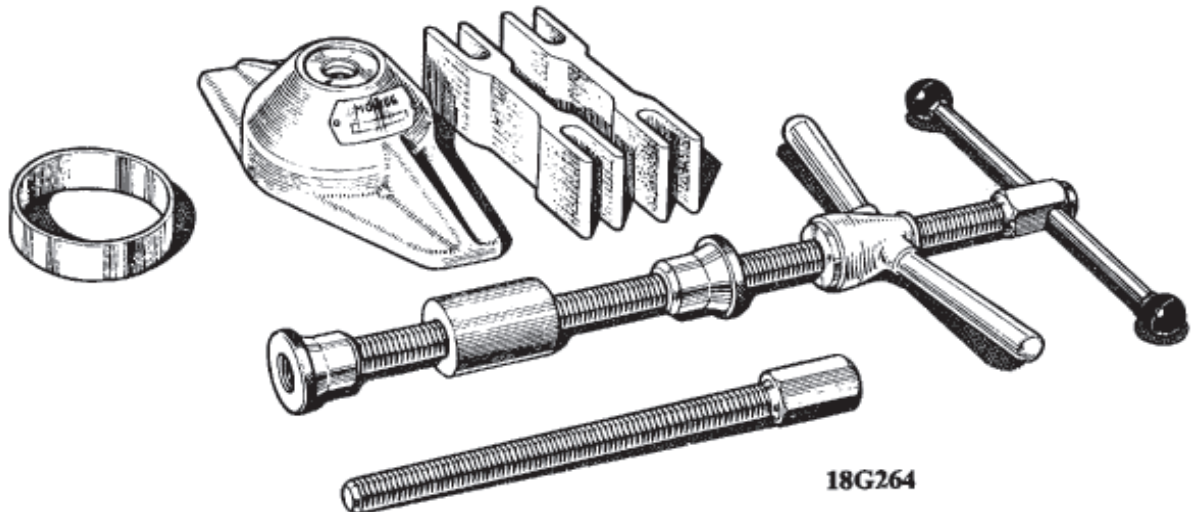
Correct assembly and adjustment of the pinion and differential gear is impossible without this special tool.



**18G191B**

**18G264. Bevel Pinion Bearing Outer Race Remover (basic tool)**

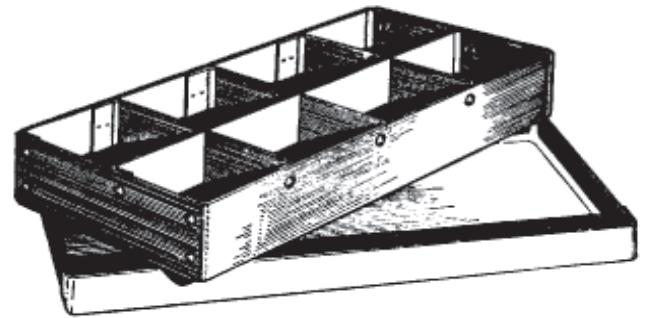
Comprising a body, centre screw with extension and tommy bar, wing nut, guide cone, and two distance pieces. A plain ring is also included to serve as a pilot when the rear bearing outer races are being replaced.



**18G264**

## 18G264K. Partitioned Fibre Box

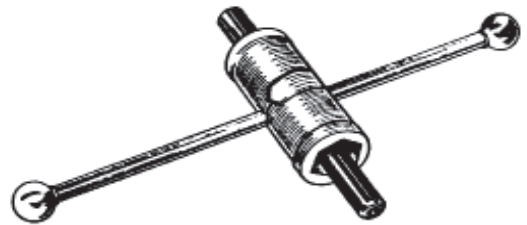
A strong fibre box for storing the bevel pinion bearing outer race remover adaptors.



18G264K

## 18G152. Rear Hub Nut Spanner

A reinforced tubular spanner complete with tommy bar, designed to pilot in the axle tube with the axle shaft withdrawn.



18G152

## 18G207. Bevel Pinion Bearing Preload Gauge

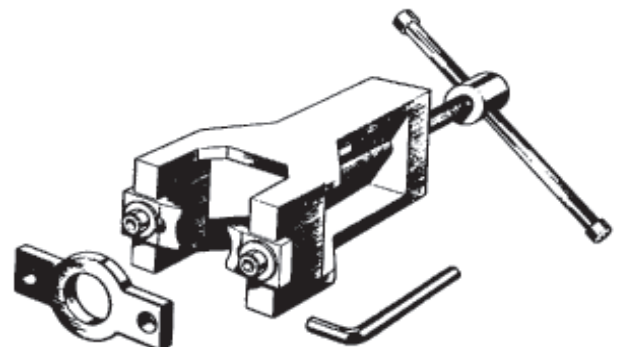
The movable arms of the tool are located in opposite holes of the bevel pinion flange and the weight moved along the rod to the poundage required.



18G207

## 18G285. Bevel Pinion Inner Race Remover and Replacer

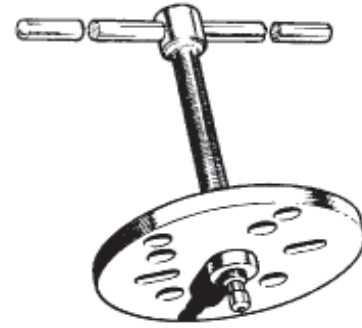
A tool which is essential when withdrawing or replacing the inner bearing race of the pinion shaft.



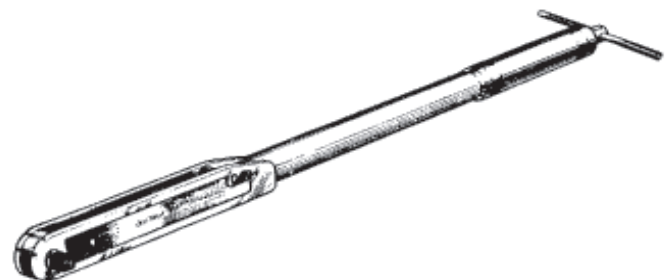
18G285

**18G304. Hub Remover (basic tool)**

The remover 18G304 is a basic tool for use with various adaptor bolts supplied separately. Screw the two adaptor bolts 18G304B onto the wheel studs and insert the thrust pad into the axle tube. The rear hub can then be removed by screwing up the centre screw against the thrust pad.

**18G304****18G304B. Adaptor Bolts— $\frac{7}{8}$  in. UNF (2)****18G304B****18G304J. Thrust Pad****18G304J****18G372. Torque Wrench**

This tool is essential if the recommended maximum torque for the bevel pinion flange securing nut is not to be exceeded. This tool is used with a standard-type socket and in conjunction with the flange holding wrench 18G34A.

**18G372**



**18G264E. Adaptor for Front Bearing**

**18G264F. Adaptor for Rear Bearing**

For use with basic tool 18G264.



**18G264E, 18G264F**