FRONT AXLE

SECTION F

INDEX

FRONT AXLE

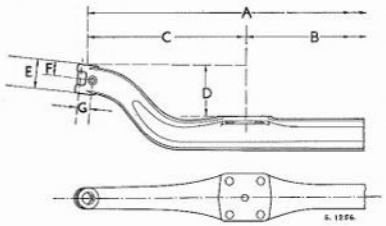
DATA

Axle bed.	
Type	"I" section beam
Hub bearings.	
Type	Opposed taper roller
Bearing adjustment	By means of shims
Bearing end float	·002/·005 in. (·051/·127 mm.)
Swivel pins.	
Swivel thrust	Taken on phosphor bronze pad
Steering geometry	See "Steering" section

MANUFACTURING DATA

	inches	*millimetres*
Stub axles.		
Dia. of bore for bushes	1·2185/1·2190	30·949/30·962
Dia. of spindle		
Inner bearing location	1·4993/1·4998	38·083/38·095
Outer bearing location	·9830/·9836	24·969/24·984
Swivel bushes.		
Inner dia. (not fitted)—standard	·9375/·9380	23·813/23·825
Oversizes available	·005/·010/·015	·127/·254/·381
Outer dia.	1·2185/1·2190	30·949/30·962
Swivel pins.		
Dia.—standard	·9373/·9375	23·808/23·813
Oversizes available	·005/·010/·015	·127/·254/·381
Thrust washers.		
Steel washer thickness	·1565/·1585	3·975/4·026
Bronze washer thickness	·1565/·1585	3·975/4·026
Hub bearing shims.		
Shim thickness	·032 (21 S.W.G.)	·81
	·0048 (40 S.W.G.)	·12
Hubs.		
KA.30 models.		
Hub bore dia.		
Inner bearing	2·9970/2·9985	76·124/76·162
Outer bearing	2·4390/2·440	62·179/62·204
Hub register dia. (for brake drum)	6·2965/6·2980	159·93/159·97
Hub bore dia. (for oil baffle)	3·249/3·250	82·525/82·55
KA.40 and KA.60 models.		
Hub bore dia.		
Inner bearing	3·1235/3·1245	79·337/79·363
Outer bearing	2·4390/2·440	62·179/62·204
Hub register dia. (for brake drum)	4·9985/5·00	126·96/127·0
Hub bore dia. (for oil baffle)	3·249/3·250	32·525/32·55

Axle bed dimensions.



A—60·9 in.	(154·686cm.)
B—34·5 in.	(87·63 cm.)
C—13·2 in.	(33·53 cm.)
D—4·3 in.	(10·922 cm.)
E—2·3573/2·3583 in.	(59·875/59·90 mm.)
F—1·18 in.	(29·972 mm.)
G—·9373/·9377 in.	(23·808/23·818 mm.)

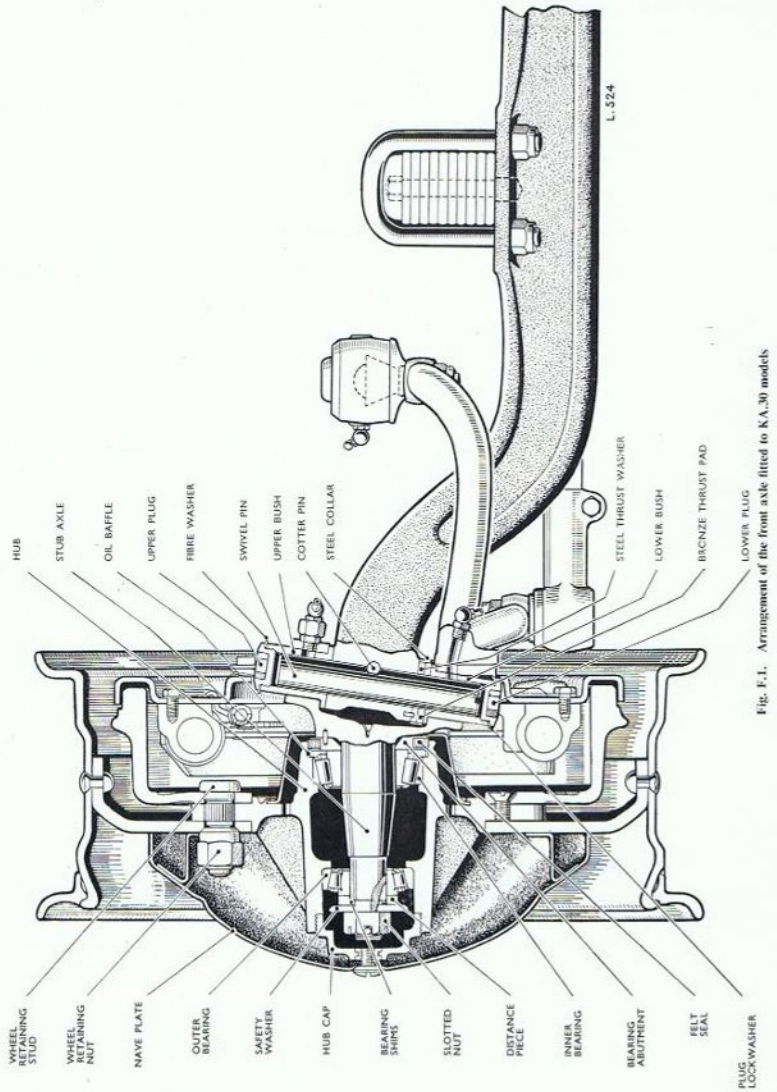


Fig. F.1. Arrangement of the front axle fitted to KA.30 models

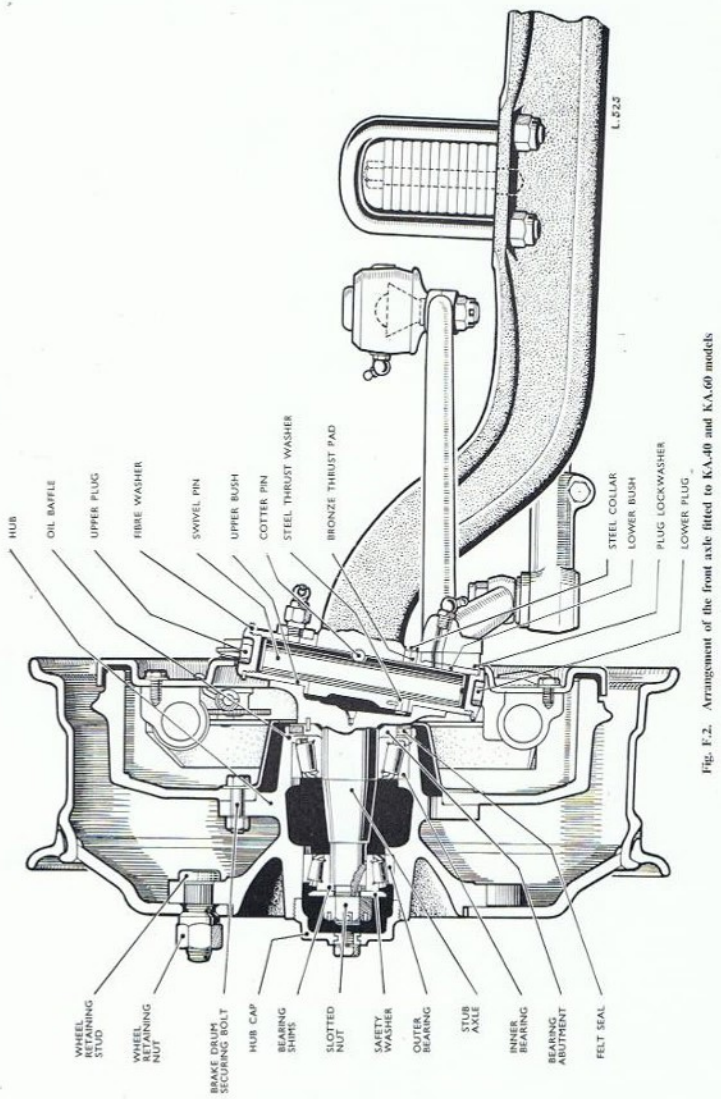


Fig. F.2. Arrangement of the front axle fitted to KA.40 and KA.60 models

FRONT AXLE

DESCRIPTION

The axle bed, an "I" section steel stamping, is of the reversed Elliot type and two integral pads locate and seat the front road springs which are secured to the axle bed by "U" bolts and self locking nuts. The outer extremities of the axle bed are bored to accommodate the swivel pins and cotter pins are used to locate and lock the swivel pins in position.

The stub axles, complete with integral wheel spindles, are connected to the eyes of the axle bed by the swivel pins and operate in hardened steel bushes that are a push fit in the stub axle bosses. The swivel pins and bushes are enclosed at each end by a screwed plug with a fibre washer under the head of the upper plug and a steel lockwasher under the head of the lower plug. The stub axles pivot about the swivel pins and the load is taken by a dowel located, hardened steel washer and a phosphor bronze thrust pad, both of which are enclosed in a steel collar fitted between the lower boss of each stub axle and the bottom face of each eye of the axle bed.

Each front hub and brake drum assembly revolves on two opposed taper roller bearings mounted on the stub axle spindles. The cups of the taper bearings are a press fit in the hub and the cones, a sliding fit on the stub axle spindles. Between the hub inner bearing and the stub axle are fitted a bearing abutment, a felt oil seal and an oil baffle; the bearing abutment being located by a small dowel fitted in the wheel spindle shoulder of the stub axle. The hub assembly is secured to the stub axle spindle by a keyed safety washer, a slotted nut, and a split pin. Interposed between the safety washer and a machined shoulder on the spindle are shims which control the adjustment of the hub bearings.

Note: On KA.30 models, a distance piece is fitted between the safety washer and the cone of the hub outer bearing.

KA.30 Models.

Each hub is secured to the brake drum by the wheel studs which have serrated shanks to form an interference fit in the stud locating holes in the hub flange thus preventing the studs from turning. Additionally, two countersunk setscrews are fitted internally from the drum interior to further secure the brake drum to the hub.

KA.40 and KA.60 Models.

The hubs are fitted to the brake drums by six special bolts, standard nuts and spring washers. The wheel studs, which are fitted to the separate outer flange of the hubs, are of the serrated shank type to prevent the studs from working loose.

An oil catcher is fitted over the inner end of each hub and on KA.30 models, this component is secured to the hub by a rolled over lip on the hub flange, whereas on KA.40/60 models, the oil catcher, together with a joint, is held by the hub to drum retaining bolts.

The backing plates of the front brake assemblies are attached to the flanges of the stub axles by six bolts and self locking nuts in each case, four of which are also used to retain the appropriate steering arm.

A steering stop is fitted to the rear of each stub axle flange to control the turning circle of the vehicle.

LUBRICATION

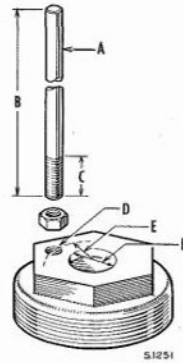
Hubs.

The hubs are packed with grease during initial assembly at the factory. Every 24,000 miles (36,000 kms.), the hubs should be removed, the old grease cleaned out, and the hubs repacked with fresh grease of the recommended grade. These operations are fully detailed under the appropriate headings in the "Hubs and Bearings" sub-section beginning on page F.8.

Important. Particular attention must be given to the method given on page F.10 for correctly repacking both hubs and bearings.

Swivel Pins and Bushes.

Lubrication of the swivel pins and bushes is effected through lubricating nipples fitted in the steering arms for the bottom bushes and in the stub axle boss for the upper bush. Lubricate on all four points every 2,000 miles (3,000 kms.) with lubricant of the recommended grade.



A — ¼ IN. (9·5 MM.) DIA. BAR MOUNTED ON HUB CAP AND SECURED WITH A LOCKNUT
B — 12·75 IN. (32·5 CM.) LENGTH
C — BAR TO BE THREADED ¼ IN. B.S.F. FOR 1 IN. (25 MM.) LENGTH
D — DRILL ONE HOLE ⅜ IN. (9·34 MM.) DIA. AND TAP ¼ IN. B.S.F. ON A RADIUS OF ¾ IN. (19 MM.) FROM THE CENTRE OF THE ¾ in. (22 MM.) DIA. CENTRE HOLE AS SHOWN
E — ¾ IN. (19 MM.) RADIUS
F — TURN OR GRIND RAISED CENTRE BOSS UNTIL FLUSH WITH THE CAP FACE. TAP OUT THE REMAINDER OF THE STEEL INSERT AND DRILL THE CENTRE HOLE TO ⅞ IN. (22 MM.) DIA.

Fig. F.3. Details of the dial test indicator support

HUBS AND BEARINGS

Checking Hub Bearing End Float.

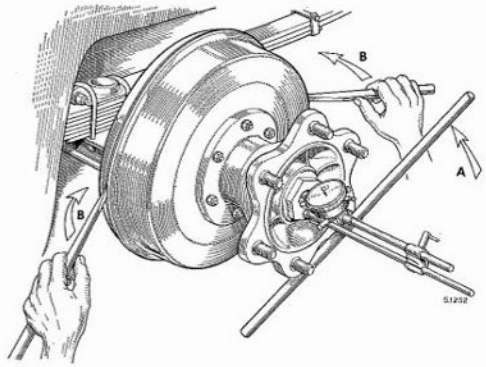
It is recommended that the check for hub bearing end float be carried out with the aid of a dial test indicator. To support the indicator, a spare hub cap, applicable to these models, should be drilled to accommodate a support rod as shown in Fig. F.3.

To check the bearing end float, proceed as follows:

1. Jack up the vehicle under the front axle and remove the road wheel. Remove the hub cap. Screw the dummy hub cap complete with the support post into the tapped bore of the hub.

2. Fit the dial test indicator to its support and position it so that the gauge pointer contacts the machined face of the stub axle spindle.

3. Using a bar approximately 48 in. (122 cm.) in length as a lever, ensure that the hub and drum assembly is at its innermost position, thus taking up the bearing end float (see Fig. F.4, position A).



A — APPLY LEVERAGE IN THE DIRECTION OF ARROW "A" TO TAKE UP BEARING END FLOAT

B — APPLY LEVERAGE IN THE DIRECTION OF ARROWS "B" TO REGISTER BEARING END FLOAT ON THE DIAL TEST INDICATOR

Fig. F.4. Checking the front hub bearing end float

4. With the hub and drum assembly still retained at its innermost position, "zero" the dial test indicator before removing the lever.

5. Using two levers, approximately 18 in. (46 cm.) in length, move the hub and drum assembly to its outermost position (i.e., the amount of axial movement permitted by the bearing end float) by exerting the pressure of the levers between the back plate assembly and the hub and drum assembly (see Fig. F.4, position B).

6. The amount of end float present will be registered by the dial test indicator, and if the reading does not compare with the limits given on the "Data" page of this section, further adjustment should be carried out, until the correct end float is obtained.

To Adjust the Hub Bearings.

1. Jack up the vehicle under the front axle until the front road wheels are clear of the ground.

Note: Remove the nave plate and slacken the road wheel securing nuts before raising the front wheels.

2. Remove the road wheel.

3. Remove the hub cap using Churchill Tool R.G.302.

4. Extract the split pin and remove the slotted nut followed by the bearing safety washer from the stub axle. Note that on KA.30 models, a distance piece is fitted between the safety washer and the hub outer bearing cone. The nut on the left hand stub axle has a right hand thread and the nut on the right hand stub axle has a right hand thread.

5. Adjustment of the hub bearings is effected by the fitment of shims, available in thicknesses of ·032 in. (·81 mm.) and ·0048 in. (·12 mm.) behind the bearing safety washer. The addition of shims increases the clearance and the removal of shims decreases the clearance.

(*a*) Add or remove shims until the hub can be rotated without any binding of the bearings and with no end float in evidence. The safety washer (also the distance piece on KA.30 models), and the nut must be refitted and tightened on each occasion that a shim is added or removed.

(*b*) With adjustment effected as at para. (*a*), remove the nut and the safety washer and add a further ·0048 in. (·12 mm.) thick shim.

(*c*) Refit the safety washer and secure the nut using a box spanner and a 12 in. (30·4 cm.) tommy bar.

Note: On KA.30 models ensure that the distance piece is refitted between the safety washer and the hub outer bearing cone.

(*d*) Check the hub bearing end float as detailed in the previous sub-section.

(*e*) Fit a new split pin and refit the original hub cap with Churchill Tool R.G.302, ensuring that the hub cap contains a quantity of grease of the recommended grade.

6. Refit the road wheels and the nave plate and lower the vehicle to the ground.

To Remove.

1. Jack up the vehicle under the front axle until the front road wheels are clear of the ground.

Note: Remove the nave plate and slacken the road wheel securing nuts before raising the front wheels.

2. Remove the road wheels.

3. Remove the hub cap using Churchill Tool R.G.302.

4. Extract the split pin and remove the slotted nut followed by the bearing safety washer from the stub axle. Note that on KA.30 models, a distance piece is fitted between the safety washer and the hub outer bearing cone. The nut on the left hand stub axle has a right hand thread and the nut on the right hand stub axle also has a right hand thread.

The adjusting shims may be left in position providing that care is taken not to lose or damage any of them.

5. Withdraw the hub and brake drum assembly. The cone of the inner bearing, together with the oil baffle, may be removed with the hub. Pull the oil baffle out of the register in the hub bore and lift out the bearing cone. Slide the bearing abutment and the felt oil seal off the stub axle spindle noting the small dowel locating the abutment in the axle spindle shoulder. Should the cone of the inner bearing remain on the stub axle together with the oil baffle, felt oil seal and bearing abutment, remove by applying pressure behind the bearing abutment with suitable levers.

To Dismantle.

1. Lift out the cone of the outer bearing.

2. The internal shoulders of the hub, on which the bearing cups locate, are slotted at diametrically opposite points to facilitate the removal of the cups. Using the Churchill Remover Pad R.G.325 and the Churchill Universal Handle 550, press out the outer bearing cup. Similarly, press out the inner bearing cup using the remover pad of Churchill Tool R.G.324 for KA.30 models (R.G.323 for KA.40/60 models) together with the Universal Handle 550 (see Fig. F.5).

Note: When **pressing out** the bearing cups, the Universal Handle 550 is used in the **reversed** position, as shown in the illustration (Fig. F.5).

When bearing removal is carried out with the hub and drum assembled, it is important that the following points are observed.

KA.30 Models. When pressing towards the inner bearing location, support the hub on the flat heads of the wheel retaining studs inside the brake drum.

When pressing towards the outer bearing location, support the hub on blocks placed radially between the wheel retaining studs at equally spaced positions.

KA.40 and KA.60 Models. When pressing towards the inner bearing location, support the hub on the heads of the hub and drum retaining bolts inside the brake drum.

When pressing towards the outer bearing location, support the hub on blocks placed radially between the wheel retaining studs at equally spaced positions.

3. KA.30 Models. To separate the brake drum from the hub, press out the wheel studs. If the same wheel studs are to be refitted, each stud must be returned to its original stud hole in the hub, therefore, identify each stud before removal (see para. 3 (*c*) of the re-assembly operation). Finally, unscrew the two countersunk screws located in the brake drum interior face and separate the drum from the hub.

Fig. F.5. Pressing out the KA.30 front hub inner bearing cup using the Remover Pad of Churchill Tool R.G.324 together with the Universal Handle 550
Note that the Universal Handle 550 is used in the reversed position

KA.40 and KA.60 Models. Remove the brake drum from the hub by withdrawing the bolts, nuts and spring washers securing the drum to the inner flange of the hub. The oil catcher will also be released at the same time; note the joint between the oil catcher and the drum.

Inspection and Overhaul.

All components should be thoroughly cleaned before inspection in clean paraffin with the exception of the bearings which should be washed out in white spirit. If, after washing and examination, the bearings are to be retained for re-assembly, they must be immediately immersed in clean thin lubricating oil to prevent corrosion.

1. Examine the bearings for cracked or distorted cages, worn or pitted rollers. Check also the cups for scoring, pitting or discoloration. Renew the bearing as an assembly, if any part is defective.

2. Check that the cups are a press fit in their respective bores in the hub. Also check that the bearing cones are a good push fit on the stub axle spindle.

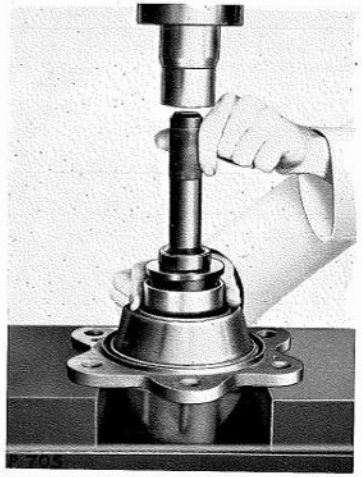


Fig. F.6. Pressing in the KA.30 front hub inner bearing cup using the Replacer Pad of Churchill Tool R.G.324 together with the Universal Handle 550

3. Renew the felt oil seal.

4. Examine the hub cap for damage and inspect the condition of the threads both on the cap and in the hub bore.

5. Inspect the bearing safety washer for scores and the washer locating tongue for damage.

6. Check that the oil baffle and bearing abutment are in good condition and not damaged.

7. Examine the wheel studs for damage and location and renew if necessary.

On KA.40 and KA.60 models, the wheel studs are renewed by pressing out the faulty studs and pressing in the new studs.

On KA.30 Models, the wheel studs also secure the brake drum to the hub and for stud renewal, refer to para. 3 (*c*) of the hub re-assembly operation.

8. Check that the hub oil catcher is not damaged, and renew as necessary. **On KA.30 Models,** the oil catcher is secured to the hub by a rolled over lip and cannot be renewed as a single item.

To Re-assemble.

1. Before refitting the bearing cups, ensure that there are no burrs or foreign matter on the shoulders and registers of the hub bores.

2. Press in the inner bearing cup using the replacer pad of Churchill Tool R.G.324 for KA.30 models (R.G.323 for KA.40/60 models) and the Churchill Universal Handle 550 (see Fig. F.6). The outer bearing cup is pressed in, using Churchill Replacer Pad R.G.327 for KA.30 models (R.G.326 for KA.40/60 models), together with the Universal Handle 550. Ensure that each cup is pressed into position against the respective hub shoulder.

Note: For this operation, the Universal Handle 550, is used in the normal position, as shown in the illustration. (Fig. F.6).

When bearing removal is carried out with the hub and drum assembled, it is important that the following points are observed.

KA.30 Models. When pressing towards the inner bearing location, support the hub on the flat heads of the wheel retaining studs inside the brake drum.

When pressing towards the outer bearing location, support the hub on blocks placed radially between the wheel retaining studs at equally spaced positions.

KA.40 and KA.60 Models. When pressing towards the inner bearing location, support the hub on the heads of the hub and drum retaining bolts inside the brake drum.

When pressing towards the outer bearing location, support the hub on blocks placed radially between the wheel retaining studs at equally spaced positions.

3. If the brake drum and hub have been separated, re-assemble in the following manner.

KA.30 Models.

(*a*) Ensure that the drum bore and the hub register are clean and free from burrs before positioning the drum on the hub. It may be necessary to tap the drum fully on the hub register using a copper or lead hammer.

(*b*) Screw in the two countersunk screws to correctly align the stud holes of each component.

(*c*) The wheel studs can then be pressed in their original stud holes in the hub and drum, as identified during the removal operation, providing that each stud is a good interference fit.

KA.40 and KA.60 Models.

(i) Ensure that the drum bore and the hub register are clean and free from burrs before positioning the drum on the hub. It may be necessary to tap the drum fully on the hub register using a copper or lead hammer.

(ii) Place a new oil catcher joint over the bolt holes in the brake drum and position the oil catcher on the joint.

(iii) Refit and securely tighten the bolts, nuts and spring washers attaching the drum to the hub inner flange, noting that the bolt head must be on the inside of the brake drum.

4. Repack the two bearing cones, with the recommended grade of grease, forcing the grease between the rollers and under the roller cages, until fully packed, working from the larger diameter end of each bearing. Liberally smear the outer protruding surfaces of the rollers and cages with fresh grease and also the working surface of the cups.

5. Repack the hub with fresh grease of the recommended grade.

Important. Whilst it is not desirable to completely fill the cavity between the inner and outer bearings with grease when repacking, it is essential that an adequate supply of grease is placed in the immediate vicinity of both bearing races. Apply the grease in the hub so as to leave a space around the stub axle when re-assembled.

To Refit.

1. Ensure that the exposed spindle surfaces of the stub axle are perfectly clean and refit the bearing abutment locating by means of the small dowel in the upper section of the spindle shoulder.

2. Refit the new felt oil seal over the small diameter of the bearing abutment.

3. Place the inner bearing cone in its cup in the hub and then push the oil baffle fully into the register in the inner end of the hub interior, noting that the

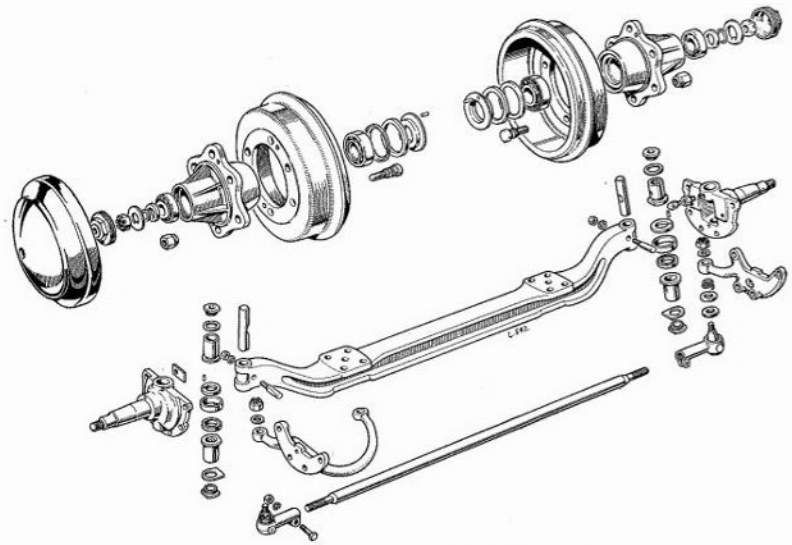


Fig. F.7. Details of the front axle assembly fitted to KA.30 models

square edge on the outer lip of the baffle must enter the hub bore first.

4. Slide the hub and drum assembly on the stub axle. Holding the hub centrally over the axle spindle, tap the cone of the inner bearing with a hollow drift to ensure that the bearing is fully located against the bearing abutment. Care should be taken during this operation to ensure that the felt oil seal remains located on the bearing abutment.

Whilst the hub is held centrally over the axle spindle, refit the cone of the outer bearing and tap the cone fully home with a hollow drift.

5. Refit the bearing shims, the safety washer and the slotted nut. On KA.30 Models, it will be necessary to refit the distance piece before refitting the safety washer.

6. Adjust the hub bearings as detailed on page F.8.

7. With the bearings adjusted correctly and a new

split pin fitted in the slotted nut, pack the space between the outer bearing and the safety washer with fresh grease of the recommended grade, also, place a quantity of grease of the same grade in the hub cap before screwing in the cap using Churchill Tool R.G.302.

8. Refit the road wheel and the nave plate and lower the vehicle to the ground.

STUB AXLES AND SWIVEL PINS

To Check the Thrust Washer for Wear.

1. Thoroughly clean the area surrounding the axle bed eye and the upper swivel pin bush flange.

2. With the vehicle standing on a level surface, check the clearance evident between the upper face of the axle bed eye and the base of the upper swivel pin bush flange.

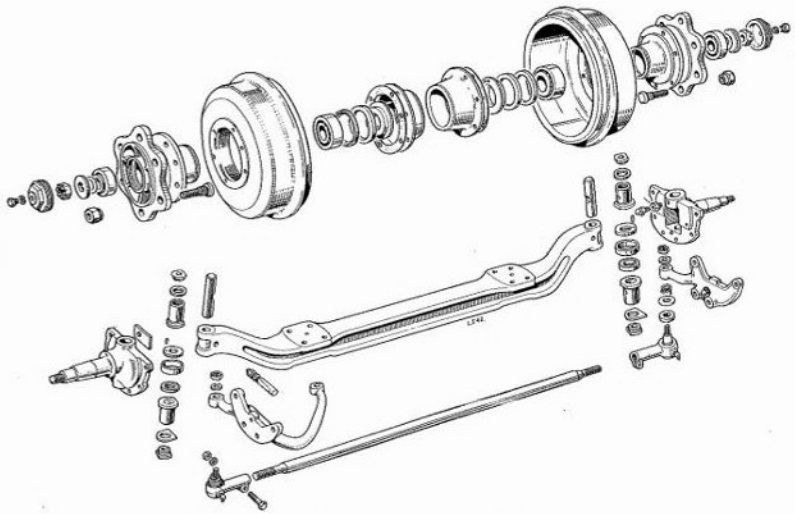


Fig. F.8. Details of the front axle assembly fitted to KA.40 and KA.60 models

Excessive clearance indicates a worn thrust washer or thrust pad.

To Check the Swivel Pin and Bushes for Wear.

1. Jack up the vehicle under the front axle until the front road wheels are clear of the ground.

2. Grasp the road wheel at the top and bottom of its circumference and attempt to rock the road wheel. Whilst carrying out this operation, an assistant should observe for movement, or check for movement by hand, between the stub axle and the axle bed eye. If excessive movement is evident, the swivel pin and bushes should be renewed. **Do not confuse slackness in the hub bearings with play in the swivel pin and bushes when carrying out this check.**

To Remove.

1. Remove the front hub and brake drum assembly as detailed in this section.

2. Remove the six bolts and self locking nuts securing the brake backing plate and steering arm to the stub axle flange.

3. Thread the brake assembly over the stub axle and lay the assembly on top of the road spring taking care not to damage the flexible brake fluid pipe.

4. The swivel pin is locked in the axle bed eye by a cotter pin. A flat on the cotter pin engages with a similar flat on the swivel pin and the cotter pin is secured on the front side of the axle bed by a self locking nut and a plain washer.

Pivot the stub axle to gain access to the cotter pin, remove the nut and washer, apply a drift to the threaded end of the pin and drive the pin out rearwards.

5. Unscrew the top swivel pin bush plug using a ·625 in. (15·88 mm.) A/F hexagon bar in the plug recess. Remove the fibre washer located under the head of the plug.

The bottom swivel pin bush plug is removed in the same manner after the tabs of the lockwasher are tapped clear.

6. Employing a brass drift, drive the swivel pin downwards and out of the stub axle and the axle bed.

Lift away the stub axle together with the thrust washer, the thrust pad and the steel collar, noting that the thrust washer is dowel located to the bottom face of the axle bed eye.

7. Push the bottom bush out of the stub axle boss. The top bush can also be pushed out after the lubricating nipple and its adaptor have been unscrewed.

8. The steering stop fitted to the stub axle flange need not be removed unless damage or wear necessitates renewal or a new stub axle is to be fitted.

Inspection and Overhaul.

Thoroughly clean all parts before inspection.

1. Suspend the stub axle between centres. Check for bend and distortion, by means of dial indicator, on the brake backing plate flange and the ground surfaces of the axle spindle which carry the hub bearings. Renew the stub axle if either of these faults are apparent.

2. Check the fit of the swivel pin in the steel bushes and renew both the swivel pin and bushes as necessary.

3. Check that the fit of the swivel pin in the axle bed bore is a light interference fit. If any slackness exists between the pin and the bore, a suitable oversize swivel pin must be fitted and the axle bed bore machined to accommodate the oversize pin with the required light interference fit.

When an oversize pin is fitted, always use the corresponding new oversize bushes.

4. Renew the cotter pin and self locking nut.

5. Inspect the thrust washer and thrust pad for wear and scores, renewing as necessary. Also ensure that the small dowel which locates the thrust washer is not damaged.

6. Check that the steering stop is not damaged or worn.

To Refit.

1. Refit the bushes in the stub axle bosses ensuring that the oil holes in the bushes align with the corresponding oil holes in the bosses.

2. Screw the lubricator and its adaptor into the top boss of the stub axle thus locating the top bush. The bottom bush is located by the machined flat on the bush flange engaging with the machined face of the steering arm when this component is refitted.

3. Re-assemble the thrust washer, thrust pad and steel collar and position them under the axle bed eye, ensuring that the small dowel in the axle bed engages the hole in the steel thrust washer. Retain these components in position by means of thick grease.

4. Offer up the stub axle over the axle bed eye and using a tapered dummy shaft align the bore of the axle bed with the swivel pin bushes and the thrust washers.

5. Insert the swivel pin in the top bush, slotted end first, noting the alignment of the machined flat on the pin with the hole in the axle bed for the cotter pin.

Drive the swivel pin into position, using a brass drift, until the machined flat on the pin aligns with the cotter pin hole to permit the fitting of the cotter pin.

6. Tap in the new cotter pin from the rear of the axle bed and secure the pin with the plain washer and the new self locking nut.

7. Screw in the swivel pin bush plugs ensuring that a new fibre washer is placed under the head of the top plug and a new lockwasher is fitted under the bottom plug. Fully tighten both plugs and secure the bottom plug by tapping the ends of the lockwasher over the two flats on the plug.

8. Refit the brake assembly by securing the brake backing plate and also the steering arm to the stub axle flange using the six bolts and self locking nuts, noting that the bolt heads are fitted to the inside of the backing plates. It is advisable to renew the self locking nuts once they have been removed.

9. Refit the hub and drum assembly and adjust the hub bearings as detailed in this section. Refit the road wheel and the nave plate.

10. Check the front wheel track (toe-in) and adjust, if necessary.

11. Lubricate the swivel pin and bushes with the recommended grade of lubricant.

FRONT AXLE ASSEMBLY

To Remove.

1. Jack up centrally under the front axle until the front road wheels clear the ground. Position suitable stands under the chassis sidemembers close to the rear of the front spring rear shackles.

Note: Remove the nave plates and slacken the road wheel securing nuts before raising the front wheels off the ground.

2. Remove the front road wheels.

3. Disconnect the front hydraulic brake flexible hoses. Refer to the "Brakes" section for the correct procedure for this operation.

4. Release the steering side rod from the steering arm and allow the rod to remain connected to the steering drop arm.

5. Remove the front shock absorbers as detailed under the appropriate heading in the "Chassis Frame, Suspension and Shock Absorbers" section.

6. Remove the four U-bolts which secure the front road springs to the axle bed. The lower shock absorber

mounting brackets will also be released at the same time.

7. Lower the jack and withdraw the front axle assembly complete.

8. For details of dismantling, overhaul and re-assembly of the front axle assembly, refer to the appropriate instructions given under sub-headings in this section.

To Refit.

Reverse the removal operations giving attention to the following points.

1. Ensure that the mating faces of the axle bed spring mounting pads and the road springs are clean and free from burrs.

2. Check that the dowel heads of the road spring centre bolts seat correctly in the locating hole of each axle bed mounting pad.

3. Check the condition of the shock absorber mounting rubbers, renewing if necessary.

4. Ensure that the steering side rod ball pin shank and the steering arm tapered bore are clean before refitting. Fully tighten the slotted securing nut and fit a new split pin.

5. Top up and bleed the hydraulic brake system after refitting the flexible brake hoses. For details of the operation required for bleeding the brake system, see "Brakes" section.

6. Check the front wheel track (toe-in) as detailed in the "Steering" section.

FRONT AXLE BED

To Remove.

1. Remove the front axle assembly as detailed in the previous sub-section.

2. Remove the stub axles and swivel pins as detailed within this section.

Inspection and Overhaul.

1. Thoroughly clean the axle bed and then examine for cracks.

2. In order to check for distortion, proceed as follows:

(*a*) The axle bed must be supported beneath each spring mounting pad on a suitable flat surface and preferably clamped in position.

(*b*) Lay a straight edge, 36 in. (19·4 cm.) in length, across the two spring mounting pads together with an engineer's protractor. Adjust the position of the axle bed on the supports until it is exactly level and horizontal, as indicated by the spirit level in the protractor on the straight edge for the longitudinal plane (axle bed length) and on the spring mounting pad for the transverse plane (axle bed width).

(*c*) Attach the Churchill Axle Aligning Rods 89A to the swivel pin bosses and using the spirit level, set the bars vertical as viewed from the ends of the axle bed.

(*d*) Check the king pin inclination using the engineer's protractor. The correct reading should be 8°.

For details of other dimensions on the axle bed, refer to the "Manufacturing Data" at the beginning of this section.

3. Check that the fit of the swivel pins in the axle bed bores are a light interference fit.

To Refit.

Refer to the appropriate sub-headings within this section for details of refitting the axle components and, finally, the refitting of the front axle assembly.

REAR AXLE

SECTION G

INDEX

REAR AXLE

DATA

Type	Fully floating
Final drive gears	Spiral bevel
Differential gears	Straight bevel
Axle casing	Pressed steel banjo
Final drive gear carrier, Differential case halves, Bevel pinion bearing sleeve	Malleable iron castings
Axle ratios (standard)	
KAH.3023 Home and Export, KAD.3023 Home and Export	5·570 : 1
KAL.3023 Home and Export, KAL.4023/KAL.4035 Home and Export	5·430 : 1
KAH.4023/KAH.4035 Home and Export, KAD.4023/KAD.4035 Home and Export, KAL.6035 Home and Export	6·000 : 1
KAB.6035 Home and Export	4·875 : 1

Overall gear ratios

Axle ratio	4·875	5·430	5·570	6·000	6·570
Top	4·875	5·430	5·570	6·000	6·570
Third	8·299	9·245	9·484	10·22	11·19
Second	14·77	16·44	16·88	18·18	19·90
First	28·13	31·33	32·15	34·62	37·91
Reverse	34·05	37·93	38·91	41·92	45·90

Adjustment for tooth contact (between crown wheel and bevel pinion)	
Bevel pinion adjustment (for setting mesh of bevel pinion in relation to the crown wheel)	Shims fitted between the bevel pinion bearing sleeve and the gear carrier. Shims are obtainable in ·003/·005 and ·012 in. (·076/·127 and ·305 mm.) thicknesses
Crown wheel adjustment (for setting mesh of crown wheel in relation to the bevel pinion)	By means of externally threaded bearing adjusters seating in the gear carrier and caps, and abutting the bearing cups. The adjusters are locked by pins registering in the castellated end faces.
Crown wheel side thrust	Taken on a phosphor bronze pad, positioned by means of a steel stud
Bearings	
Hub bearings	Taper roller
Adjustment	By means of an adjusting nut, secured by a lockwasher and locknut
Bevel pinion bearings	Taper roller
Adjustment	By shims fitted between the bearings and the two distance pieces. A single distance piece is fitted on KAH.3023 and KAD.3023 models, and the shims are located between the distance piece and the outer bearing cone. Shims are obtainable in ·003/·005 and ·012 in. (·076/·127 and ·305 mm.) thicknesses

Bearings—*Data continued*	
Bevel pinion pilot bearing (all models, excepting KAH.3023 and KAD.3023 models)	Parallel roller (the bearing cup is retained in the gear carrier and the cone is a press fit on the bevel pinion spigot)
Lubrication	
Drain plug	Fitted beneath the axle casing banjo
Combined filler and oil level plug (all models, excepting KAH.3023 and KAD.3023 models)	Located in the casing rear cover
Filler plug (KAH.3023 and KAD.3023 models only)	Positioned on the upper side of the gear carrier
Oil level plug (KAH.3023 and KAD.3023 models only)	Situated in the casing rear cover
Oil capacity	
—All models, excepting KAH.3023 and KAD.3023 models	5 pint (2·75 litre)
—KAH.3023 and KAD.3023 models only	7 pint (4 litre)

MANUFACTURING DATA

	inches	*millimetres*
Differential (All Models, excepting KAH.3023 and KAD.3023 Models).		
Backlash (crown wheel to bevel pinion)	·009 in. to ·012 in. (·229 mm. to ·305 mm.)	
Internal diameter of pinions	1·0060/1·0045	25·552/25·514
Diameter of cross pin spigots	1·001/1·000	25·425/25·400
Clearance between cross pin spigot and internal diameter of pinion	·0035 in. to ·0060 in. (·089 mm. to ·152 mm.)	
Internal diameter of differential case on register for bevel wheel	2·194/2·188	55·728/55·575
Diameter of bevel wheel spigot	2·182/2·180	55·423/55·372
Clearance between bevel wheel spigot and internal diameter of differential case	·006 in. to ·014 in. (·152 mm. to ·356 mm.)	
Thrust washer thickness		
Pinion	·037/·036	·940/·914
Bevel wheel	·065/·063	1·651/1·600
Crown wheel thrust pad thickness	·210/·200	5·334/5·080
Average clearance, thrust pad to crown wheel	·015	·381
Differential (KAH.3023 and KAD.3023 Models Only).		
Backlash (crown wheel to bevel pinion)	·006 in. to ·009 in. (·152 mm. to ·229 mm.)	
Internal diameter of pinions	1·0675/1·0655	27·115/27·064
Diameter of cross pin spigots	1·0620/1·0615	26·975/26·962
Clearance between cross pin spigot and internal diameter of pinion	·0035 in. to ·0060 in. (·089 mm. to ·152 mm.)	
Internal diameter of differential case on register for bevel wheel	1·8905/1·8895	48·019/47·993
Diameter of bevel wheel spigot	1·8877/1·8855	47·949/47·892
Clearance between bevel wheel spigot and internal diameter of differential case	·0018 in. to ·0050 in. (·046 mm. to ·127 mm.)	
Crown wheel thrust pad thickness	·210/·200	5·334/5·080
Average clearance, thrust pad to crown wheel	·015	·381

TORQUE WRENCH DATA

All Models, excepting KAH.3023 and KAD.3023 Models.

Axle shaft to hub stud nuts	40 lb. ft. (5·53 kg. m.)
Driver coupling nut	200 lb. ft. (27·65 kg. m.)
Bevel pinion bearing sleeve to gear carrier setscrews	55 lb. ft. (7·60 kg. m.)
Gear carrier to casing setscrews	60 lb. ft. (8·30 kg. m.)
Rear cover to casing setscrews	60 lb. ft. (8·30 kg. m.)
Gear carrier bearing cap setbolts	175 lb. ft. (24·19 kg. m.)
Differential case (half) setbolts	55 lb. ft. (7·60 kg. m.)
Differential case to crown wheel setbolts	90 lb. ft. (12·44 kg. m.)
Brake assembly to casing, setbolts and nuts	35 lb. ft. (4·84 kg. m.)

KAH.3023 and KAD.3023 Models Only.

Axle shaft to hub setbolt nuts	25 lb. ft. (3·46 kg. m.)
Wheel stud, hub to brake drum backnuts	175 lb. ft. (24·19 kg. m.)
Driver coupling nut	150 lb. ft. (20·74 kg. m.)
Bevel pinion bearing sleeve to gear carrier setscrews	35 lb. ft. (4·84 kg. m.)
Gear carrier to casing setscrews	35 lb. ft. (4·84 kg. m.)
Rear cover to casing setscrews	25 lb. ft. (3·46 kg. m.)
Gear carrier bearing cap stud nuts, or bolts	125 lb. ft. (17·28 kg. m.)
Differential case (half) and crown wheel setbolt nuts	65 lb. ft. (8·99 kg. m.)
Brake assembly to casing, setbolts and nuts	35 lb. ft. (4·84 kg. m.)

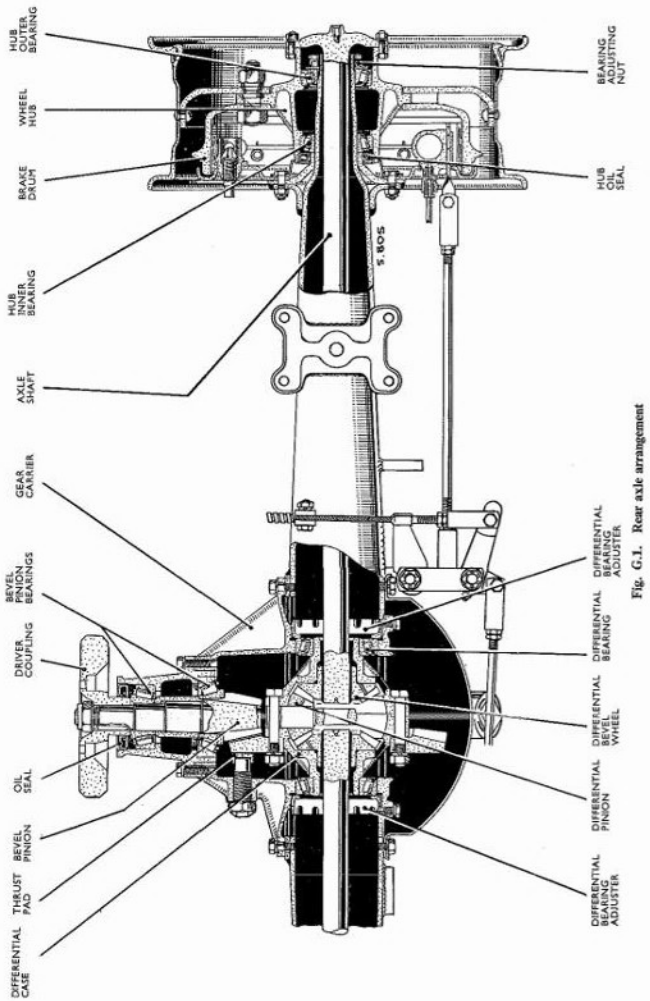


Fig. G.1. Rear axle arrangement

REAR AXLE

For information in respect of the Rear Axle as fitted to KAL.3023, and all KA.40 and KA.60 Models, see pages G.20 to G.35.

DESCRIPTION

The rear axle is of the fully floating type, enclosed in a pressed steel banjo casing, each end of the casing being reduced in diameter to take the opposed taper roller bearings, on which the hubs revolve. Mounting plates welded to the casing adjacent to the reduced ends provide the means of anchoring the brake assemblies. Positioned adjacent to the mounting plates and again welded to the casing are pressed steel saddles, which seat the road springs. In addition various smaller brackets, also welded to the casing, provide support for the compensator linkage, handbrake cable, brake hose three-way connector and the shock absorber links.

The gear carrier, housing the complete final drive is secured to the front of the banjo centre section of the casing, while the casing is closed at the rear by a pressed steel cover, which incorporates an oil level plug located in a cast housing. The oil filler plug is situated at the top of the gear carrier. Screwed into the casing above and below the final drive, is a breather and a drain plug respectively.

The final drive is by a spiral bevel crown wheel and pinion. The drive from the propeller shaft is transmitted to the bevel pinion, via a driver coupling of the "transmission damper" type, which is located radially on the bevel pinion shaft by means of two feather keys and retained with a washer and Simmonds nut. The shaft of the bevel pinion is supported in two opposed taper roller bearings housed in a bearing sleeve. These bearings are preloaded, shims being provided for obtaining this accurately. The shims are located together with a distance piece between the bearing cones and positioned so as to abut the outer bearing cone and the small diameter end of the distance piece. To prevent lubricant loss, an oil seal is pressed into the end of the bearing sleeve, and the sealing lip seats around the boss on the driver coupling. The bearing sleeve is retained on the gear carrier by setscrews, and shims are provided between the flange on the sleeve and the carrier for the purpose of accurately setting the depth of tooth contact between the pinion and the crown wheel. To ensure lubricant in sufficient quantities is supplied to the bevel pinion bearings, oil is thrown from the crown wheel and directed, via a collecting duct in the gear carrier, through an aligning passage in the bearing sleeve and hence into the annulus formed between the pinion bearings. Any oil which finds its way through the outer bearing is checked by the oil seal and excess oil drains back to the axle casing through the bearing races.

The crown wheel locates on an accurately ground register formed in one half of the two piece differential case, and is secured to the differential case by means of long setbolts and nuts. The differential case revolves on opposed taper roller support bearings, which are preloaded and housed in the gear carrier. Bearing caps secured to the gear carrier by means of studs, nuts and split pins serve to clamp the support bearings on early models, whilst bolts and spring washers serve to secure the bearing caps on later models. A castellated screwed sleeve fitted over and abutting the cup of each bearing act as bearing adjusters. The bearing adjusters also enable the whole differential assembly and crown wheel to be moved bodily to either side for the purpose of obtaining the correct backlash between the crown wheel and pinion teeth.

A thrust pad is provided to support the crown wheel at times of sudden excessive loads. This thrust pad comprises a phosphor bronze ferrule on a steel stud, and is mounted in the gear carrier directly behind the crown wheel at the point of mesh with the pinion. The stud is secured by means of a locknut and lockwasher.

The differential assembly contains in the two piece case, two bevel wheels in constant mesh with two pinions. One pinion is located on each spigot of a cross pin, and the pin is supported at each end in bores formed between the two differential case halves. Holes drilled in the outer ends of the cross pin align with similar holes in the differential case and the setbolts passing through these holes secure the pin. The bevel wheels are splined internally to take the axle shafts and are fitted to similar bores, one in each half of the differential case, where they mesh with the differential pinions.

From the differential assembly the drive is taken by fully floating axle shafts to the hubs, a flange integral with the shaft being secured to the hub by setbolts and nuts.

The hubs revolve on opposed taper roller bearings carried on the axle casing. Shoulders integral with the hub, locate the cups of the bearings, whilst the cone of the inner bearing is located in position against a shoulder formed by the brake assembly mounting plates and the cone of the outer bearing is retained by a bearing safety washer and two nuts, one for bearing adjustment purposes and the other acting as a locknut. A lockwasher is interposed between the nuts. The hub is sealed against lubricant loss, with an oil seal fitted to the inner end, and a joint fitted at the outer end, between the hub and axle shaft flange.

An oil catcher is secured at its outer flanged end by means of the same setbolts and nuts which mount the brake backing plate to the axle casing. The inner edge of the oil catcher is positioned adjacent to the oil seal and provides a protective shield to catch any oil, which may be thrown from the seal and functions in conjunction with a drain hole provided in the mounting plates.

Studs seated in the hub flange, each located by a dowel, provide the means of attaching the brake drums on the inner side by backnuts, and the road wheels on the outer side by means of the retaining nuts.

OPERATION

The drive is transmitted by the propeller shaft to the bevel pinion and the meshing crown wheel, through the differential pinions and bevel wheels to the axle shafts and hence to the hubs and wheels. For the drive at the propeller shaft to be available at the road wheels for traction, both wheels must contact the ground, without slip occurring, thus the "couple" existing between the differential cross pin and the axle shafts, through the medium of the differential pinions and bevel wheels is maintained under these drive conditions.

The differential gearing enables the rear wheels to rotate at independent speeds when the vehicle is deviated from the straight ahead, i.e., cornering, etc., with the result that the differential pinions are caused to rotate about the cross pin and around the meshing bevel wheels positioned on either side. The drive is still maintained however to the road wheels by means of the "couple" existing within the differential gearing.

When the vehicle is driven straight ahead and the forces opposing the road wheels are equal, no rotation of the differential pinions occurs about the meshing bevel wheels, the drive being transmitted by the "couple" existing within the differential gearing.

LUBRICATION

Axle.

Every 8,000 mile (12,000 km.) the axle should be drained, flushed and refilled with fresh oil of the recommended grade.

The drain plug is located underneath the axle casing and the cranked solid key supplied in the tool kit should be used for removing the plug. Separate oil filler and level plugs are incorporated, the level plug being located in the rear cover, whilst the filler plug is screwed into the top of the gear carrier. The oil level is correct when oil overflows from the orifice for the level plug.

Wheel Hubs.

The hubs are packed with grease during original assembly at the factory. Every 24,000 mile (36,000 km.) the hubs should be cleaned out and repacked with fresh grease of the recommended grade. To carry out this operation the hub must be removed, cleaned, repacked and refitted as described under the appropriate sub-headings of "Wheel Hubs and Bearings", on pages G.9, G.11 and G.12.

Important: Whilst it is not desirable to completely fill the cavity between the inner and outer bearings with grease when repacking, it is essential to ensure an adequate supply of grease is placed in the immediate vicinity of both bearing races. Apply the grease in the hub so as to leave a space around the axle casing when assembled. On re-assembly of the hub to the axle casing, pack the space between the safety washer and the outer bearing with grease. Finally pack the cavity around the adjusting and lock nuts with grease.

AXLE SHAFTS

To Remove.

1. Unscrew and remove the nuts and spring washers that secure the axle shaft flange to the setbolts in the wheel hub.

2. Remove the axle shaft. Two $\frac{5}{16}$ in. B.S.F. tapped holes are provided in the shaft flange to assist the initial break. Insert two suitable bolts into these holes and screw them in alternately and equally until a lever can be applied between the flange and the hub.

3. Withdraw the setbolts from the wheel hub.

Inspection.

1. Examine the shaft generally for bend or cracks and the splines for wear or twist. Renew the axle shaft if damage is evident. The axle shaft splines may be tested for backlash, using a new differential bevel wheel as a gauge.

2. Check the flange setbolts for stretch and the threads for damage, renewing as necessary.

To Refit.

1. Ensure the mating faces of the hub and the axle shaft flange are clean and free of burrs, then fit a new joint to the flange on the hub.

2. Insert the shaft into the axle casing, ensuring that after engaging the splines in the differential bevel wheel, the shaft is entered squarely. If necessary a few light hammer blows may be applied to the flange of the shaft to ensure that the shaft is fully home.

3. Refit the securing setbolts to the hub flange, engaging the setbolts in the holes on the axle shaft flange.

4. Refit the nuts and spring washers, screw down alternately and tighten securely to a torque wrench reading of 25 lb. ft. (3·46 kg. m.).

WHEEL HUBS AND BEARINGS

Checking Hub Bearings for End Float.

It is recommended that every 12,000 mile (18,000 km.) the hub bearings should be checked for end float, noting that the hubs should not be removed unnecessarily.

To check the end float, proceed as follows:

1. Jack up the vehicle under the rear axle until the road wheels clear the ground and suitably support the axle casing on stands.

2. Remove the road wheels.

3. Withdraw the axle shafts (see above).

4. To record hub end float readings, utilise a dial gauge and suitably secure to the axle shaft flange on the hub, using the Gauge Post, Churchill Tool R.G. 334, Code 1. Insert the Adaptor Pad, Churchill Tool R.G. 334, Code 2 in the outer end of the axle

casing and position the dial gauge so that its pointer contacts the adaptor pad on the centrally disposed depression.

5. With a bar approximately 48 in. (122 cm.) long applied to the ground and to the outer face of the hub, exert leverage to move the hub and drum assembly for its maximum movement in an inward direction. Zero the scale of the dial gauge with the hub maintained in this position, and then remove the bar.

6. Applying two levers approximately 18 in. (46 cm.) long at diagonally opposite positions between the brake backing plate and the lip of the brake drum, exert pressure to displace the hub and drum assembly through its maximum outward travel.

7. Observe the reading on the dial gauge when the hub is in its outermost position. For the hub bearings to be in correct adjustment, an axial end float reading of between ·003 in. to ·006 in. (·076 mm. to ·152 mm.) must be obtained on the dial gauge. Remove the two levers, the dial gauge and the adaptor pad. If the reading obtained is outside the designed axial end float limits, the hub bearings must be adjusted as detailed under "To Adjust the Hub Bearings". However, if the axial end float on the hub bearings is correct, remove the gauge post, install the axle shafts and refit the road wheels.

To Adjust the Hub Bearings.

1. Jack up the rear axle until the road wheels clear the ground and suitably support the axle casings on stands.

2. Remove the road wheels.

3. Withdraw the axle shafts (see page G.8).

4. Straighten the tabs of the lockwasher and remove the outer, or locknut, using Churchill Tool R.G.95.

5. Withdraw the lockwasher.

6. To adjust the hub bearings to within the end float limit of ·003 in. to ·006 in. (·076 mm. to ·152 mm.), proceed in the following manner:

(*a*) To record hub end float readings, utilise a dial gauge and suitably secure to the axle shaft flange on the hub, using the Gauge Post, Churchill Tool R.G. 334, Code 1. Insert the Adaptor Pad, Churchill Tool R.G. 334, Code 2 in the outer end of the axle casing, and position the dial gauge so that its pointer contacts the adaptor pad on the registration depression at the centre of the pad.

(*b*) With a bar approximately 48 in. (122 cm.) long applied to the ground and to the outer face of the hub, exert leverage to move the hub and drum assembly for its maximum movement in an inward direction. Zero the scale of the dial gauge with the hub maintained in this position, and then remove the bar.

(*c*) Applying two levers approximately 18 in. (46 cm.) long at diagonally opposite positions between the brake backing plate and the lip of the brake drum, exert pressure to displace the hub and drum assembly through its maximum outward travel.

(*d*) With the hub maintained in this position, observe the reading on the dial gauge. For the adjustment to be correct an end float reading of between ·003 in. to ·006 in. (·076 mm. to ·152 mm.) must be obtained. Remove the two levers, the dial gauge and the adaptor pad.

(*e*) Should the reading obtained be outside the designed axial end float limits, slacken back the adjusting nut to increase, or screw in the adjusting nut to decrease the hub end float, until a reading within the correct limits is obtained. Use Churchill Tool R.G. 95 to rotate the adjusting nut.

7. Refit the lockwasher and the locknut. Tighten the locknut, taking care not to move the adjusting nut.

8. Check again to ascertain that the end float reading has not altered. Remove the gauge post from the hub flange. Secure both the locknut and the adjusting nut by turning a tab on the lockwasher over a flat on each of the nuts.

9. Refit the axle shafts and the road wheels.

To Remove.

1. Jack up the rear of the vehicle until the road wheels clear the ground and suitably support the axle on stands.

2. Remove the road wheels.

3. Withdraw the axle shafts (see page G.8).

4. Straighten the tabs on the lockwasher and then remove the locknut, lockwasher, adjusting nut and the bearing safety washer. The removal of these nuts is facilitated by the use of Churchill Tool R.G.95.

5. Ensure the handbrake is in the "off" position, then withdraw the hub complete with brake drum, bearings and oil seal, using Churchill Main Tool R.G.51B with the Bridge R.G.51B–9 and the Adaptor Set R.G.51B–10. Alternatively if difficulty is experienced in freeing the hub and brake drum assembly, apply light blows with the aid of a hide faced hammer in diagonally opposite positions on the drum lip.

To Dismantle.

1. In certain instances the inner bearing cone and the oil seal will remain on the axle casing and removal is facilitated by the use of suitable levers applied behind the inner bearing cone, until the cone is freed from the axle casing. Ensure the rollers and cage of the bearing cone are not damaged during this operation. It is usual for the inner bearing cone and oil seal to be withdrawn with the hub assembly. Remove the hub bearings as follows:

(*a*) Tap the oil seal and inner bearing cone clear of the register in the hub (if these components have been withdrawn with the hub), using light and alternate blows applied by means of a drift to the flat face of the bearing cone. Care must be taken to avoid damage to the bearing cage.

1 DIFFERENTIAL BEARING ADJUSTER
2 ADJUSTER LOCKING SCREW
3 DIFFERENTIAL BEARING
4 RIGHT HAND DIFFERENTIAL CASE HALF
5 to 7 CROWN WHEEL AND DIFFERENTIAL CASE SECURING BOLT, WASHER AND NUT
8 DIFFERENTIAL PINION WHEEL
9 DIFFERENTIAL PINION
10 DIFFERENTIAL CROSS PIN
11 LEFT HAND DIFFERENTIAL CASE HALF
12 CROWN WHEEL
13 AXLE SHAFT FLANGE JOINT
14 AXLE SHAFT
15 WHEEL HUB TO AXLE SHAFT SETBOLTS
16 HUB BEARING ADJUSTING NUT LOCKWASHER
17 HUB BEARING SAFETY WASHER
18 HUB OUTER BEARING
19 WHEEL RETAINING NUT
20 WHEEL STUD
21 WHEEL STUD DOWEL PEG
22 HUB
23 BRAKE DRUM
24 WHEEL STUD BACKNUT
25 HUB INNER BEARING
26 OIL SEAL
27 OIL CATCHER
28 GEAR CARRIER CAP BOLTS
29 FILLER PLUG
30 CROWN WHEEL THRUST PAD
31 THRUST PAD STUD
32 and 33 STUD LOCKWASHER AND LOCKNUT
34 BEVEL PINION INNER BEARING
35 BEARING SPACER PIECE
36 BEARING SHIM
37 BEVEL PINION OUTER BEARING
38 BEVEL PINION BEARING SLEEVE
39 DRIVER COUPLING
40 and 41 DRIVER COUPLING SECURING NUT AND WASHER
42 COUPLING OIL SEAL
43 BEARING SLEEVE SECURING SETSCREW
44 BEVEL PINION
45 COUPLING KEY
46 BEVEL PINION ADJUSTMENT SHIM
47 GEAR CARRIER

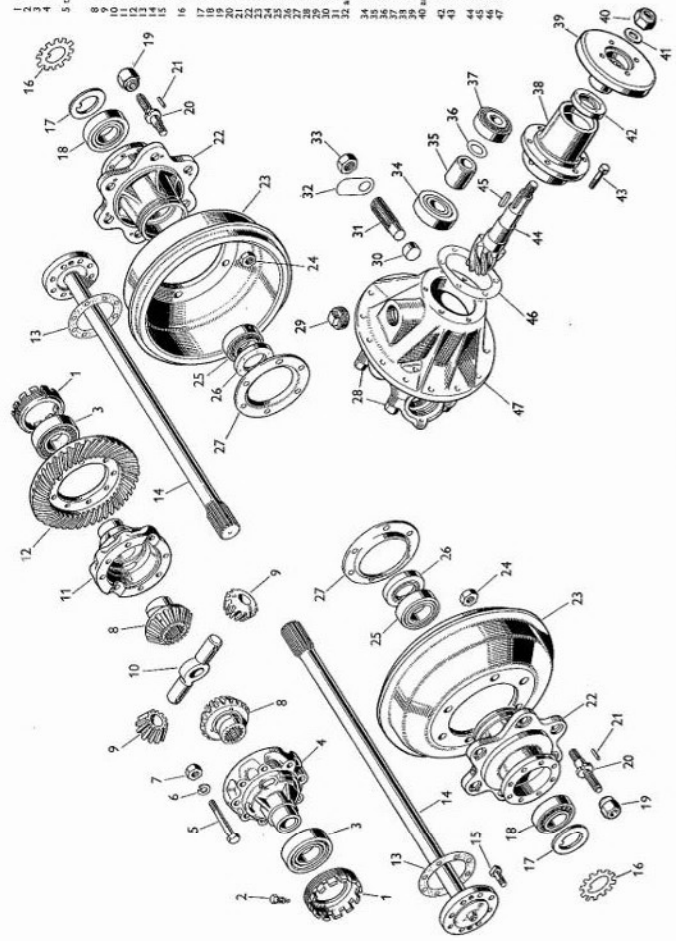


Fig. G.2. Rear axle details

(*b*) To facilitate removal of the inner bearing cup, use of the Churchill Adaptor Pad R.G.322 is recommended, in conjunction with the Universal Handle 550. Press out the bearing cup from its register in the hub.

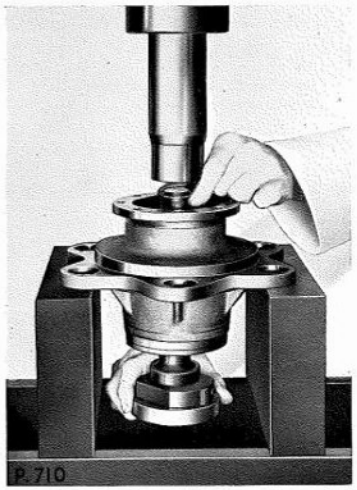


Fig. G.3. Pressing out the wheel hub inner bearing cup, using the Churchill Tool R.G.322 in conjunction with the universal handle 550

(*c*) The outer bearing cup is removed in a similar manner as described above in para. (*b*) for the inner bearing, but for this application the use of Churchill Adaptor Pad R.G.321, in conjunction with the Universal Handle 550 is recommended. Press out the bearing cup from its register in the hub.

2. If it is necessary to separate the hub from the drum, the backnuts must first be removed and the drum can be driven off with light blows, using a hide faced hammer. It will also be necessary to remove the appropriate backnuts to facilitate wheel stud renewal.

Inspection and Overhaul.

Clean all the components thoroughly before inspection. The bearings should be cleaned in white spirit and blown out using clean, dry compressed air. The air stream must not be allowed to spin the rollers and cage whilst cleaning the cone of the bearing, but the cage should be rotated slowly by hand. After cleaning, the complete bearing, if being retained for re-assembly, must be immediately lubricated with sufficient thin oil to prevent corrosion.

1. Examine the bearing rollers and the track of the cones for wear or pitting, and the roller cage for damage. Examine also the bearing cups for wear or pitting. If any of these conditions are apparent the complete bearing must be renewed.

2. The bearing cups must be an interference fit in the hub. Renew the hub if the cups slip into their registers.

3. Renew the oil catcher if damaged beyond repair. This will be freed upon releasing the brake backing plate setbolts and nuts. When refitting the new oil catcher, ensure the lip on the inner edge is facing outward towards the hub locations and tighten the backing plate setbolts and nuts to a torque wrench reading of 35 lb. ft. (4·84 kg. m.).

4. Renew the oil seal if damaged in any way.

5. Check the threads of the wheel studs. If damaged beyond repair renew the studs. Renew also the backnuts if they have been removed.

To Re-assemble.

Prior to carrying out this operation, ensure the bearing registers in the hub are clean and free from burrs, and lightly smear with lubricant.

1. If the hub and brake drum have been separated, or the backnuts removed for wheel stud renewal, re-assemble the components by reversing the removal operations, observing the following points:

(*a*) As a precaution against the backnuts working loose, the wheel studs are staked at the Factory on original assembly, therefore, always renew the backnuts when assembling and if the same wheel studs are used again, the threads must be redressed before attempting to fit new backnuts.

(*b*) When refitting the new wheel studs, line up the semi-circular recess in the shoulder of the stud with the hole provided in the hub flange, then tap the stud into position. Drive the dowel peg through the recess in the wheel stud and into the hole in the hub flange, ensuring that it does not protrude from the hub flange surface, which locates the brake drum.

(*c*) The backnuts must be tightened to a torque wrench reading of 175 lb. ft. (24·19 kg. m.).

(*d*) Finally stake each wheel stud to its respective backnut.

2. To facilitate fitting of the bearing cups (thick end foremost), to their respective registers in the hub, it is recommended that the Churchill Adaptor Pads R.G.322 and R.G.321 are used, these pads being applicable to the inner and outer bearing cups respectively. These adaptor pads are for use on a press, in conjunction with the Churchill Universal Handle 550. Press each bearing cup into its register in turn until flush against the shoulder in the hub (see Fig. G.4). Remove the adaptor pads. Ensure the bearing cups abut their respective shoulders in the hub squarely.

3. Repack the two bearing cones with the recommended grade of fresh grease, forcing the grease in between

the rollers and under the roller cages until fully packed, working from the larger diameter end of each bearing. Liberally smear the outer protruding surfaces of the rollers and cages with grease, also the working face of the bearing cups in the hub.

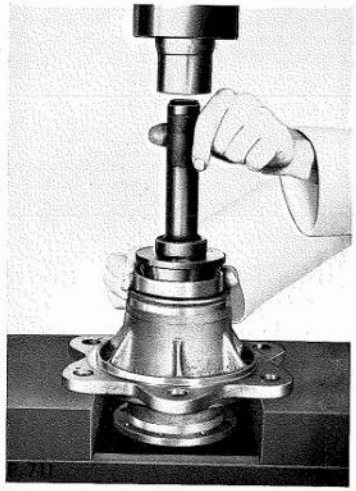


Fig. G.4. Pressing in the wheel hub inner bearing cup, using the Churchill Tool R.G.322, in conjunction with the universal handle 550

4. Repack the hub with grease (see "Important Note" under "Lubrication—Wheel Hubs", on page G.8).

5. Complete the re-assembly by placing the inner bearing cone into its cup and then refit the oil seal squarely into the register in the hub with the sealing lip facing the bearings, until the oil seal is flush with the inner end face of the hub.

To Refit.

To refit the hubs reverse the removal procedure, adjusting the hub bearings as detailed on page G.9. Refit the axle shafts as detailed on page G.8.

BEVEL PINION ASSEMBLY

To Remove.

The bevel pinion, together with its two taper roller bearings, distance piece, adjustment shims, oil seal and driver coupling form a complete sub-unit assembled to the pinion bearing sleeve, and can be removed as an assembly.

1. Disconnect the propeller shaft from the driver coupling and suitably support the shaft.

2. Remove the setscrews securing the bearing sleeve to the gear carrier. Withdraw the assembly, tapping lightly on the rear of the driver coupling flange with a soft faced hammer, if necessary to effect removal.

Note: The thickness and number of shims fitted between the bearing sleeve and the gear carrier should be noted so that the same thickness can be used on re-assembly.

To Dismantle.

1. Remove the driver coupling securing nut. Tap the coupling free using a soft faced hammer, or if a heavy interference fit with the pinion shaft is encountered, the coupling may then be withdrawn with the aid of Churchill Main Tool 55, the Legs R.G.55–8 and the Adaptor Set R.G.55–10 (see Fig. G.5).

2. Remove the two feather keys from the bevel pinion shaft.

3. Grip the bearing sleeve on either side of the drilled flange (threaded portion of pinion downwards) and bump the end of the pinion on a wood, or lead block until the pinion and the cone of the inner bearing are clear of the sleeve. This operation will also free the distance piece and shims. Remove the oil seal from its register in the bearing sleeve by tapping on the inner face of the outer bearing cone, when the oil seal and bearing cone will be free for withdrawal.

4. The operation of removing the bearing cups from the bearing sleeve is facilitated by the use of the Churchill Adaptor Pads R.G.315 and R.G.323, these pads being applicable to the inner and outer bearing cups respectively. Firstly, remove the inner bearing cup, using the appropriate split adaptor pad, in conjunction

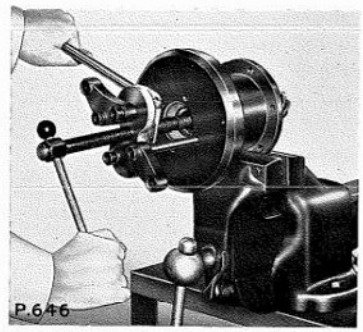


Fig. G.5. Withdrawing the driver coupling, using the Churchill Main Tool 55 in conjunction with the legs R.G.55-8 and the adaptor set R.G.55-10

with the Churchill Universal Handle 550. Press out the inner bearing cup from its register in the bearing sleeve (see Fig. G.6). Press out the remaining bearing cup in a similar manner as described above for the cup of the inner bearing, but in this case use the Churchill Adaptor Pad R.G.323 to facilitate this operation (see Fig. G.7).

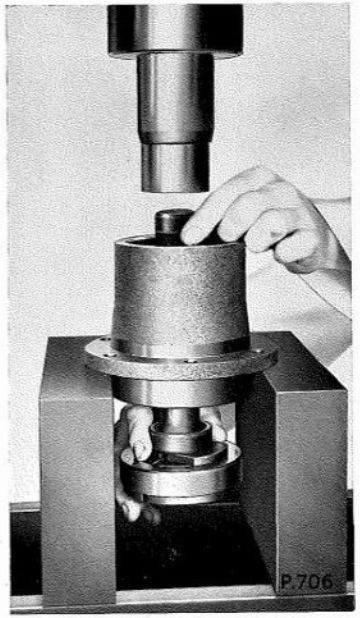


Fig. G.6. Pressing out the bevel pinion inner bearing cup from the bearing sleeve, using the Churchill Tool R.G.315, in conjunction with the universal handle 550, applied in the normal position

Fig. G.7. Pressing out the bevel pinion outer bearing cup from the bearing sleeve, using the Churchill Tool R.G.323, in conjunction with the universal handle 550, applied in the reversed position

Note: When pressing **out** the outer bearing cup, the Universal Handle 550 is used in the **reversed** position, as shown in the illustration.

5. To remove the cone of the inner bearing from the bevel pinion shaft, employ Churchill Main Tool R.G. 4221B and the Adaptor Set R.G.4221B–22 (see Fig. G.8). Alternatively the bearing may also be removed by applying a drift between the teeth of the pinion and tap alternately on opposite sides of the cone taking care not to damage the bearing cage.

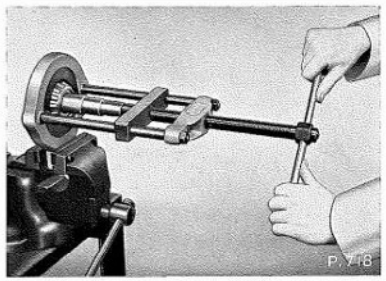


Fig. G.8. Withdrawing the inner bearing cone from the bevel pinion, using the Churchill Tool R.G.4221B and the adaptor set R.G.4221B-22

Inspection and Overhaul.

1. Wash all bearings in white spirit and blow out using clean, dry compressed air. When dealing with the bearing cone the air stream must not be allowed to spin the rollers and cage whilst cleaning, but the cage should be slowly rotated by hand. After cleaning, the complete bearing, if being retained for re-assembly,

must be immediately lubricated in sufficient thin oil to prevent corrosion. Examine the bearings for wear or pitting on the track of the cones, rollers and bearing cups, also examine the roller cage for damage. The bearings must be renewed complete, i.e., cup and cone, if such damage is evident.

2. Examine the oil seal and renew if operating inefficiently.

3. Examine the teeth of the bevel pinion and if these are damaged the pinion should be renewed.

Note: The pinion and crown wheel must be renewed as a pair, due to their being matched during manufacture to ensure quiet running.

4. Renew the feather keys if they are damaged.

5. Examine the driver coupling bolt holes for elongation and the two keyways for wear.

To Re-assemble.

1. Ensure there are no burrs or foreign matter on the shoulders inside the bearing sleeve, which might cause the bearing cups to pitch. To facilitate fitting of the bearing cups (thick end face foremost) to their respective registers in the bearing sleeve, it is recommended that the Churchill Adaptor Pads R.G.315 and R.G.323 are used, in conjunction with the Churchill Universal Handle 550, these adaptor pads are applicable to the inner and outer bearing cups respectively.

Fig. G.9. Pressing in the bevel pinion inner bearing cup, using the Churchill Tool R.G.315 in conjunction with the universal handle 550, applied in the normal position

Note: For this operation the Universal Handle 550 is used in the normal position as shown in the illustration.

Press each bearing cup into its register, until flush with the shoulder in the bearing sleeve (see Figs. G.9 and G.10). Remove the adaptor pads. Ensure the bearing cups abut their respective shoulders in the bearing sleeve squarely.

Fig. G.10. Pressing in the bevel pinion outer bearing cup, using the Churchill Tool R.G.323, in conjunction with the universal handle 550, applied in the normal position

2. Place the bevel pinion in an upright position on a wood or lead block, and with Churchill Hollow Drift R.G.77, Code 2 tap the cone of the inner bearing on to the pinion. Ensure the bearing abuts against the gear teeth. Churchill Tool R.G.4221B and the Adaptor Set R.G.4221B–22 may also be used for this operation as shown at Fig. G.11.

3. Slide the distance piece and shims on to the bevel pinion. The shims are fitted to facilitate bearing preload adjustment.

4. Smear the bearings with thin lubricant, then place the bearing sleeve complete with the cups, over the pinion shaft. Fit the cone of the outer bearing and tap it into position with the aid of Churchill Hollow Drift R.G.77, Code 2.

5. The pinion bearings must now be checked for preload and if necessary adjusted. **Carry out this operation without fitting the oil seal.** Fit the driver coupling to the pinion shaft and tighten its securing nut to a torque

wrench reading of 150 lb. ft. (20·74 kg. m.). Whilst tightening the nut rotate the bearing sleeve. It is suggested that a slave nut be employed during adjustment of the pinion bearings as it is not recommended that nuts with fabric, or nylon inserts be removed and refitted unnecessarily.

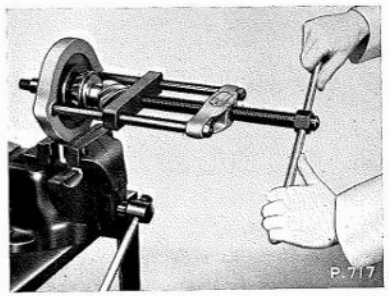


Fig. G.11. Fitting the bevel pinion inner bearing cone, using the Churchill Tool R.G.4221B and the adaptor set R.G.4221B-22

With the pinion held stationary a noticeable drag should be felt when the bearing sleeve is turned. This drag should be equivalent to a torque of 10 to 15 lb. in. (11·51 to 17·27 kg. cm.).

To check bearing preload proceed as follows:

(*a*) Wrap a length of cord around the sleeve, with one end anchored by a split pin located in one of the sleeve setscrew holes, then with a pound scale attached to the other end, pull on a line tangential to the outer diameter of the sleeve (see Fig. G.12).

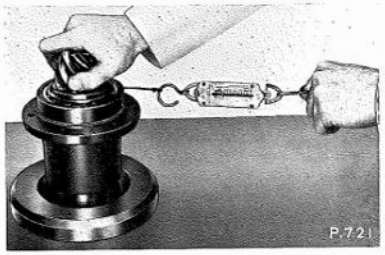


Fig. G.12. Checking the bevel pinion bearing preload, using a spring balance

(*b*) To give the correct torque reading, a figure of 4·5 to 6·5 lb. (2·04 to 2·95 kg.) should be obtained on the pound scale. It is important that the sleeve must be rotating when taking this reading, due to the starting torque being higher.

6. If the reading is not within the correct limits, remove the driver coupling and dismantle the assembly (see paras. 1 to 3 under "To Dismantle", on page G.12), then change the shims fitted between the distance piece and the outer bearing race, i.e., if the reading is too high, increase the thickness, but if the reading is too low decrease the thickness. Shims of three different thicknesses are available, these being ·003/·005 and ·012 in. (·076/·127 and ·305 mm.).

Repeat the above operation until the correct reading is obtained, each time tightening the coupling securing nut to the correct torque wrench figure (see para. 5).

7. When the bearings have been adjusted for preload, remove the driver coupling and fit the oil seal to the top of the bearing sleeve.

8. Refit the two feather keys and tap the coupling on to the pinion shaft, tightening the coupling securing nut to a torque wrench reading of 150 lb. ft. (20·74 kg. m.).

To Refit.

Insert the bevel pinion assembly into the gear carrier, locating between the bearing sleeve flange and the gear carrier, the same thickness of shims as removed, and noting the following:

1. Ensure the oil passage in the spigot on the bearing sleeve lines up with the mating passage in the bore of the gear carrier.

2. Reference should be made to "Adjusting Tooth Contact" (see page G.17). Until the correct thickness of shims has been ascertained, secure the assembly temporarily with three setscrews.

3. The setscrews must be finally tightened to a torque wrench reading of 35 lb. ft. (4·84 kg. m.).

DIFFERENTIAL AND DRIVE GEAR ASSEMBLY

To Remove.

1. Drain the oil from the axle casing.

2. Remove the axle shafts (see page G.8).

3. Disconnect the propeller shaft from the driver coupling. Swing the rear end of the propeller shaft to one side and suitably support.

4. Remove the setscrews and nuts that secure the gear carrier to the axle casing, when the complete differential and drive gear assembly may be withdrawn.

To Dismantle.

1. Remove the bevel pinion assembly. The removal and dismantling procedures for this assembly are detailed on page G.12.

2. Remove the differential bearing adjuster locking screws and spring washers from the bearing caps.

3. Remove the split pins and nuts that secure the bearing caps and lift off the caps. On later models the

bearing caps are secured by bolts and spring washers. The bearing adjusters may be lifted from the gear carrier after this operation.

Note: To ensure the bearing caps are refitted to their original position, suitably identify one of the caps to the gear carrier with centre dots.

4. Tap back the lockwasher and slacken the locknut securing the crown wheel thrust pad stud. Screw back the stud until the pad bears against the inside wall of the carrier.

5. Lift the differential assembly complete with the crown wheel from the gear carrier. To break the fit between the bearing cups and the gear carrier, rock the assembly. **Do not allow the bearing cups to be interchanged.**

6. Remove the nuts securing the crown wheel, then tap the crown wheel clear of the differential case and the setbolts with a soft faced hammer.

7. Check that the differential case halves are marked and if they are not marked, do so, thus ensuring that the two halves are re-assembled in the same relative position. Tap out the differential case setbolts and split the case. Lift out the differential pinions, the cross pin and bevel wheels.

8. The bearing cones may be withdrawn from the differential case bosses with the aid of Churchill Main Tool R.G.4221B and the Adaptor Set R.G.4221B-18A (see Fig. G.13).

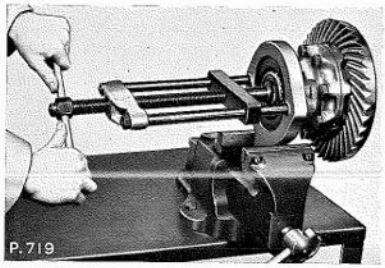


Fig. G.13. Withdrawing the bearing cone from the differential case, using the Churchill Tool R.G.4221B, and the adaptor set R.G.4221B-18A

9. To remove the thrust pad unscrew its stud until the pad is forced off by the gear carrier.

Inspection and Overhaul.

1. With respect to the bevel pinion assembly, refer to page G.13.

2. Examine the crown wheel for wear and defects. If the teeth are chipped or worn the crown wheel must be renewed.

Note: If the crown wheel is renewed the pinion must be renewed also, the two components being carefully matched during manufacture.

3. Check the bevel wheels for wear on the splines which engage with the axle shafts, the splines of a new axle shaft may be used as a gauge in this instance; check also the gear teeth for wear or damage. The latter examination also applies to the differential pinions. Inspect the bore of the pinions for wear or scoring. If damage or wear is excessive on any of these components, the faulty components should be renewed.

4. Examine the pinion cross pin for wear or scores.

5. Examine the inner faces of the differential case, on which the gears bear, for scores. If deep scoring is evident the complete case must be renewed, as the two halves are machined together to very close limits.

6. Wash the bearings in white spirit and blow out using clean, dry compressed air. The air stream must not be allowed to spin the rollers and cage whilst cleaning the bearing cones, but the cage should be slowly rotated by hand. After cleaning, the complete bearings, if being retained for re-assembly, must be immediately lubricated with thin oil to prevent corrosion. Inspect the bearings for wear, pitting or damage and renew as complete bearings, i.e., cup and cone, if necessary.

7. Renew the crown wheel thrust pad if worn.

8. Check all the setscrews and bolts for stretching and damaged threads.

To Re-assemble.

1. Smear the back faces of the bevel wheels and pinions, also the cross pin with lubricant.

2. Place the differential bevel wheels into their respective bore in each half of the differential case.

3. Fit the differential pinions to the cross pin, one on each spigot and place these components in one of the case halves, locating the cross pin in such a manner, so as to line up the bolt holes in the cross pin spigots with those in the case.

4. Unite the differential case halves, ensuring that the marks on the case halves made during dismantling are coincident. Ensure also at this stage that the bolt holes in the cross pin are still in alignment with those in the differential case, by threading setbolts through.

5. Remove any burrs or foreign matter from the front face of the crown wheel and the corresponding register and locating face on the differential case. Refit the crown wheel so as to abut the differential case half identified by the two counterbored setbolt holes. Refit the remaining differential case setbolts to the vacant holes, so as to register the bolt heads in the opposite case half to the one locating the crown wheel, i.e., with the nuts and washers adjacent to the crown wheel back face. Securely tighten the nuts, to a torque wrench reading of 65 lb. ft. (8·99 kg. m.).

6. Smear the bearings with thin lubricant and refit the bearing cones to the differential case bosses, using a suitable drift making certain that they abut against their respective shoulder on the differential case. The bearing cones are an interference fit and the force required to fit them must be applied to the outer face. Ensure the bearing cups are not interchanged.

7. Screw the thrust pad stud into the gear carrier until it protrudes far enough to allow the thrust pad to be fitted. Fit the pad and unscrew the stud until the pad bears against the gear carrier.

8. Lower the differential and crown wheel assembly, complete with the bearing cups into the gear carrier. Engage the bearing adjusters with their mating threads in the gear carrier and fit the bearing caps, with the marks made during dismantling coincident (see para. 3 under "To Dismantle"). Refit the cap nuts, but do not tighten at this stage. On later models the bearing caps are secured by means of bolts and spring washers.

9. Position the differential assembly approximately central in the carrier and also remove all slackness from the bearings by screwing in the adjusters.

10. The bearings must now be preloaded to give a torque of 15 to 18 lb. in. (17·27 to 20·72 kg. cm.). The cap nuts, or bolts, must be tightened to a torque reading of 125 lb. ft. (17·28 kg. m.) before checking the preload.

11. Check the preload as follows:

Wrap a length of cord around the differential case and anchor one end to the case. With a pound scale attached to the free end, pull on a line tangential to the outer diameter of the case (see Fig. G.14), when a reading of 4 to 5 lb. (1·81 to 2·27 kg.) must be obtained for the preload to be correct.

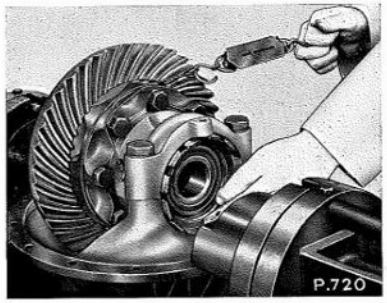


Fig. G.14. Checking the differential bearing preload, using a spring balance

Note: Ensure the assembly is rotating before noting the spring balance reading as the starting torque will be higher.

12. If the reading is incorrect slacken the appropriate cap nuts, or bolts, and tighten, or loosen one of the bearing adjusters until the correct reading is obtained. Before re-checking the preload tighten the cap nuts, or bolts, to 125 lb. ft. (17·28 kg. m.).

13. Re-assemble the pinion assembly (see page G.14) and refit the assembly (see page G.15), when the correct tooth contact can be determined as detailed under "Adjusting Tooth Contact", below.

Adjusting Tooth Contact.

1. Check the backlash. Using the Churchill Tool PT.4008, position the dial gauge to contact one of the crown wheel teeth so that it will record any movement of that tooth (see Fig. G.15). Hold the driver coupling

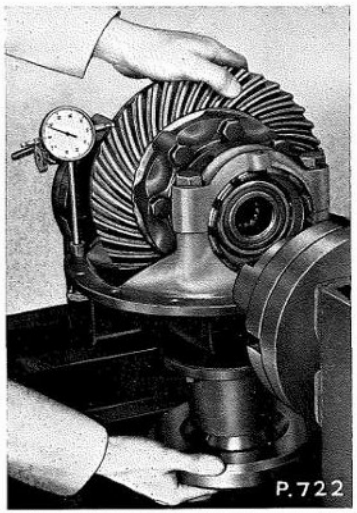


Fig. G.15. Checking for backlash between the crown wheel and bevel pinion teeth, using the Churchill Tool PT.4008

firm and rock the crown wheel back and forth to take up any play between the gear teeth, noting the movement recorded on the dial gauge. Carry out this check in a number of different positions so that any high spot can be taken into consideration. The correct backlash is ·006 in. to ·009 in. (·152 mm. to ·229 mm.).

2. If the backlash is incorrect, adjust as follows:

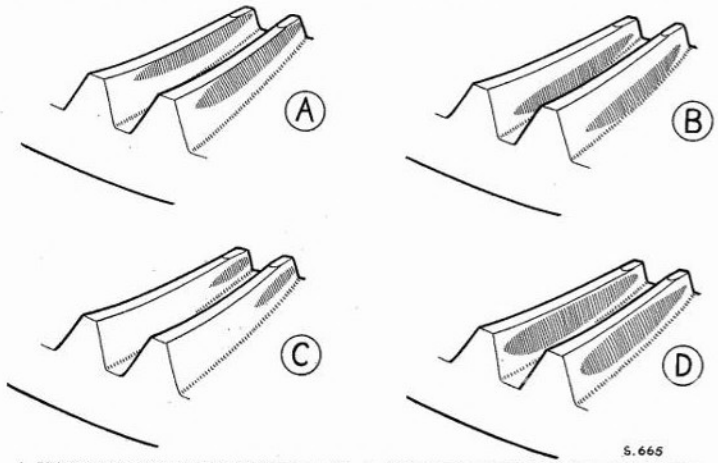
(*a*) **Excessive backlash.** The bearing adjuster facing the teeth of crown wheel must be unscrewed and the whole assembly moved over by tightening the opposite adjuster an **equal** amount.

(*b*) **Insufficient backlash.** Slacken the adjuster behind the crown wheel, then move the assembly in an opposite direction to 2(*a*) by tightening the other adjuster an **equal** amount.

Note: When unscrewing an adjuster note the number of castellations which pass by the aperture in the bearing cap for the adjuster locking screw. The opposite adjuster can then be screwed in by an equal amount in a similar manner. In this way the adjustment of the differential bearings will not be altered.

After effecting the adjustment, the bearing cap nuts, or bolts must be tightened again to the correct torque wrench reading before the backlash is re-checked.

3. Carry out a check to ensure the tooth contact is correct. Brush a thin coat of marking paste over a number of the crown wheel teeth (a suitable paste may be made by mixing red lead with engine oil). Rotate the pinion in a clockwise direction and apply hand pressure to the crown wheel against the direction of rotation in order to obtain a clear mark. Compare the marks on the drive side of the crown wheel teeth with those illustrated at Fig. G.16 when a diagnosis of adjustment may be made as follows:



A INDICATES THAT THE SETTING OF THE PINION IS TOO FAR AWAY FROM THE CROWN WHEEL.
B INDICATES THAT THE PINION IS TOO FAR INTO MESH WITH THE CROWN WHEEL.
C INDICATES INSUFFICIENT BACKLASH (WHEN THE MARKING IS AT THE OPPOSITE END OF THE TEETH, EXCESSIVE BACKLASH IS PRESENT).
D INDICATES THE CORRECT MESHING OF THE BEVEL PINION WITH THE CROWN WHEEL.

Fig. G.16. Specimen tooth engagement markings on the crown wheel

(*a*) Incorrect adjustment as shown by "A" indicates that the pinion is too far away from the crown wheel. To rectify this, remove shims from between the bevel pinion bearing sleeve and the gear carrier.
Note: Alteration to the shimming will within all probability affect the backlash.

(*b*) Incorrect adjustment as illustrated by "B" indicates that the pinion is too far into mesh with the crown wheel. This is corrected by adding shims between the bevel pinion bearing sleeve and the gear carrier.

(*c*) Incorrect adjustment as illustrated by "C" indicates insufficient backlash. When the mark is at the opposite end of the teeth, i.e., the "heel", it indicates excessive backlash. To correct backlash refer to para. 2.

(*d*) Correct adjustment as shown at "D" will give a mark square with the edge of the gear "toe" and the length of the tooth, contact extending for approximately three-quarters of the tooth length.

4. When the adjustment is correct, secure the adjusters by installing the locking screws, and the bearing cap nuts by inserting the split pins. On later models, the bearing caps are secured by bolts and spring washers. Fit the remaining setscrews securing the pinion bearing sleeve and tighten these setscrews to a torque wrench reading of 35 lb. ft. (4·84 kg. m.).

5. Screw in the thrust pad stud to re-establish the correct clearance between the pad and the back of the crown wheel. This should be ·015 in. (·381 mm.), which can be checked with a feeler gauge. Lock the stud with its locknut and secure the latter with the lockwasher.

Note: Tighten the thrust pad hard against the crown wheel before checking the clearance to ensure the pad is seated correctly on its stud.

To Refit.

To refit the drive gear and differential assembly reverse the dismantling procedure, renewing the joint

between the gear carrier and the axle casing. The setscrews and nuts securing the gear carrier should be tightened to a torque wrench reading of 35 lb. ft. (4·84 kg. m.). If the rear cover was removed, renew the joint between the cover and axle casing, and tighten the setscrews to a torque wrench reading of 25 lb. ft. (3·46 kg. m.). Refill the axle with clean oil of the recommended grade to the correct level.

REAR AXLE ASSEMBLY

To Remove.

1. Drain the axle casing.

2. Jack up the rear of the vehicle preferably on a trolley jack until the road wheels clear the ground. Place suitable stands beneath the chassis sidemembers in front of the rear spring front brackets.

3. Remove the road wheels.

4. Disconnect the propeller shaft from the driver coupling. Do not allow the propeller shaft to hang from the centre coupling, but suitably support at the rear end.

5. Disconnect the handbrake cable from the compensator lever located on the axle casing. Remove the pinch bolt from the cable abutment bracket on the axle casing, then lift the handbrake cable clear of the axle.

6. Disconnect the hydraulic brake rear hose from the three-way connector on the axle casing (see "Brakes" section).

7. Disconnect the shock absorber links from the casing brackets.

8. Remove the nuts then withdraw the "U" bolts and "U" bolt pads, which secure the rear springs to the axle casing.

9. Steady the rear axle at its outer hub ends, when the axle assembly can be lowered and moved rearwards on the trolley jack and withdrawn from beneath the vehicle.

To Dismantle.

1. Remove the axle shafts and the hubs (see pages G.8 and G.9 respectively).

2. Disconnect the brake pipes from the brake wheel cylinders by removing the sleeve nuts. Disconnect the transverse brake rods at the compensator lever.

3. Remove the bolts and nuts securing the brake backing plate to the flange on the axle casing. This operation will also free the hub oil catcher, observing that the inner lip of the oil catcher is positioned to face outward towards the hub locations. Withdraw the brake assemblies complete with their wheel cylinders and transverse brake rods.

4. If it is required to completely remove and dismantle the handbrake compensator assembly, refer under the "Brakes" section.

5. Remove the rear cover and the differential and drive gear assembly, after withdrawing the setscrews and nuts. By positioning the axle suitably, a crane can be employed for lifting the differential and drive gear assembly clear.

6. To dismantle the hubs, and the differential and drive gear assembly, refer to the instructions given under the appropriate headings in this section.

Inspection and Overhaul.

1. Remove the breather on top of the axle casing and ensure it is clear of obstruction. Renew, if necessary.

2. Examine the threads on the ends of the axle casing. If damaged, redress with the die nut, Churchill Tool R.G.201.

3. Clean the axle thoroughly externally and internally with paraffin or immerse in a degreasing bath.

4. To inspect and overhaul the various sub-assemblies refer to the appropriate headings in this section.

5. Examine the hub oil catchers for damage and renew, if necessary.

To Re-assemble.

When carrying out this operation reverse the dismantling procedure, observing the following:

1. Use a new joint between the axle casing and the rear cover, and between the axle casing and the gear carrier.

2. Tighten the gear carrier securing nuts and setscrews to a torque wrench reading of 35 lb. ft. (4·84 kg. m.), and the rear cover setscrews and nut to a torque wrench reading of 25 lb. ft. (3·46 kg. m.).

3. Tighten the brake assembly backing plate mounting setbolts and nuts to a torque wrench reading of 35 lb. ft. (4·84 kg. m.).

4. Re-assemble and refit the handbrake compensator assembly (if completely removed in previous operations) as detailed under the "Brakes" section.

5. Refit the hubs and axle shafts as detailed on pages G.12 and G.8 respectively.

To Refit.

Reverse the procedure for removal, noting the following:

1. Ensure the spring dowel bolts register with the locating holes in the spring saddles.

2. Tighten the spring "U" bolts as far as possible with the vehicle unladen. Final tightening must be carried out with the vehicle laden (see "Chassis Frame, Suspension and Shock Absorbers" section).

3. Connect the handbrake cable and adjust if necessary (see "Brakes" section). Connect also the various hydraulic pipe connections and bleed the brakes as detailed under the "Brakes" section.

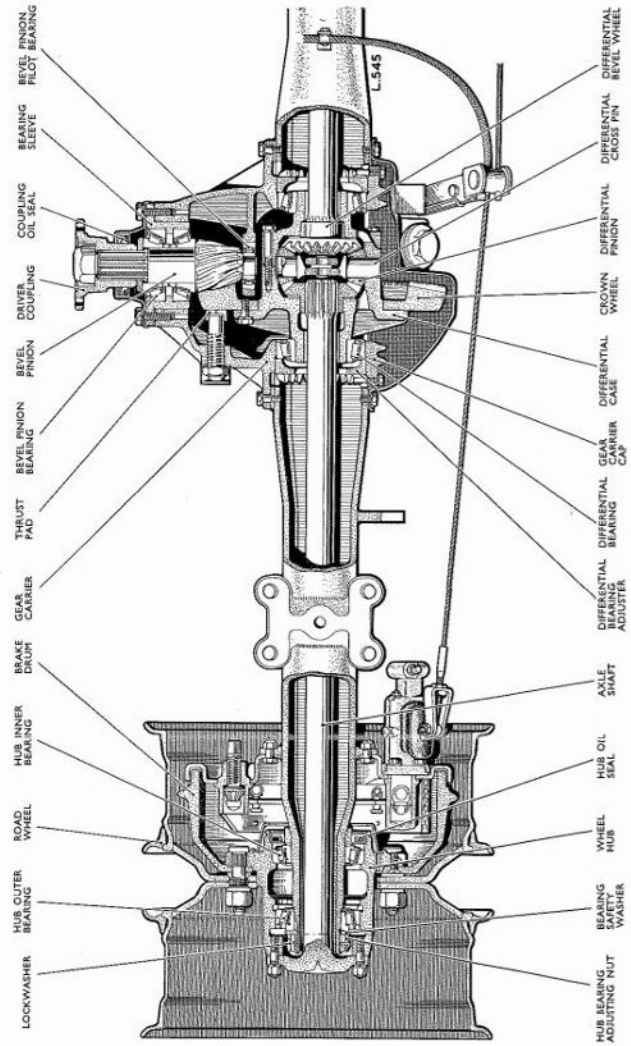


Fig. G.17. Rear axle arrangement
KA.60 Model illustrated

REAR AXLE

For information in respect of the rear axle as fitted to KAH.3023 and KAD.3023 Models, see pages G.6 to G.19.

DESCRIPTION

The fully floating rear axle is enclosed in a pressed steel banjo casing. Both ends of the casing are reduced to take taper roller bearings on which the hubs revolve. The mounting plates welded to the casing adjacent to the reduced ends provide the means of anchoring the brake assemblies. Also welded to the casing adjacent to the mounting plates are pressed steel saddles, which seat the road springs. Brackets attached to the axle casing at the rear, anchor the shock absorber links. The bushed handbrake compensator lever is located on the rear axle cover by a welded bracket, and is connected to the wheel cylinder operating levers, via cables.

Secured to the front of the banjo centre section of the casing is a gear carrier housing the complete final drive. The rear opening is closed by a pressed steel cover, which incorporates a combined oil filler and level plug. Screwed into the casing above and below the final drive is a breather and a drain plug respectively.

The final drive is by a spiral bevel crown wheel and pinion. A splined coupling takes the drive from the propeller shaft to the bevel pinion. The bevel pinion shaft is supported in two opposed taper roller bearings housed in a bearing sleeve. These bearings are pre-loaded, shims being provided for obtaining this accurately. The shims are located, along with two distance pieces, between the bearings.

Additional support for the pinion is obtained through a parallel roller bearing, the bearing cup is retained in the gear carrier, whilst the bearing cone is pressed on to the pinion spigot.

To prevent the loss of lubricant, a seal, housed in a steel pressing, is fitted around the boss of the driver coupling. The oil seal housing and the pinion bearing sleeve are retained on the gear carrier by the same set-screws. Shims fitted between the flange of the bearing sleeve and the gear carrier provide the means for setting the depth of tooth contact between the pinion and the crown wheel.

To ensure an adequate supply of lubricant to the pinion taper roller bearings, the following feature is incorporated. An aperture in the gear carrier above the bevel pinion aligns with an oil passage machined in the bearing sleeve and this passage connects with the annulus formed between the bearings. The aperture in the gear carrier is in the path of the oil thrown off by the crown wheel and therefore directs this oil to the passage in the bearing sleeve, where it passes through to the bearings. Any oil which finds its way through the front bearing is taken back to the axle casing, via a semi-circular recess formed in the oil seal housing, which is in line with a hole through the bearing sleeve, shims and the gear carrier.

The crown wheel is bolted to the flanged half of a two piece case, which contains the differential gears. This whole assembly revolves on opposed taper roller bearings housed in the gear carrier. These bearings are pre-loaded. A large serrated nut fitted over and abutting each bearing cup serves as a bearing adjuster and also enables the whole assembly to be moved bodily to either side for the purpose of obtaining the correct backlash between the crown wheel and pinion teeth.

A thrust pad is provided to support the crown wheel at times of sudden excessive loads. This thrust pad comprises a phosphor bronze ferrule on a steel stud, and is mounted in the gear carrier directly behind the crown wheel at the point of mesh with the pinion. The stud is secured by means of a locknut and lockwasher.

The differential assembly includes a two-piece case, which contains two bevel wheels in constant mesh with four pinions. The bevel wheels are splined internally to take the axle shafts, one wheel being fitted to each half of the differential case. Two pins in the form of a cross carry the pinions, the diametrically opposed pinions being on the same pin. Side thrust between the casing and the differential gears is taken on phosphor bronze washers.

From the differential, the drive is taken by fully floating axle shafts to the hubs, a flange integral with the shaft being secured to the hub by studs and nuts.

The hubs revolve on taper roller bearings carried by the axle casing. A shoulder integral with the hub, and a retaining ring, locate the cups of the inner and the outer bearings respectively. The cone of the inner bearing is retained in position by an abutment collar welded to the axle casing. The cone of the outer bearing is held in position by a bearing safety washer and two nuts, one for bearing adjustment purposes and the other for locking the adjusting nut. The locknut is in turn secured by a lockwasher fitted between the two nuts.

To safeguard against the hub losing its lubricant, an oil seal is fitted to the inner end of the hub. The oil seal seats around the abutment collar on the axle casing. An oil catcher is peened to the hub by its outer flanged edge, its inner edge being positioned adjacent to the oil seal to provide a protective shield to catch any oil which may be thrown from the seal. The axle shaft flange joint seals the outer end of the hub.

The wheel studs pressed into the hub flange provide radial location for the brake drums and the means of attaching the road wheels, each brake drum being additionally secured to the hub flange by two setscrews.

The brake drums are readily withdrawn upon removal of the road wheels, and securing setscrews. On KA.40 and KA.60 Models a detachable taper faced locating collar is positioned over each wheel stud and these register in the spherical seating of the inner road wheel mounting holes (twin rear road wheels are fitted to these models). On KAL.3023 Models single rear road wheel equipment is used.

OPERATION

The drive is transmitted by the propeller shaft to the bevel pinion and the meshing crown wheel, through the differential pinions and bevel wheels to the axle shafts, and hence to the hubs and wheels. For the drive at the propeller shaft to be available at the road wheels for traction, both wheels must contact the ground, without slip occurring, thus the "couple" existing between the differential cross pins and the axle shafts, through the medium of the differential pinions and bevel wheels is maintained under these drive conditions.

The differential gearing enables the rear wheels to rotate at independent speeds when the vehicle is deviated from the straight ahead, i.e., cornering, etc., with the result that the differential pinions are caused to rotate about the cross pins and around the meshing bevel wheels positioned on either side. The drive is still maintained however to the road wheels by means of the "couple" existing within the differential gearing.

When the vehicle is driven straight ahead and the forces opposing the road wheels are equal, no rotation of the differential pinions occurs about the meshing bevel wheels, the drive being transmitted by the "couple" existing within the differential gearing.

LUBRICATION

Axle.

Every 8,000 mile (12,000 km.) the axle should be drained, flushed and refilled with fresh oil of the recommended grade.

The drain plug is located underneath the axle casing. The cranked solid key provided in the tool kit should be used for removing the drain plug.

A combined filler and level plug is located in the rear cover. The oil level is correct when oil overflows from the orifice for the plug.

Wheel Hubs.

The hubs are packed with grease during original assembly at the factory. Every 24,000 mile (36,000 km.) they should be cleaned out and repacked with fresh grease of the recommended grade. To carry out this operation the hub must be removed, cleaned, repacked and refitted as described under the appropriate sub-headings of "Wheel Hubs and Bearings", on pages G.23, G.26 and G.27.

Important: Whilst it is not desirable to completely fill the cavity between the inner and outer bearings with grease when repacking, it is essential to ensure an adequate supply of grease is placed in the immediate vicinity of both bearing races. Apply the grease in the hub so as to leave a space around the axle casing when assembled. On re-assembly of the hub to the axle casing pack the space between the safety washer and the outer bearing with grease. Finally pack the cavity around the adjusting and lock nuts with grease.

AXLE SHAFTS

To Remove.

1. Unscrew and remove the nuts and spring washers securing the axle shaft flange to the studs in the wheel hub.

2. Remove the axle shaft. Two $\frac{7}{16}$ in. U.N.F. tapped holes are provided in the axle shaft flange to effect the initial break. Insert two suitable bolts into these holes and screw them in alternately and equally until a lever can be applied behind the flange.

Inspection.

1. Examine the shaft generally for bend and the splines for wear or twist. Renew the axle shaft if damage is detected. The axle shaft splines may be tested for back-lash using a new differential bevel wheel as a gauge.

2. Check the flange studs for stretch and the threads for damage, renewing as necessary.

To Refit.

1. Ensure the mating faces of the hub and the axle shaft are perfectly clean and free from burrs, then fit a new joint to the flange of the hub.

2. Insert the shaft into the axle casing, ensuring that after engaging the splines in the differential bevel wheel, the shaft is entered squarely; this condition being assured after the holes in the axle flange are mated to the studs positioned in the hub. If necessary a few light hammer blows may be applied to the flange of the shaft to ensure the shaft is fully home.

3. Refit the nuts and spring washers, screw down alternately, and tighten securely to a torque wrench reading of 40 lb. ft. (5·53 kg. m.).

WHEEL HUBS AND BEARINGS

Checking Hub Bearings for End Float

It is recommended that every 12,000 mile (18,000 km.) the hub bearings should be checked for end float, noting that the hubs should not be removed un-necessarily.

To check the end float, proceed as follows:

1. Jack up the vehicle under the rear axle until the road wheels clear the ground and suitably support the axle casing on stands.

2. Remove the road wheels, apply suitable spacers over the wheel studs and refit the wheel retaining nuts, thus securing the brake drum during the ensuing operations.

3. Withdraw the axle shafts (see above).

4. To record hub end float readings, utilise a dial gauge and suitably secure to one of the axle shaft flange stubs on the hub, using the Gauge Post, Churchill Tool R.G.335, Code 1. Insert the Adaptor Pad, Churchill Tool R.G.335, Code 2, in the outer end of the axle casing and position the dial gauge so that its pointer

contacts the adaptor pad on the centrally disposed depression.

5. With a bar approximately 48 in. (122 cm.) long applied to the ground and to the outer face of the hub, exert leverage to move the hub and drum assembly for its maximum movement in an inward direction. Zero the scale of the dial gauge with the hub maintained in this position, and then remove the bar.

6. Applying two levers approximately 18 in. (46 cm.) long at diagonally opposite positions between the brake backing plate and the lip of the brake drum, exert pressure to displace the hub and drum assembly through its maximum outward travel.

7. Observe the reading on the dial gauge when the hub is in its outermost position. For the hub bearings to be in correct adjustment, an axial end float reading of between ·004 in. to ·007 in. (·102 mm. to ·178 mm.) must be obtained on the dial gauge. Remove the two levers, the dial gauge and the adaptor pad. If the reading obtained is outside the designed axial end float limits, the hub bearings must be adjusted as detailed under "To Adjust the Hub Bearings". However, if the axial end float on the hub bearings is correct, remove the gauge post, install the axle shafts and refit the road wheels.

Fig. G.18. Checking the rear hub bearing for end float, using the Churchill Tool R.G.335, in conjunction with a dial gauge (*1st checking operation illustrated*)

To Adjust the Hub Bearings.

1. Jack up the rear axle until the road wheels clear the ground and suitably support the axle casing on stands.

2. Remove the road wheels, apply suitable spacers over the wheel studs and refit the wheel retaining nuts, thus securing the brake drum, during the ensuing operations.

3. Withdraw the axle shafts (see page G.22).

4. Straighten the tabs of the lockwasher and remove the outer, or locknut, using Churchill Tool R.G.71D.

5. Withdraw the lockwasher.

6. To adjust the hub bearings to within the end float limit of ·004 in. to ·007 in. (·102 mm. to ·178 mm.), proceed in the following manner:

(*a*) To record hub end float readings, utilise a dial gauge and suitably secure to one of the axle shaft flange studs on the hub, using the Gauge Post, Churchill Tool R.G.335, Code 1. Insert the Adaptor Pad, Churchill Tool R.G.335, Code 2, in the outer end of the axle casing, and position the dial gauge so that its pointer contacts the adaptor pad on the registration depression at the centre of the pad.

(*b*) With a bar approximately 48 in. (122 cm.) long applied to the ground and to the outer face of the hub, exert leverage to move the hub and drum assembly for its maximum movement in an inward direction. Zero the scale of the dial gauge with the hub maintained in this position, and then remove the bar.

(*c*) Applying two levers approximately 18 in. (46 cm.) long at diagonally opposite positions between the brake backing plate and the lip of the brake drum, exert pressure to displace the hub and drum assembly through its maximum outward travel.

(*d*) With the hub maintained in this position, observe the reading on the dial gauge. For the adjustment to be correct an end float reading of between ·004 in. to ·007 in. (·102 mm. to ·178 mm.) must be obtained. Remove the two levers, the dial gauge and the adaptor pad.

(*e*) Should the reading obtained be outside the designed axial end float limits, slacken back the adjusting nut to increase, or screw in the adjusting nut to decrease the hub end float, until a reading within the correct limits is obtained. Use Churchill Tool R.G.71D to rotate the adjusting nut.

7. Refit the lockwasher and the locknut. Tighten the locknut, taking care not to move the adjusting nut.

8. Check again to ascertain that the end float reading has not altered. Remove the gauge post from the hub flange. Secure both the locknut and the adjusting nut by turning one pair of the lockwasher tabs into adjacent slots.

9. Refit the axle shafts and the road wheels.

To Remove.

1. Jack up the rear of the vehicle until the road wheels clear the ground, and suitably support the axle on stands.

2. Remove the road wheels.

3. Withdraw the axle shafts (see page G.22)

1 ADJUSTER LOCKING SCREW
2 DIFFERENTIAL BEARING ADJUSTER
3 DIFFERENTIAL BEARING
4 DIFFERENTIAL CASE
5 RIGHT HAND DIFFERENTIAL CASE HALF
6 BEVEL WHEEL THRUST WASHER
7 DIFFERENTIAL BEVEL WHEEL
8 PINION THRUST WASHERS
9 DIFFERENTIAL PINION
10 DIFFERENTIAL CROSS PINS
11 CROWN WHEEL
12 LEFT HAND DIFFERENTIAL CASE HALF
13 CROWN WHEEL SECURING STUD
14 and 15 ROAD WHEEL RETAINING NUT AND LOCKING COLLAR
16 BRAKE DRUM
17 AXLE SHAFT
18 AXLE SHAFT FLANGE JOINT
19 HUB BEARING ADJUSTING NUT LOCKWASHER
20 HUB BEARING SAFETY NUT
21 WHEEL HUB TO AXLE SHAFT STUD
22 WHEEL HUB
23 WHEEL STUD
24 HUB OUTER BEARING
25 OUTER BEARING RETAINING RING
26 HUB INNER BEARING
27 HUB OIL SEAL
28 GEAR CARRIER CAP BOLTS
29 GEAR CARRIER
30 and 31 LOCKSTRAP AND LOCKNUT
32 THRUST PAD STUD
33 CROWN WHEEL THRUST PAD
34 BEVEL PINION PILOT BEARING
35 to 37 BEVEL PINION BEARING SECURING BOLT, WASHERS AND NUT
38 BEVEL PINION ADJUSTMENT SHIM
39 BEVEL PINION BEARINGS
40 BEARING SPACER
41 BEARING WASHER
42 BEVEL PINION BEARING
43 BEVEL PINION BEARING SLEEVE
44 HOUSING JOINT
45 OUTER OIL SEAL
46 OIL SEAL HOUSING
47 BEARING SLEEVE SECURING STUD NUT
48 DRIVER COUPLING
49 DRIVER COUPLING SECURING NUT
50

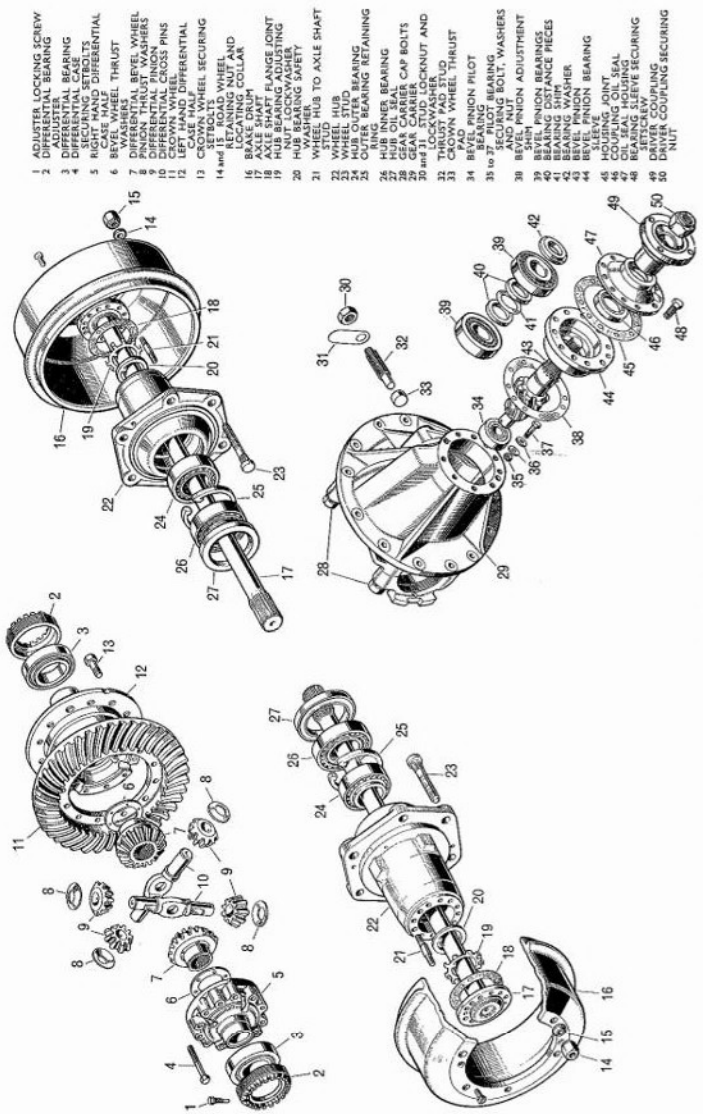


Fig. G.19. Rear axle details

4. Straighten the tabs of the lockwasher and then remove the locknut, lockwasher and adjusting nut, using Churchill Tool R.G.71D. Withdraw the bearing safety washer.

5. Ensure the handbrake is in the "off" position, and withdraw the hub and drum assembly complete with the taper roller bearings and oil seal, using Churchill Main Tool R.G.51B, with the Bridge R.G.51B–9 and the Adaptor Pad STN.6447.

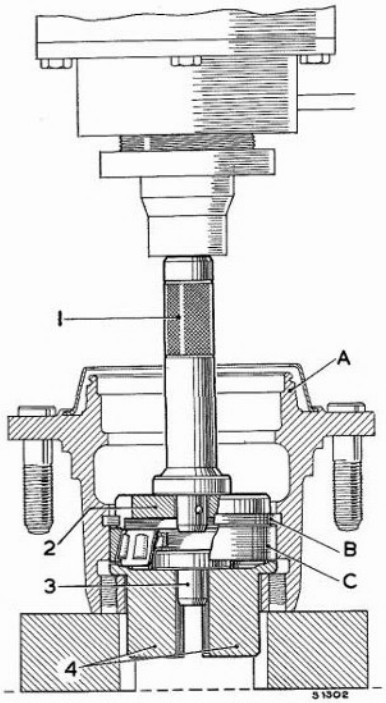
To Dismantle.

1. In some instances the cone of the inner bearing and the oil seal will remain on the axle casing, and are removed using suitable levers applied behind the inner bearing cone, until the cone is freed from the axle casing. Ensure the rollers and cage of the bearing cone are not damaged during this operation. When the inner bearing cone and the oil seal are withdrawn with the hub assembly, first remove these components from the hub by means of a drift applied to the bearing cone, and lightly tap until the oil seal is displaced, when both the oil seal and bearing cone will fall free.

2. If required the brake drum may be separated from the hub, after first releasing the two retaining setscrews, noting that if the same components are to be used on re-assembly, it is desirable to suitably identify the brake drum to the hub with centre dot markings, thus ensuring the two components are subsequently mated as on original assembly. If difficulty is experienced in freeing the brake drum from its register on the hub, apply light blows using a hide faced hammer until the hub is driven through the drum. **Do not disturb** the wheel studs positioned in the hub flange. On KA.40 and KA.60 Models the separating of the brake drum will free the locating collars positioned on the wheel studs.

3. If bearing removal is carried out with the hub and drum assembled, ensure that whilst pressing from the outside of the hub, support **must be** given to the assembly on the inner hub flange, or on the wheel stud heads, for under no circumstances must the drum rim be used, as this would transfer the whole load of the pressing operation on to the two brake drum securing setscrews.

Fig. G.20. Pressing out the wheel hub inner bearing cup, using the Churchill Tool R.G.314, in conjunction with the universal handle 550



1 UNIVERSAL HANDLE 550
2 ADAPTOR PAD R.G.333, CODE 1
3 LOCATING BUTTON R.G.333, CODE 4
4 SPLIT ADAPTOR PAD R.G.333, CODE 3

A WHEEL HUB
B BEARING RETAINING RING
C HUB OUTER BEARING

Fig. G.21. Removing the wheel hub outer bearing, using the Churchill Tool R.G.333, in conjunction with the universal handle 550 (*1st removal stage illustrated—relieving the bearing retaining ring. 2nd removal stage is similar to the operation shown in Fig. G.22, except that the bearing retaining ring has been removed previously to allow for the exit of the complete bearing from the hub.*)

4. Using the Split Adaptor Pad, Churchill Tool R.G.314 in conjunction with the Universal Handle 550, press out the inner bearing cup from its register in the hub, noting that the hub must be supported on its flange face only (see Fig. G.20).

5. Locate the Split Adaptor Pad, Churchill Tool R.G.333, Code 3, in the bore at the outer end of the hub, so that the feet formed on the adaptor, pass into the recess above the thin end face of the outer bearing cup, and retain the adaptor in this position using the Locating Button, Churchill Tool R.G.333, Code 4, applied to the inner end of the split adaptor pad. Insert the Adaptor Pad, Churchill Tool R.G.333, Code 1, so as to abut the thick inner end face of the outer bearing cup (the slot in the pad accommodating the retaining ring ears), and using the Churchill Universal Handle 550 applied to the adaptor pad, press the bearing cup outward slightly (see Fig. G.21), until it is possible to compress and withdraw the bearing retaining ring with suitable pliers. Reverse the hub and ensure that the Split Adaptor Pad, Churchill Tool R.G.333, Code 3, is located correctly in the hub bore. Support the hub on its inner flanged face only, and using the Churchill Universal Handle 550, applied to the split adaptor pad, press out the complete outer bearing from its register in the hub.

6. The wheel studs should only be removed from the hubs, if renewal is necessary and in this case proceed as detailed under "Inspection and Overhaul", para. 5.

Inspection and Overhaul.

Thoroughly clean all the components before inspection in clean paraffin and the bearings in white spirit, and blow out the bearings using clean, dry compressed air, noting that the air stream must not be allowed to spin the rollers and cage whilst cleaning the cone of the bearing, but the cage should be rotated slowly by hand. After cleaning, the complete bearing, if being retained for re-assembly, must be immediately lubricated with sufficient thin oil to prevent corrosion.

1. Examine the bearing rollers and track of the cone for wear or pitting, also the roller cage for damage. Examine the bearing cups for wear or pitting. If any of these conditions are apparent, the complete bearing must be renewed.

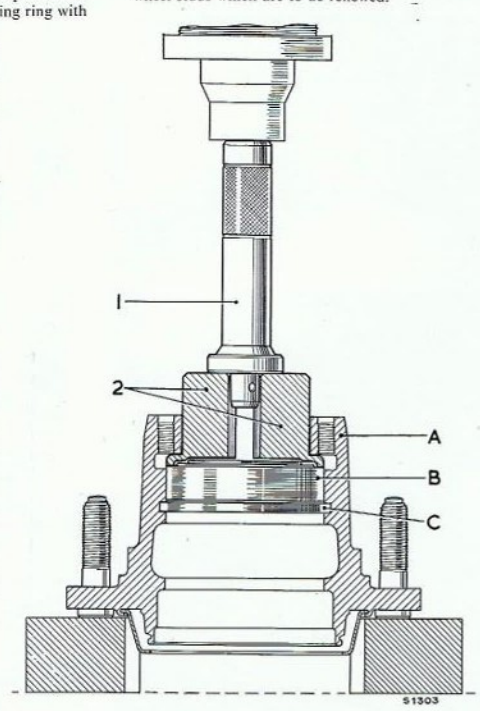
2. The bearing cups must be an interference fit in the hub. Renew the hub if the cups slip into their registers.

3. Examine the oil catcher for damage and rectify, as necessary.

4. The oil seal must be renewed if damaged in any way.

5. Check the wheel studs for damage to the threads, and for full location in the hub flange. If damaged beyond repair, renew the studs as follows:

(*a*) The wheel studs are an interference fit in the flange of the hub and when removing, it is necessary to suitably support the hub flange and press out those wheel studs which are to be renewed.



1 UNIVERSAL HANDLE 550
2 SPLIT ADAPTOR PAD R.G.333, CODE 3

A WHEEL HUB
B HUB OUTER BEARING
C BEARING RETAINING RING

Fig. G.22. Fitting the wheel hub outer bearing, using the Churchill Tool R.G.333, in conjunction with the universal handle 550 (*2nd fitting stage illustrated—pressing in the outer bearing cup to abut the bearing retaining ring. 1st fitting stage is similar to the operation shown in Fig. G.21, except that the bearing retaining ring is not fitted, thus allowing the bearing cone to be pressed into the hub register until past the retaining ring groove.*)

(*b*) To fit a new wheel stud, enter the threaded end into the vacant bore until the serrated collar on the stud abuts the face of the hub flange, support the flange, and press the wheel stud into position, ensuring the stud is square to the flange face.

6. Inspect the groove in the hub which locates the outer bearing retaining ring and pay particular attention to ensure it is clear of all foreign matter and no burrs exist on the edge seating the retaining ring.

7. Examine the outer bearing retaining ring. Renew if weak or damaged.

To Re-assemble.

Prior to carrying out this operation ensure the bearing registers in the hub are clean and free from burrs and lightly smear with lubricant.

1. By using the Churchill Adaptor Sets R.G.314 and R.G.333 in conjunction with the Universal Handle 550, the task of assembling the hub inner and outer bearings respectively, is greatly facilitated.

2. Repack the two bearing cones with the recommended grade of grease forcing the grease between the rollers and under the roller cages, until fully packed, working from the larger diameter end of each bearing. Liberally smear the outer protruding surfaces of the rollers and cages with grease, also the working face of the bearing cups.

3. Locate the Split Adaptor Pad, Churchill Tool R.G.333, Code 3, in the bore at the outer end of the hub and retain the adaptor in this position using the Locating Button, Churchill Tool R.G.333, Code 4, applied to the inner end of the split adaptor pad. Enter the complete outer bearing (thin end face of the bearing cup foremost) into the hub, with the Churchill Adaptor Pad, R.G.333, Code 1, abutting the inner thick end face of the outer cone of this bearing, and by using the Universal Handle 550 applied to the adaptor pad, press the bearing cup in until the retaining ring groove is just clear. Remove the adaptor pad and refit the retaining ring, ensuring that it seats on the bottom of the groove in the hub. Reverse the hub and support on the hub flange face only (see para. 3 under "To Dismantle", on page G.25). Ensure the Split Adaptor Pad, Churchill Tool R.G.333, Code 3, is located correctly in the hub bore. Using the Universal Handle 550 applied to the split adaptor pad (see Fig. G.22), press in the complete outer bearing, until its cup abuts firmly and squarely against the retaining ring.

4. Fit the Churchill Split Adaptor Pad R.G.314 into the cup of the inner bearing and using the Universal Handle 550 applied to the adaptor pad (see Fig. G.23), press the bearing cup (thick end foremost) into the register in the hub, until flush against its shoulder. Remove the adaptor pad. Ensure the bearing cup is abutting the shoulder in the hub squarely.

5. Repack the hub with grease (see "Important Note" under "Lubrication—Wheel Hubs", on page G.22).

6. Complete the re-assembly by placing the cone into the cup of the inner bearing and refit the oil seal squarely in its register, with the sealing lip facing the bearings.

Fig. G.23. Pressing in the wheel hub inner bearing cup, using the Churchill Tool R.G.314, in conjunction with the universal handle 550

To Refit.

To refit the hubs, reverse the removal procedure, and adjust the hub bearings, as described on page G.23.

BEVEL PINION ASSEMBLY

To Remove.

The bevel pinion, together with its two taper roller bearings, distance pieces, adjustment shims, oil seal, oil seal housing and driver coupling, form a complete sub-unit assembled to a bearing sleeve, and can be removed as such, proceeding as follows:

1. Disconnect the propeller shaft from the driver coupling and suitably support the shaft.

2. Remove the differential and drive gear assembly (see page G.30), or move the crown wheel away from the pinion. If this operation is not observed the cone of the pinion pilot bearing will foul the crown wheel teeth.

3. Remove the setscrews securing the bearing sleeve to the gear carrier. These setscrews also secure the oil seal housing. Withdraw the assembly, by tapping the rear of the driver coupling flange with a soft metal, or hide faced hammer.

Note: The thickness of the shims fitted between the two components should be noted so that the same thickness can be used on re-assembly.

4. The cone of the bevel pinion pilot bearing will come away with the pinion. The bearing cup complete with rollers and cage, however, will remain in the gear carrier and to obtain access for removal necessitates the withdrawal of the gear carrier from the axle for the purpose of removing the differential and crown wheel assembly. Then proceed to remove the split pin, nut and bolt securing the bearing retaining washers, when it is possible to tap the bearing cup from its location in the gear carrier.

To Dismantle.

1. Remove the Simmonds nut securing the driver coupling. Tap the coupling free using a soft metal hammer, or if a heavy interference fit with the pinion shaft is encountered, withdraw the driver coupling with the aid of Churchill Main Tool 55, in conjunction with the Legs R.G.55–8 and the Adaptor Set R.G.55–10 on All Models, excepting KAH.40 and KAD.40 Models. In the case of KAH.40 and KAD.40 Models the Adaptor Set R.G.55–5 must be utilised, in conjunction with the Main Tool 55.

2. Lift away the oil seal housing followed by the bearing washer.

3. Grip the bearing sleeve on either side of the drilled flange (threaded portion of pinion downwards) and bump the end of the pinion on a block of wood, or lead, until the pinion and the cone of the inner bearing are free of the sleeve. This operation will also free the cone of the outer bearing, the distance pieces and the shims.

4. To remove the inner bearing cone from the bevel pinion, employ Churchill Main Tool R.G.4221B, in conjunction with the Adaptor Set R.G.4221B–13, as shown at Fig. G.24. The bearing may also be removed by applying a drift between the teeth of the bevel pinion and tapping alternately on opposite sides of the bearing cone, taking care not to damage the roller cage.

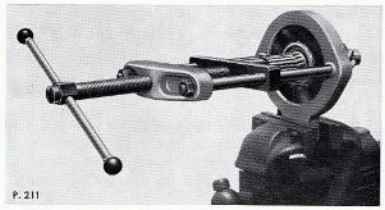


Fig. G.24. Withdrawing the inner bearing cone from the bevel pinion, using the Churchill Tool R.G.4221B and the adaptor set R.G.4221B-13

5. The bearing cups are an interference fit and will have remained in the bearing sleeve, their removal is facilitated by the use of Churchill Adaptor Pad R.G.315, in conjunction with the Universal Handle 550. Press out each bearing cup in turn (see Fig. G.25).

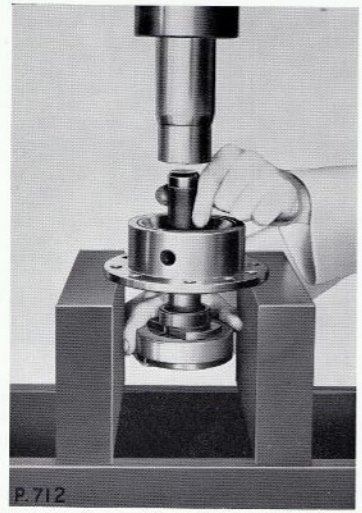


Fig. G.25. Pressing out the bevel pinion outer bearing cup from the bearing sleeve, using the Churchill Tool R.G.315, in conjunction with the universal handle 550

Inspection and Overhaul.

1. Wash the bearings in white spirit and blow out using clean, dry compressed air, noting that the air stream must not be allowed to spin the rollers and cage of the bearing, but the cage should be rotated slowly by hand. After cleaning, the complete bearings, if being retained for subsequent re-assembly, must be immediately lubricated with sufficient thin oil to prevent corrosion. Examine the bevel pinion support bearing rollers, tracks of the cones and bearing cups for wear or pitting, also the roller cage for damage. Bearings must be renewed complete, i.e., cup and cone if damage is evident. Inspect the bevel pinion pilot bearing for slackness, wear or damage, such as pitting on the bearing rollers or tracks. Renew the complete bearing if necessary.

2. Fit the driver coupling to its splines and check for backlash. Renew the coupling if backlash is present. Examine the coupling bolt holes for elongation.

3. Examine the teeth of the bevel pinion. If these are damaged or pitted the pinion should be renewed.

Note: The bevel pinion and the crown wheel must be renewed as a pair, due to their being matched during manufacture to ensure quiet running. Replacement bevel pinions are supplied complete with pilot bearing.

4. If the oil seal has been operating inefficiently, or is damaged in any way, it should be renewed. The oil seal is an interference fit in its housing and should not be removed unless renewal is necessary.

Press the new seal into position with the sealing lip uppermost, taking care not to damage it in any way.

To Re-assemble.

1. If the bevel pinion pilot bearing has been renewed, press the new bearing cone on to the pinion until it is flush against its shoulder, then stake over the pinion in four places, either by means of a steel ball and a press or using a shouldered drift.

Note: If the bearing is being fitted to a pinion from which a faulty race has been removed, burrs will have to be removed from the top edge of the spigot to which it is fitted. Care should be taken, when carrying out this operation, not to remove more metal than necessary, otherwise difficulty will be experienced when attempting to stake over the pinion to secure the new pilot bearing cone.

2. Make certain there are no burrs, or foreign matter on the shoulders inside the bearing sleeve, which might cause the bearing cups to pitch. The use of Churchill Adaptor Pad R.G.315 is recommended to facilitate the fitting of the bearing cups, in conjunction with the Universal Handle 550. Press each bearing cup (thick end face foremost) into its respective register, until flush with the shoulders in the bearing sleeve (see Fig. G.26). Remove the adaptor pad. Ensure the bearing cups abut their respective shoulders in the bearing sleeve squarely.

Fig. G.26. Pressing in the bevel pinion outer bearing cup, using the Churchill Tool R.G.315 in conjunction with the universal handle 550

3. Place the bevel pinion in an upright position and with Churchill Hollow Drift R.G.106A tap the cone of the inner bearing into position. The bearing must abut the gear teeth. Churchill Main Tool R.G.4221B may also be used for this operation as shown in Fig. G.27, in conjunction with the Adaptor Set R.G.4221B–13.

Fig. G.27. Fitting the bevel pinion inner bearing cone, using the Churchill Tool R.G.4221B and the adaptor set R.G.4221B-13

4. Slide the two distance pieces and shims on to the bevel pinion. The shims are fitted to facilitate bearing adjustment. For the initial check use the original thickness of shims, fitting them between the distance pieces.

5. Smear a film of thin lubricant over the bearings, then place the bearing sleeve, complete with the bearing cups, over the pinion shaft. Fit the outer bearing cone, using the Churchill Hollow Drift R.G.106A. Top the assembly with the bearing washer.

6. At this stage adjust the pinion bearings. **Carry out this operation without fitting the oil seal.** Fit the coupling to the pinion shaft and tighten its securing nut to a torque wrench reading of 200 lb. ft. (27·65 kg. m.). Whilst tightening the nut rotate the bearing sleeve. It is suggested that a slave nut be employed during adjustment of the pinion support bearings, as it is not recommended that nuts with fabric or nylon inserts be removed and refitted unnecessarily.

With the pinion held stationary a noticeable drag should be present when the bearing sleeve is turned. This drag should be equivalent to a torque of 13 to 17·5 lb. in. (14·96 to 20·14 kg. cm.). To check the bearing preload, proceed as follows:

(*a*) Wrap a length of cord around the sleeve with one end anchored by a split pin in one of the bearing sleeve setscrew holes, then with a pound scale attached to the opposite end, pull on a line tangential to the outer diameter of the sleeve (see Fig. G.28).

(*b*) To give the correct torque, a reading of 6 to 8 lb. (2·72 to 3·63 kg.) should be obtained on the pound scale (see Fig. G.28). It should be noted that the sleeve must be turning when taking this reading, due to the starting torque being higher.

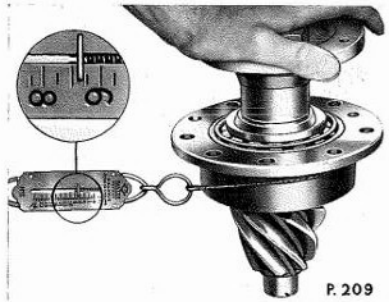


Fig. G.28. Checking the bevel pinion bearing preload, using a spring balance

7. If the reading is not within the correct limits, remove the driver coupling and dismantle the assembly (see paras. 1 and 3 under "To Dismantle", on page G.28), then change the shims fitted between the distance pieces, i.e., if the reading is too high, increase the thickness, but if the reading is too low decrease the thickness. Shims are available in ·003/·005 and ·012 in. (·076/·127 and ·305 mm.) thicknesses. Repeat the above operation until the correct reading is obtained, each time tightening the coupling nut to the torque wrench figure given in para. 6.

8. When the bearings have been satisfactorily adjusted for preload, remove the driver coupling. Slide the oil seal complete with its housing on to the coupling boss. Refit the coupling to the pinion shaft, tightening the nut to a torque wrench reading of 200 lb. ft. (27·65 kg. m.).

Note: Use a new joint between the oil seal housing and the bearing sleeve.

To Refit.

If the bevel pinion pilot bearing is renewed, proceed to fit the new bearing cup complete with rollers and cage to the bore in the gear carrier and retain in position using two washers in conjunction with a bolt and nut, finally locking the nut with a split pin.

Insert the bevel pinion assembly into the gear carrier, locating between the bearing sleeve flange and the gear carrier the same thickness of shims as removed, noting the following:

1. Ensure the drain hole in the flange of the bearing sleeve and the shims align with the corresponding hole in the gear carrier. This also applies to the semi-circular recess formed in the oil seal housing.

2. Reference should be made to "Adjusting Tooth Contact" (see page G.33). Until the correct thickness of shims has been ascertained, secure the assembly temporarily with three setscrews. The setscrews must be finally tightened to a torque wrench reading of 55 lb. ft. (7·60 kg. m.).

DIFFERENTIAL AND DRIVE GEAR ASSEMBLY

To Remove.

1. Drain the oil from the rear axle casing.

2. Remove the axle shafts (see page G.22).

3. Disconnect the propeller shaft from the driver coupling and suitably support the shaft.

4. Remove the setscrews securing the gear carrier to the axle casing, when the complete differential and drive gear assembly may be withdrawn.

To Dismantle.

1. Remove the bevel pinion assembly. The removal and dismantling procedures for this assembly are detailed on pages G.27 to G.28.

2. Remove the differential bearing adjuster locking screws and spring washers from the bearing caps.

3. Remove the setbolts and spring washers securing the bearing caps and lift off the caps.

Note: To ensure the bearing caps are refitted to their original position, suitably identify one of the caps to the gear carrier with centre dot markings.

4. Tap back the lockwasher and slacken the locknut securing the crown wheel thrust pad stud. Screw back the stud until the pad bears against the inside wall of the carrier.

5. Lift the differential assembly complete with the crown wheel from the gear carrier. To break the fit between the bearing cups and the gear carrier, "rock" the assembly. **Do not allow the bearing cups to be interchanged.**

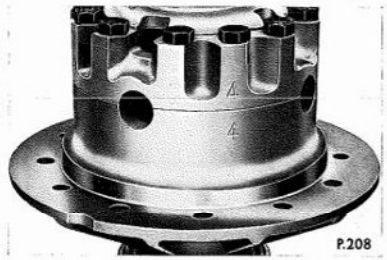


Fig. G.29. Identification marking on the differential case halves

6. Remove the setbolts securing the crown wheel, then pre-heat the crown wheel and tap it clear of the differential case.

7. Examine the differential case. If it is not marked as shown in Fig. G.29, it should be marked now, to ensure the two halves are re-assembled in the same relative position. Remove the securing setbolts and spring washers and split the case. Lift out the differential pinions together with their cross pins and thrust washers, followed by the bevel wheels and their thrust washers.

8. The bearing cone and rollers may be withdrawn from the differential case bosses with the aid of Churchill Main Tool R.G.4221B, in conjunction with the Adaptor Set R.G.4221B–15 (see Fig. G.30).

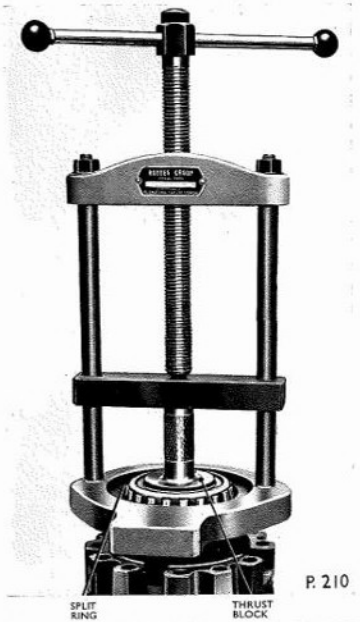


Fig. G.30. Withdrawing the bearing cone from the differential case, using the Churchill Tool R.G.4221B and the adaptor set R.G.4221B-15

9. Remove the split pin, nut and bolt retaining the two washers securing the cone of the bevel pinion pilot bearing in the gear carrier. Using a suitable drift, tap the cone out of its housing.

10. To remove the thrust pad, unscrew its stud until the pad is forced off by the gear carrier.

Inspection and Overhaul.

1. In respect to the bevel pinion assembly, refer to page G.28.

2. Examine the crown wheel for wear and defects. If the teeth are chipped or worn the crown wheel must be renewed.

Note: If the crown wheel is renewed the pinion must be renewed also, the two components being carefully matched during manufacture.

3. Check the bevel wheels for wear on the splines which engage with the axle shafts, the splines of a new axle shaft may be used as a gauge in this instance; also check the gear teeth for wear or damage. The latter examination also applies to the differential pinions. Inspect the bore of the pinions for wear or scoring. If damage or wear is excessive on any of these components, the faulty component(s) should be renewed.

4. Check the thrust washers for wear.

5. Examine the pinion cross pins for wear or scores.

6. Examine the inner faces of the differential case for scores. If deep scoring is evident the complete case must be renewed as the two halves are machined together to very close limits.

7. Wash the bearings in white spirit and blow out using clean, dry compressed air. The air stream must not be allowed to spin the rollers and cage whilst cleaning the cone of the bearing, but the cage should be slowly rotated by hand. After cleaning, the complete bearing, if being retained for re-assembly, must be immediately lubricated with thin oil to prevent corrosion. Inspect the bearings for wear, pitting or damage and if either is excessive, renew the complete bearing.

8. Renew the crown wheel thrust pad if worn.

9. Check all the setscrews and bolts for stretching and damaged threads.

To Re-assemble.

1. Smear the thrust washers and the cross pins lightly with grease, also the back faces of the differential pinions and bevel wheels.

2. Insert one bevel wheel complete with its thrust washer into one half of the differential case. Fit two pinions with their thrust washers to each of the cross pins and place them in the case. Install the remaining bevel wheel and thrust washer in the other half of the differential case.

3. Unite the two halves of the differential case, ensuring that the marks shown at Fig. G.29 are coincident. Screw in the setbolts together with spring washers and tighten to a torque wrench reading of 55 lb. ft. (7·60 kg. m.).

4. Pre-heat the crown wheel and refit. The back face of the crown wheel and its mating face on the differential case must be clean and free from burrs. Screw in the

setbolts and tighten to a torque wrench reading of 90 lb. ft. (12·44 kg. m.).

5. Smear the bearings with a film of thin lubricant and fit them to the differential case bosses, making sure they fit hard against their respective shoulders. The bearings are an interference fit and the force required to fit them must be applied to the bearing cone. Ensure the bearing cups are not interchanged.

Note: On early models the bosses on the differential case stand proud of the bearing cone when the bearing is pressed fully home, and for this reason a tube is recommended to facilitate the fitting operation.

6. Fit the bevel pinion pilot bearing cup complete with rollers and cage to the gear carrier and locate in position with the two washers, securing with a bolt, nut and split pin.

7. Screw the thrust pad stud into the gear carrier until it protrudes far enough to facilitate the fitting of the thrust pad. Fit the pad, then unscrew the stud until the pad bears against the gear carrier.

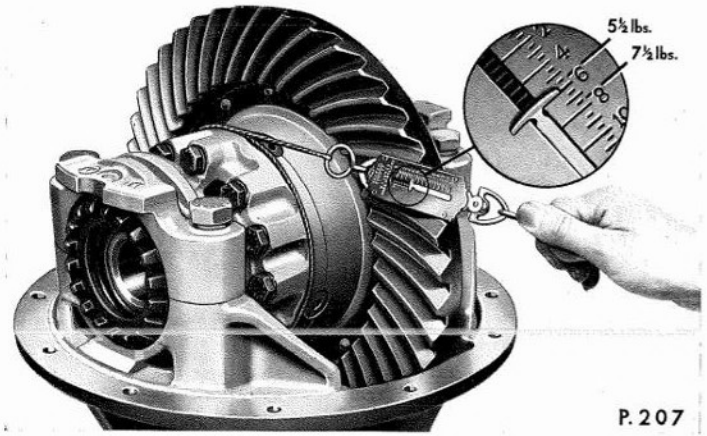


Fig. G.31. Checking the differential bearing preload, using a spring balance

8. Lower the differential and crown wheel assembly complete with the bearing cups into the gear carrier. Engage the bearing adjusters with their mating threads in the gear carrier and install the bearing caps. Make certain the identification marks made on the bearing cap and the gear carrier during dismantling are coincident, and before the caps are fully home start the cap setbolts.

9. Prior to tightening the cap setbolts, position the differential assembly approximately central, making due allowance for the subsequent installation of the bevel pinion assembly, complete with the pilot bearing cone. Remove the slackness from the bearing by screwing in the adjusters, using Churchill Wrench R.G.179.

10. The bearings must now be preloaded to give a torque of 17 to 23 lb. in. (19·57 to 26·47 kg. cm.). The cap setbolts must be tightened to a torque wrench reading of 175 lb. ft. (24·19 kg. m.) before checking the preload.

11. Check the preload as follows:

Wrap a length of cord around the differential case and anchor one end to the case. With a pound scale attached to the free end, pull on a line tangential to the outer diameter of the case (see Fig. G.31). A reading of 5·5 to 7·5 lb. (2·49 to 3·40 kg.) must be obtained for the preload to be correct.

Note: Ensure that the assembly is rotating before noting the spring balance reading, as the starting torque will be higher.

12. If the reading is incorrect slacken the appropriate cap setbolts and tighten or loosen one of the bearing adjusters until the correct reading is obtained. Before re-checking the preload, tighten the cap setbolts to a torque wrench reading of 175 lb. ft. (24·19 kg. m.).

13. Re-assemble the pinion assembly (see page G.29) and refit the pinion assembly to the gear carrier (see page G.30), when the correct tooth contact between the crown wheel and pinion can be determined as described in the ensuing operation.

Adjusting Tooth Contact.

1. Check the backlash. Using the Churchill Tool PT.4008, position the dial gauge to contact one of the crown wheel teeth so as to record any movement of that tooth (see Fig. G.32). Hold the driver coupling firm, and rock the crown wheel back and forth to take up any play between the gear teeth, noting the movement recorded on the dial gauge. Carry out this check in a number of different positions so that any high spot can be taken into consideration. The correct backlash is ·009 in. to ·012 in. (·229 mm. to ·305 mm.).

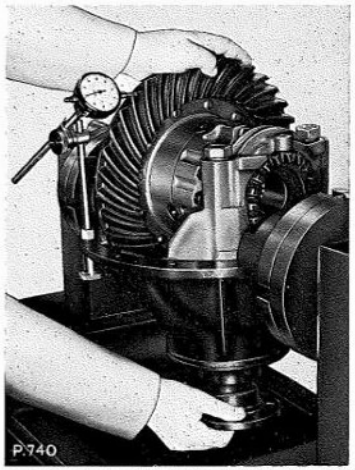


Fig. G.32. Checking for backlash between the crown wheel and bevel pinion teeth, using the Churchill Tool P.T.4008

2. If the backlash is incorrect adjust as follows:

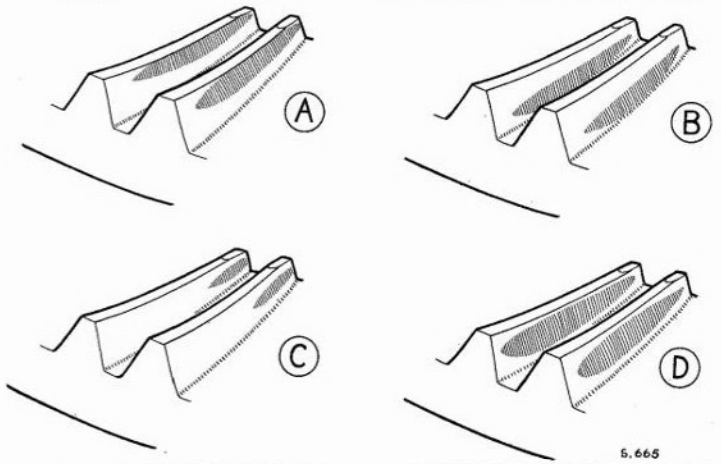
(*a*) **Excessive Backlash.** The bearing adjuster facing the teeth of the crown wheel must be unscrewed and the whole differential assembly moved over by tightening the opposite adjuster an **equal** amount.

(*b*) **Insufficient Backlash.** Slacken the bearing adjuster behind the crown wheel, then move the differential assembly in an opposite direction to 2(*a*) by tightening the other adjuster an **equal** amount.

Note: When unscrewing an adjuster note the number of castellations which pass by the aperture in the bearing cap for the adjuster locking screw. The opposite adjuster can then be screwed in by an equal amount in a similar manner. In this way the adjustment of the differential bearing preload will not be altered.

After effecting the adjustment, bearing cap bolts must be tightened again to the correct torque wrench reading before the backlash is re-checked.

3. Carry out a check to ensure that the tooth contact is correct. Brush a thin coat of marking paste over a number of the crown wheel teeth (a suitable paste may be made by mixing red lead with engine oil). Rotate the pinion in a clockwise direction and apply hand pressure to the crown wheel against the direction of rotation in order to obtain a clear mark. Compare the marks on the drive side of the crown wheel teeth with those illustrated in Fig. G.33, when a diagnosis of adjustment may be made as follows:



A INDICATES THAT THE SETTING OF THE PINION IS TOO FAR AWAY FROM THE CROWN WHEEL.

B INDICATES THAT THE PINION IS TOO FAR INTO MESH WITH THE CROWN WHEEL.

C INDICATES INSUFFICIENT BACKLASH (WHEN THE MARKING IS AT THE OPPOSITE END OF THE TEETH, EXCESSIVE BACKLASH IS PRESENT).

D INDICATES THE CORRECT MESHING OF THE BEVEL PINION WITH THE CROWN WHEEL.

Fig. G.33. Specimen tooth engagement markings on the crown wheel

(*a*) Incorrect adjustment as shown by "A" indicates that the pinion is too far away from the crown wheel. To rectify this, remove shims from between the bevel pinion bearing sleeve and the gear carrier.

Note: Alteration to the shimming will within all probability affect the backlash.

(*b*) Incorrect adjustment as illustrated by "B" indicates that the pinion is too far into mesh with the crown wheel. This is corrected by adding shims between the bevel pinion bearing sleeve and the gear carrier.

(*c*) Incorrect adjustment as illustrated by "C" indicates insufficient backlash. When the mark is at the opposite end of the teeth, i.e., the "heel", it indicates excessive backlash. To correct backlash refer to para. 2.

(*d*) Correct adjustment as illustrated at "D" will give a mark square with the edge of the gear "toe" and the length of the tooth, contact extending for approximately three-quarters of the tooth length.

4. When the adjustment is correct, secure the adjusters by installing the locking screws and fit the remaining setscrews securing the bevel pinion bearing sleeve. Tighten the latter to a torque wrench reading of 55 lb. ft. (7·60 kg. m.).

5. Screw in the thrust pad stud to re-establish the correct clearance between the pad and the back of the crown wheel. This should be ·015 in. (·381 mm.), which can be checked with a feeler gauge. Lock the stud with its locknut and secure the latter with the lockwasher.

Note: Tighten the thrust pad hard against the crown wheel before checking the clearance, to ensure the pad is seated correctly on its stud.

To Refit.

To refit the differential and drive gear assembly reverse the dismantling procedure, renewing the joint between the gear carrier and the axle casing. The setscrews securing the gear carrier should be tightened to a torque reading of 60 lb. ft. (8·30 kg. m.). If the rear cover was removed, renew the joint between the cover and the axle casing, and fit the cover, tightening the setscrews to a torque reading of 60 lb. ft. (8·30 kg. m.), also refit the compensator lever to the bracket on the rear cover and adjust the handbrake cable, as detailed under the "Brakes" section.

Refit the axle shafts as detailed on page G.22 and tighten the stud nuts to a torque wrench reading of 40 lb. ft. (5·53 kg. m.).

Refill the axle casing with clean oil of the recommended grade to the correct level.

REAR AXLE ASSEMBLY

To Remove.

1. Drain the axle casing.

2. Jack up the rear of the vehicle preferably on a trolley jack until the road wheels clear the ground. Place stands beneath the chassis sidemembers in front of the rear spring front brackets.

3. Remove the road wheels.

4. Disconnect the propeller shaft from the driver coupling. Do not allow the propeller shaft to hang from the centre bearing coupling, but suitably support to one side of the vehicle.

5. Disconnect the handbrake cable jaw from the wheel cylinder operating lever. Release the clamp bolt from the compensator lever positioned on the bracket welded to the axle cover, separate the lever halves, and withdraw the abutment barrel from its location. Loop off the handbrake secondary cable from the abutment barrel, disconnect the main handbrake cable from the support bracket on the axle casing, then lift the main handbrake cable clear of the axle.

6. Disconnect the hydraulic brake rear hose from the three-way connector on the axle casing (see "Brakes" section).

7. Remove the nuts, then withdraw the "U" bolts and "U" bolt pads, which secure the rear springs to the axle casing.

8. Steady the rear axle at its outer ends, when the axle assembly may be lowered, moved rearward on the trolley jack and withdrawn from beneath the vehicle.

To Dismantle.

1. Remove the axle shafts (see page G.22) and the hubs (see page G.23).

2. Disconnect the brake pipes from the brake wheel cylinders.

3. Remove the bolts and nuts securing the brake backing plate to the flange on the axle casing and withdraw the brake assemblies, complete with the handbrake secondary cable.

4. Remove the nut and washer securing the compensator lever to the bracket on the rear cover and withdraw.

5. Remove the rear cover and the differential and drive gear assembly, after withdrawing the setscrews. By positioning the axle suitably, a crane can be employed for lifting the differential and drive gear assembly clear.

6. To dismantle the hubs and the differential and drive gear assembly, refer to the appropriate headings in this section.

Inspection and Overhaul.

1. Remove the breather on top of the axle casing and ensure it is clear of obstruction. Renew, if necessary.

2. Examine the threads on the ends of the axle casing. If damaged, redress with Churchill Die Nut R.G.72.

3. Clean the axle casing thoroughly externally and internally with paraffin or immerse in a degreasing bath.

4. Inspect the components comprising the compensator linkage (see "Brakes" section).

5. To inspect and overhaul the various sub-assemblies refer to the appropriate headings in this section.

To Re-assemble.

When carrying out this operation reverse the dismantling procedure, observing the following:

1. Use a new joint between the axle casing and the rear cover, and between the axle casing and the gear carrier. Tighten the rear cover and gear carrier setscrews to a torque wrench reading of 60 lb. ft. (8·30 kg. m.).

2. Re-assemble the compensator linkage (see "Brakes" section).

3. Refit the hubs and the axle shafts as detailed on pages G.27 and G.22 respectively. Tighten the axle shaft stud nuts to a torque wrench reading of 40 lb. ft. (5·53 kg. m.).

4. Tighten the brake assembly backing plate mounting setbolts and nuts to a torque wrench reading of 35 lb. ft. (4·84 kg. m.).

To Refit.

Reverse the procedure given for removal, noting the following:

1. Ensure the spring dowel bolts register with the locating holes in the spring saddles.

2. Tighten the spring "U" bolt nuts as far as possible with the vehicle unladen. Final tightening must be carried out with the vehicle laden (see "Chassis Frame, Suspension and Shock Absorbers "section).

3. Connect the handbrake cable and adjust, if necessary (see "Brakes" section). Reconnect the brake pipes and bleed the brake hydraulic system as detailed under the "Brakes" section.

CHASSIS FRAME, SUSPENSION AND SHOCK ABSORBERS

SECTION H

INDEX

CHASSIS FRAME, SUSPENSION AND SHOCK ABSORBERS

DATA

Chassis frame.

Channel section dimensions

123 in. W.B. (when factory built van body is fitted)	6 in. (152·4 mm.) deep, with 2½ in. (57·2 mm.) flanges, $\frac{5}{32}$ in. (4 mm.) thick
123 in. W.B. (when factory built van body is **not** fitted)	6·06 in. (153·9 mm.) deep, with 2¼in. (57·2 mm.) flanges, $\frac{3}{16}$ in. (4·8 mm.) thick
135 in. W.B.	7½ in. (190·5 mm.) deep, with 2½ in. (63·5 mm.) flanges, $\frac{7}{32}$ in. (5·5 mm.) thick
Frame dimensions	See Fig. H.2

Front road springs.

Width of leaves	
All models	1·990/2·000 in. (50·546/50·800 mm.)
Spring eye centres—laden	
All models	39 ± ⅛ in. (990·60 ± 3·175 mm.)

Model	*Number of leaves*	*Thickness of leaves*	*Free camber to main leaf*	*Deflection per 2240 lb. (1016 kg.)*
KA.30 and KA.40 Home and Export	8	Top 5 leaves $\frac{5}{16}$ in. (7·938 mm.) 3 leaves $\frac{9}{32}$ in. (7·14 mm.)	2·49 in. (63·246 mm.) at eye centres	3·31 in. (84·074 mm.)
KA.60 Home and Export	12	¼ in. (6·35 mm.)	2·38 in. (60·452 mm.) at eye centres	3·86 in. (98·044 mm.)

Rear road springs.

Width of leaves	
All models	2·49/2·50 in. (63·245/63·5 mm.)
Spring eye centres—laden	
All models	47 ± ⅛ in. (1066·8 ± 3·175 mm.)

Model	*Number of leaves*	*Thickness of leaves*	*Free camber to main leaf*	*Deflection per 2240 lb. (1016 kg.)*
KA.30 Home and Export	9	$\frac{5}{16}$ in. (7·938 mm.)	3·016 in. (76·241 mm.) at eye centres	3·69 in. (93·726 mm.)
KA.40 Home and Export	10	$\frac{5}{16}$ in. (7·938 mm.)	3·175 in. (80·645 mm.) at eye centres	3·32 in. (84·328 mm.)
KA.60 Home and Export	14	$\frac{5}{16}$ in. (7·938 mm.)	2·285 in. (58·039 mm.) at eye centres	2·375 in. (60·325 mm.)

Spring and shackle pins.

Outer diameter	
Front	·9195/·920 in. (23·356/23·368 mm.)
Rear	·8085/·809 in. (20·536/20·549 mm.)

Spring and shackle pin bushes.

Internal diameter (not fitted)	
Front	·9255/·928 in. (23·508/23·571 mm.)
Rear	·815/·8175 in. (20·701/20·765 mm.)

Exhaust system.

Type	Down pipe from exhaust manifold, single silencer and tail pipe
Silencer	Three chamber, resonant type
Tail pipe	Exhausting to drive side of the vehicle

CHASSIS FRAME, SUSPENSION AND SHOCK ABSORBERS

DESCRIPTION

Chassis Frame.

The chassis frame is of riveted construction, and consists of two channel section steel sidemembers, braced by steel crossmembers.

Road Springs.

The four road springs are of the semi-elliptic type, each spring being shackled at its rear end to allow free movement under operating conditions. All the spring eyes and shackles are fitted with steel bushes.

Case hardened, steel pins, brazed into steel brackets, locate both the front eye of the front road spring and the cast iron shackle at the rear of the spring. These front spring pin brackets are bolted to the frame sidemember at each position by three bolts, nuts and spring washers.

The rear road springs are located on the frame sidemembers by case hardened, steel pins pressed into cast iron hanger brackets which are riveted to the respective sidemember. The bushed front eye of each rear spring operates directly on the foremost fixed spring pin, whereas each rear spring rear bushed eye operates on the spring pin fitted in the cast iron rear shackle which is in turn supported by the rearmost fixed shackle pin.

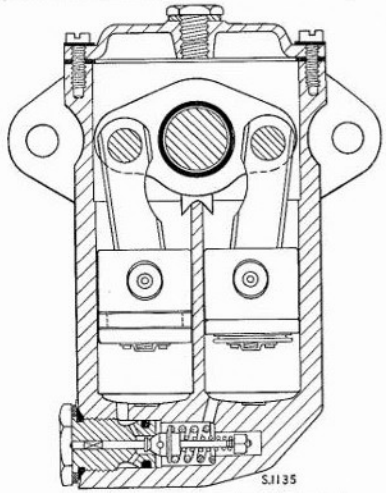


Fig. H.1. Sectional arrangement of the shock absorber

Shock Absorbers.

The shock absorbers are of the double acting, self regulating, piston type and are bolted to the frame members. The operating arm outer end of each shock absorber is connected to the appropriate axle bracket, by a link arm which is rubber mounted at both ends.

The operating arm inner end is splined to a spindle, housed in the body and the internal end of the spindle connects with a crank assembly that operates a connecting rod and piston in both the compression and rebound cylinders, which are integral with the shock absorber body. Each piston crown is fitted with a small recuperating valve and both cylinders are connected by a drilling to the valve chamber at the base of the shock absorber body. The main operating valve is located in the valve chamber by the hexagon headed valve screw, and consists basically of a compression valve controlled by a large outer spring located against an integral shoulder in the valve chamber, and a rebound valve controlled by a smaller inner spring abutting the valve retaining nut.

Oil sealing rings are fitted to the inner and outer ends of the valve screw and a flat washer is positioned under the external head of the valve screw.

A filler plug is fitted in the top of the shock absorber, either in the cover plate or in the body and a special fluid (see "Recommended Lubricants") is used to completely fill the shock absorber body up to the bottom of the filler hole boss.

Exhaust System.

The exhaust pipe is secured at the forward end to the exhaust manifold flange by bolts, (or studs) nuts and spring washers. The rear end of the exhaust pipe is clamped to an extension tube of the silencer, the main body of which is centrally supported by a rubber mounted clamp to a hanger bracket bolted on the chassis frame. The silencer rear extension pipe is clamped to the exhaust tail pipe which is also supported by rubber mountings to a hanger bracket riveted to the chassis frame.

LUBRICATION

All models have lubricating nipples fitted to each spring and shackle pin. These points should be lubricated every 2,000 miles (3,000 km.) with the correct grade of lubricant (see "Recommended Lubricants").

The fluid level of the shock absorbers should be checked periodically to ensure that the level is maintained at the bottom of the filler hole boss.

CHASSIS FRAME

Checking Alignment.

Reference should be made to Fig. H.2 when checking the alignment of the chassis frame.

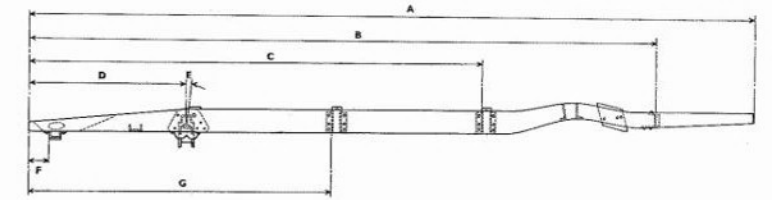
Overhaul.

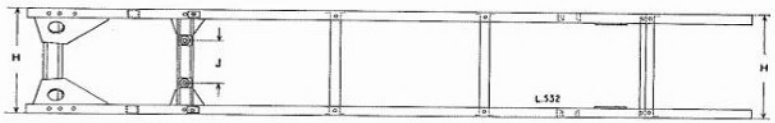
1. Damaged crossmembers should be straightened or removed for renewal before any attempt is made to straighten the sidemembers.

2. To remove the frame rivets, first drill the heads of the existing rivets and then cut them off with a sharp cold chisel, finally knocking out the remaining parts of the rivets with a punch.

rear spring front hanger bracket (for rear spring removal). Remove the applicable road wheels.

3. If either of the front springs are being removed, it is necessary to disconnect the lower end of the shock absorber arm link from the eye in the mounting pad.





	123 in. W.B.	135 in. W.B.
A	199-55 in. (5·07 m.)	211·55 in. (5·38 m.)
B	177·18 in. (4·5 m.)	189·18 in. (4·80 m.)
C	127·96 in. (3·25 m.)	139·96 in. (3·55 m.)
D	44·25 in. (1·12 m.)	44·25 in. (1·12 m.)
E	4°	4°
F	6·09 in. (0·15 m.)	6·09 in. (0·15 m.)
G	85·17 in. (2·16 m.)	97·17 in. (2·47 m.)

	123 in. W.B.	135 in. W.B.
H	30·0 in. (0·762 m.) (When factory built van body is not fitted)	30·0625 in. (0·763 m.)
	29·938 in. (0·761 m.) (When factory built van body is fitted)	
J	16·0 in. (0·41m.)	16·0 in. (0·41m.)

Fig. H.2. Chassis frame dimensions

When refitting, use either hot rivets, or bolts, nuts and lockwashers as follows:

If hot rivets are used, bolt the parts temporarily but firmly in place, using close fitting bolts and remove the bolts as the riveting proceeds.

If bolts, nuts and lockwashers are used in place of rivets, use bolts of **high tensile steel** and of larger diameter than the original rivets. Ream out the rivet holes and ensure that the bolts are a tight fit. The portion of the bolt shank which contacts the members should not be threaded. Thoroughly tighten and lock the nuts in position by staking the end of each bolt, and recheck for tightness periodically.

ROAD SPRINGS

To Remove.

1. Jack up the chassis under the front or rear axle, dependent upon which spring is being removed, until the road wheels are clear of the ground. It is advisable to release the wheel nuts of the appropriate road wheel prior to jacking the axle, to facilitate the removal of the road wheel in the next operation.

2. Place a support stand under each sidemember, immediately behind the front spring rear hanger bracket (for front spring removal) or immediately in front of the

4. Remove the spring "U" bolt nuts. Tap the "U" bolts upwards taking care not to damage the threads, remove the bolts together with the "U" bolt pad on the top leaf of the spring.

5. Remove the split cotter pin(s) by tapping out using a $\frac{1}{4}$ in. (7 mm.) diameter steel bar for a drift. These cotter pins are fitted to retain the two spring pins and the shackle pin which secure each rear spring, but on the front springs, a cotter pin is fitted to retain each rear spring pin and each remaining spring and shackle pin is retained by a washer and a self locking nut.

6. Lower the jack positioned under the axle sufficiently to remove any load from the spring.

7. To remove the front spring, remove the lubricators, unscrew the self locking nuts and withdraw the washers at the front and rear fixed spring pins. Ensure that the spring centre bolt head is clear of the axle spring pad by lowering the axle, if necessary. The spring can then be withdrawn in a transverse direction clear of the vehicle, complete with the rear shackle assembly.

8. To remove the rear spring, remove the lubricators and extract the spring pin at each spring eye using the

Churchill Extractor R.G.65A. The lubricator thread of each pin is $\frac{1}{8}$ in. B.S.P. and the correct adaptor supplied with the tool is R.G.65A/6. Disengage the spring centre bolt head from the axle spring pad, lowering the axle if necessary, and remove the spring from the vehicle.

To Dismantle.

1. The shackle pin in the rear eye of the front spring is removed either by pressing out or drifting out, using a $\frac{3}{4}$ in. (19 mm.) diameter bar or alternatively, by using the same Churchill Extractor and adaptor as for the rear spring pins. Ensure that the split cotter pin is first removed, as detailed in "To Remove", (para. 5.).

2. To remove the rear spring shackle, withdraw the shackle pin using the same Churchill Extractor and adaptor as for the rear spring pins, and detach the shackle.

3. Before dismantling the spring, check the free camber of the main leaf by placing the spring flat on a level surface and positioning a straight edge across the spring eye centres. Measure the distance from the top of the main leaf to the line of the straight edge corresponding with the spring eye centres. Refer to the "Data" page of this section for the correct dimensions.

4. Scribe an indicating line down one side of the spring adjacent to the centre to mark all leaves thus enabling the leaves to be re-assembled to their original positions.

5. Remove the spring clip bolts after unscrewing the nuts, and detach the bolt ferrules.

6. Clamp the central section of the spring in a vice to relieve the centre bolt nut of pressure and remove the nut. Open the vice jaws gradually, separate the spring leaves and remove the centre bolt.

Inspection and Overhaul.

Thoroughly clean all parts with paraffin and dry before inspection.

1. Carefully examine each leaf for cracks, distortion and wear, renewing as necessary.

2. Inspect the spring eye bushes, the shackle bushes and their respective pins for wear and renew as necessary. At the same time, ensure that the lubrication drillings in the pins are free from obstruction. To renew the bushes, press out the old bushes and press in the new bushes ensuring that the bush ends, inside the bores, are equidistant from the faces of the spring eyes or shackle.

3. Check the spring centre bolt for wear or damage particularly on the bolt head. Ensure that the bolt thread and the nut is in good condition.

4. Examine each spring clip carefully for cracks and check that each clip is securely riveted to its spring leaf.

5. Inspect the "U" bolts for wear, damage or distortion. Also check the bolt thread condition.

To Re-assemble.

1. Smear both flat surfaces of each leaf with graphite grease.

2. Re-assemble the leaves in their correct order, noting the scribed indicating line made before dismantling, and thread a $\frac{3}{8}$ in. (9·5 mm.) diameter rod through the centre hole in each leaf. Compress the leaves at the centre section, with the rod still in position and refit the centre bolt by withdrawing the guide rod and following through with the centre bolt. Refit the centre bolt nut and tighten securely.

3. Refit the spring clip ferrules, bolts and nuts noting that the bolt heads should be to the outside of the spring when refitting the spring to the vehicle. Fully tighten the nuts.

4. The front spring shackle is refitted to the spring rear eye by tapping the spring pin through the shackle bores and the spring eye bush. Smear the pin with clean gear oil before refitting and ensure that the cotter pin groove in the pin aligns with the pin bores in the shackle. Fit a new split cotter pin noting that the pin has a lead chamfer to assist fitment.

Note: Care must be taken not to damage the thread for the lubricator when refitting the spring pin.

5. If the rear spring shackle has been removed, refit the shackle to the hanger bracket by tapping the shackle pin through the bracket bores and the shackle bush. Smear the pin with clean gear oil before refitting and ensure that the cotter pin groove in the pin aligns with the pin bores in the hanger bracket. Fit a new split cotter pin noting that the pin has a lead chamfer to assist fitment.

Note: Care must be taken not to damage the thread for the lubricator when refitting the spring pin.

6. If new leaves have been fitted to the spring, it is advisable to re-check the free camber as described in "To Dismantle" (para. 3).

To Refit.

Refitting is a reversal of the removal procedure with attention to the following points.

1. Ensure that the pad is placed over the spring centre bolt nut before refitting the "U" bolts. If the "U" bolt nuts can be turned by hand along the bolt threads until the bolt thread projects, it is necessary to renew the nuts, as the self locking insert in the nut head will be excessively worn. When the "U" bolts have been refitted and the bolt nuts tightened evenly and securely, finally check the tightness of the spring centre bolt nut and peen over the end of the bolt thread. Always re-tighten the "U" bolts, after the initial tightening, when the vehicle is fully laden.

2. If either of the front springs have been removed, refit the lower end of the shock absorber arm link to the eye of the mounting pad, add the spring washer and nut, finally tightening the nut securely.

3. When refitting the front springs, first check that the hanger bracket securing bolt nuts are fully tightened. Refit the front springs and secure in position with the plain washer and self locking nut at each spring pin. If either self locking nut can be turned by hand along the spring pin thread until the bolt thread passes through the insert in the nut head, renew the nut.

4. Refit the spring with the heads of the spring clip bolts to the outside of the vehicle, i.e., nearest to the road wheel.

5. Refit the spring pins to locate the rear spring by the same procedure as described for the shackle pin in "To Re-assemble" (para. 5).

6. Refit the lubricators removed from each point and on completion, lubricate each pin with the recommended grade of lubricant.

7. On completing the refitting operation, check that the bump rubbers, fitted to the underside of each sidemember at the respective spring positions, are in good order and secure on the mountings.

SHOCK ABSORBERS

To Remove.

1. Disconnect the lower end of the arm link from the eye in the mounting pad or bracket.

2. Remove the two bolts and self-locking nuts (front shock absorbers) or the two bolts, washers and plain nuts (rear shock absorbers) securing each shock absorber body to the chassis frame. The shock absorber complete with the link arm can then be lifted away from the vehicle.

3. The link arm is separated from the operating arm by removing the plain nut and spring washer and tapping the link arm free.

Inspection and Overhaul.

No adjustment of the shock absorbers is required, or provided for, and therefore no attempt should be made to dismantle the assembly.

In the event of a shock absorber becoming inoperative it should be removed and a replacement unit fitted.

When there is any question of the suspension not being adequately damped, the condition of the road springs and tyre pressures should also be considered.

If the shock absorber does not appear to function satisfactorily, an indication of its resistance can be obtained by carrying out the following check:

1. Secure the shock absorber in a vice, holding by the **fixing lugs only,** in order to avoid any possibility of distorting the cylinders in the shock absorber body.

2. Work the shock absorber arm through six to eight strokes to expel any air which may be present in the compression chamber.

3. Move the arm up and down through one complete cycle. A moderate resistance throughout the full stroke should be felt; if, however, the resistance is erratic and free movement of the lever arm is noted, it may indicate lack of fluid, in which case the shock absorber should be topped up as follows.

(*a*) Before removing the filler plug carefully clean the exterior of the shock absorber particularly in the vicinity of the filler hole boss. **This is important** as it is essential that no dirt or foreign matter enters the operating chamber.

(*b*) Top up with "Armstrong" Super (thin) Shock Absorber Fluid No. 624. While adding the fluid, the lever arm should be worked through its full stroke to expel air from the operating chamber.

(*c*) Fill the body with fluid to the bottom of the filler hole boss.

4. If the addition of fluid gives no improvement, a new shock absorber should be fitted.

5. Too much resistance, i.e., when it is not possible to move the lever arm slowly by hand, probably indicates a broken internal part or a seized piston, in which case the shock absorber should be changed.

To Refit.

Refitting is a reversal of the removal instructions. The shock absorber arm should be operated a few times before re-connecting the link.

EXHAUST PIPE

To Remove.

1. Release the nuts and spring washers securing the exhaust pipe flange to the manifold flange.

2. Release the bolt, nut and spring washer retaining the clip on the front silencer tube extension.

3. Free the exhaust pipe flange from the manifold studs (bolts are fitted to certain engine manifolds) and withdraw the exhaust pipe from the silencer tube extension. Remove the gasket from the flange or manifold face.

Inspection and Overhaul.

Ensure that the exhaust pipe is free from obstruction and that both the exhaust pipe and the manifold flange faces are clean, free from scores or damage and in good condition.

To Refit.

Reverse the removal procedure using a new flange gasket. Tighten the exhaust flange nuts and the silencer tube clip bolt nut securely. Check for leakage on completing the operation.

SILENCER

To Remove.

1. Release the bolt, nut and spring washer retaining the clip on the front silencer tube extension.

2. Remove the mounting bolt, nut and spring washer securing the silencer centre clamp to the hanger bracket. Remove the two mounting rubbers now released.

3. Remove the mounting bolt, nut and spring washer securing the tail pipe support clip to the rear hanger bracket. Remove the two mounting rubbers now released.

4. The silencer complete with the tail pipe can then be withdrawn from the vehicle.

5. Withdraw the bolt, nut and spring washer retaining the clip on the rear silencer tube extension and free the tail pipe from the silencer.

6. Release the tail pipe support clip after removing the setscrew, nut and spring washer.

Inspection and Overhaul.

1. Examine the silencer for loose baffles, holes in the silencer casing, or splits in the casing seams. Renew if either fault is evident, except where it may be possible to weld any split seams.

2. Inspect the silencer centre clamp ensuring that the shackle plates are just free to move on their rivets.

3. Check that the mounting rubbers are not worn or deteriorated and renew as necessary. Also ensure that the two hanger brackets are secure on the chassis frame.

4. Ensure that the tail pipe is free from obstruction and damage, particularly at the end opposite from the silencer.

To Refit.

Reverse the removal procedure, tightening each clip and mounting bolt nut securely. Check for leakage on completing the operation.

TAIL PIPE

The removal and refitting of the tail pipe, is facilitated by removing the silencer and tail pipe as an assembly. Refer to the previous sub-section for details.

SERVICE DATA

Note :—This page is provided for recording references to Service Data Bulletins applicable to the preceding Section

SERVICE DATA			WORKSHOP MANUAL	
DATE	SHEET NO.	VOLUME NO.	PAGE REF.	SUBJECT

STEERING

SECTION J

INDEX

STEERING

DATA

Steering Gear	
Model	Cam gears
KA.30 and KA.40 models	D.H.; Cam and peg
KA.60 models	D.H.Q.; Cam and roller peg
Ratio	
KA.30 and KA.40 models	18:1
KA.60 models	18:1
Oil capacity	
KA.30 and KA.40 models	1¼ pints (·71 litre)
KA.60 models	1½ pints (·852 litre)
Dia. of steering wheel	18 in. (45·7 cm.)
End float of inner column	·0015 in. (·038 mm.) preload to ·001 in. (·025 mm.) end float
End thrust of cam	Taken on opposed ball bearing races
Adjustment of cam	By shims at each end of steering box casing
Meshing of cam and rocker shaft peg	
KA.30 and KA.40 models	6 to 20 lb. in. (6·9 to 23 kg.cm.) — Torque measured at the steering wheel in the "straight ahead" position
KA.60 models	6 to 30 lb. in. (6·9 to 34·5 kg.cm) — Torque measured at the steering wheel in the "straight ahead" position
Adjustment of rocker shaft peg mesh	
KA.30 and KA.40 models	By adjusting screw and locknut in side cover
KA.60 models	By shims fitted between side cover and steering box casing
Steering wheel travel—lock to lock	3¾ turns approx.
Torque loading of drop arm retaining nut	150 lb. ft. (20·74 kg.m.)
Steering Geometry	
Toe-in (Track)	⅛ in. (3 mm.) taken at the outer wall of the tyre, midway between the wheel rim and the tyre tread
Wheel camber angle	1° positive
Castor angle—laden	2° 28′.
—unladen	
—KA.30 models	3° 39′—with front axle weight of 2440 lb. (1106 kg.).
—KA.40 models	3° 39′—with front axle weight of 2400 lb. (1088 kg.).
—KA.60 models	3° 45′—with front axle weight of 2490 lb. (1129 kg.).
King pin inclination	8°
Steering Side Rod	
Type	Self adjusting ball pin and socket
Distance between centres	14·40 in. (36·576 cm.)
Track Rod	
Type	Self adjusting ball pin and socket
Distance between centres	56·9 in. (144·5 cm.) nominal, subject to adjustment for toe-in (track)

MANUFACTURING DATA

Rocker shaft outer dia.	
KA.30 and KA.40 models	1·2485/1·2493 in. (31·712/31·733 mm.)
KA.60 models	1·2475/1·2488 in. (31·687/31·72 mm.)
Rocker shaft bush internal dia. (fitted)	1·2498/1·2508 in. (31·730/31·745 mm.)
Thickness of casing cover shims (fitted as required)	·0024 in. (·061 mm.) ·005in. (·127 mm.) ·010 in. (·254 mm.)

STEERING

DESCRIPTION

The steering gear assembly is mounted by means of an integral steering box casing extension to the upper flange of the chassis sidemember and additionally, a bracket is welded to the sidemember to further support the steering gear. A rubber bushed bracket, attached to the base of the instrument panel and clamped to the steering gear outer column, provides support to the upper section of the steering gear assembly. A finger-tip controlled, dipper switch is located on the outer column, at the base of the steering wheel, and a hand-brake lever assembly, mounted at right angles to the outer column, is secured to a relay shaft which is carried in two support brackets. These brackets are clamped by "U" bolts to "D" shaped mounting brackets which are, in turn, die cast on to the upper and lower sections of the outer column.

The inner column and cam of the steering gear form a single unit, which is assembled in the steering box casing and single row ball bearing races provide the seatings for the top and bottom shoulders of the cam. These ground shoulders form the inner cups of the bearing races and separate outer cups retained by the bottom cover and outer column socket respectively, are used to locate the bearings in the casing bores.

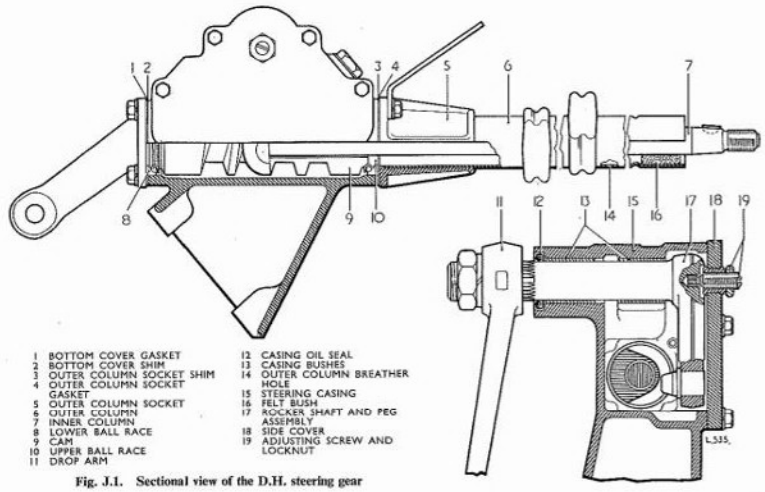
Shims are fitted between the bottom cover and the casing and by varying the thickness of these shims, any end float in the inner column and cam can be eliminated.

On KA.30 and KA.40 models, the rocker shaft assembly has a fixed rocker peg, which is pressed into the rocker arm, whereas on KA.60 models, the rocker shaft incorporates a rocker peg that rotates within a circle of hardened steel rollers. The rocker peg meshes with the cam on the inner column and, on KA.30 and KA.40 models, the depth of meshing is controlled by an adjusting screw, secured by a locknut to the side cover. The nose of the adjusting screw bears upon a hardened steel disc pressed into a drilling in the rocker arm. On KA.60 models, the depth of mesh between the rocker peg and the cam is governed by the amount of shims fitted between the side cover and the steering box casing.

Two phosphor bronze bushes, pressed in the rocker shaft bore of the steering box casing, provide the operating surfaces for the rocker shaft. An oil seal, fitted in the outer end of the rocker shaft bore in the casing, prevents the lubricant from escaping at this point.

The drop arm is carried on tapered splines machined in the outer end of the rocker shaft and is secured by means of a plain nut and a spring washer. A master spline on the rocker shaft, matches a similar spline in the broached bore of the drop arm, to correctly position the drop arm in relation to the rocker shaft and cam.

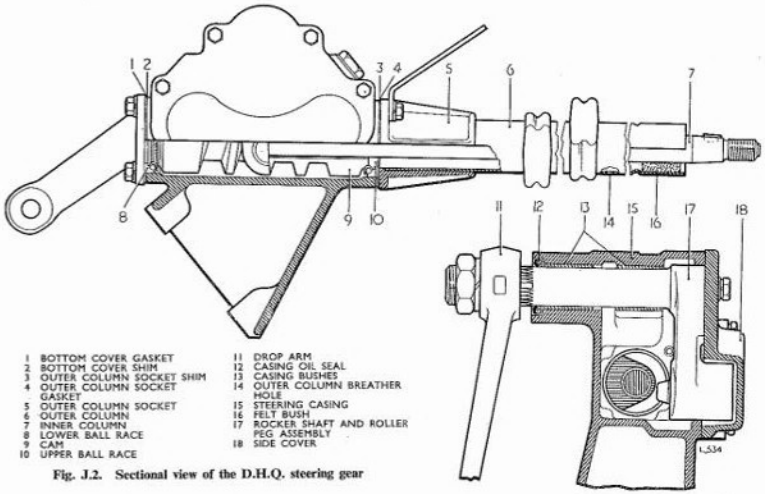
An adjustable steering side rod, incorporating self adjusting ball joint assemblies, is secured at one end of the tapered plain bore of the drop arm and, at the opposite end of the rod, to the steering arm which is bolted to the stub axle.



1 BOTTOM COVER GASKET
2 BOTTOM COVER SHIM
3 OUTER COLUMN SOCKET SHIM
4 OUTER COLUMN SOCKET GASKET
5 OUTER COLUMN SOCKET
6 OUTER COLUMN
7 INNER COLUMN
8 LOWER BALL RACE
9 CAM
10 UPPER BALL RACE
11 DROP ARM
12 CASING OIL SEAL
13 CASING BUSHES
14 OUTER COLUMN BREATHER HOLE
15 STEERING CASING
16 FELT BUSH
17 ROCKER SHAFT AND PEG ASSEMBLY
18 SIDE COVER
19 ADJUSTING SCREW AND LOCKNUT

Fig. J.1. Sectional view of the D.H. steering gear

A track rod, also using self adjusting ball joint assemblies, is located at the rear of the front axle beam and links the appropriate steering arm attached to each stub axle. Adjustment of the track rod length is provided to enable the front wheel track (toe-in) to be set correctly.



1 BOTTOM COVER GASKET
2 BOTTOM COVER SHIM
3 OUTER COLUMN SOCKET SHIM
4 OUTER COLUMN SOCKET GASKET
5 OUTER COLUMN SOCKET
6 OUTER COLUMN
7 INNER COLUMN
8 LOWER BALL RACE
9 CAM
10 UPPER BALL RACE
11 DROP ARM
12 CASING OIL SEAL
13 CASING BUSHES
14 OUTER COLUMN BREATHER HOLE
15 STEERING CASING
16 FELT BUSH
17 ROCKER SHAFT AND ROLLER PEG ASSEMBLY
18 SIDE COVER

Fig. J.2. Sectional view of the D.H.Q. steering gear

LUBRICATION

A plug fitted in the upper part of the steering box casing acts as a filler and level plug. The oil level should be checked every 6,000 miles (9,000 kms.) and for the steering box to be correctly filled, the lubricant should be just level with the aperture obtained by removing the plug.

Lubrication nipples are provided at each ball joint assembly of the steering side rod and the track rod, and should be lubricated every 2,000 miles (3,000 kms.).

Always use the recommended lubricants when periodical attentions are carried out.

ADJUSTMENTS

To Adjust Meshing of the Rocker Shaft Peg.

KA.30 and KA.40 Models.

An adjusting screw and a locknut in the side cover provides the means of controlling the depth of mesh of the rocker shaft peg. To adjust, proceed as follows:—

Screw the adjusting screw in or out of the side cover, after slackening the locknut, until a slight highspot can be felt at the steering wheel with the road wheels in the "straight ahead" position.

The correct amount of torque required to move the rocker shaft over the "straight ahead" point of travel is 6 to 20 lb. in. (6·9 to 23 kg.cm.) which is equivalent to a spring balance reading of 1 to 2·75 lb. (·454 to 1·25 kg.) taken on a tangential pull from the outer extremity of one of the steering wheel spokes. This torque reading must be measured at the steering wheel with the steering side rod disconnected from the drop arm. Fully tighten the adjusting screw locknut and re-check the amount of torque on completion.

KA.60 Models.

Adjustment of the rocker shaft peg mesh on these models is controlled by the amount of shims between the side cover and the steering box casing. To adjust, proceed as follows:—

1. Remove the side cover and the shims, noting the number and thickness of the shims.

2. Alter the thickness of the shims, by removing shims to reduce the clearance between the cam and the rocker peg, or by adding shims to increase the clearance.

3. After altering the shim thickness, check that the side cover gasket is in good condition, renewing as necessary, refit the side cover and fully tighten the side cover setscrews.

4. Check the amount of torque required to turn the steering wheel at the "straight ahead" position. The correct amount of torque required to move the rocker shaft over the "straight ahead" point of travel is 6 to 30 lb. in. (6·9 to 34·5 kg.cm.) which is equivalent to a spring balance reading of 1 to 4 lb. (·454 to 1·8 kg.) taken on a tangential pull from the outer extremity of one of the steering wheel spokes. This torque reading must be measured at the steering wheel with the steering side rod disconnected from the drop arm.

5. Refill the steering box to the correct level, on completion of the operation, using the recommended grade of lubricant.

To Adjust Inner Column End Float.

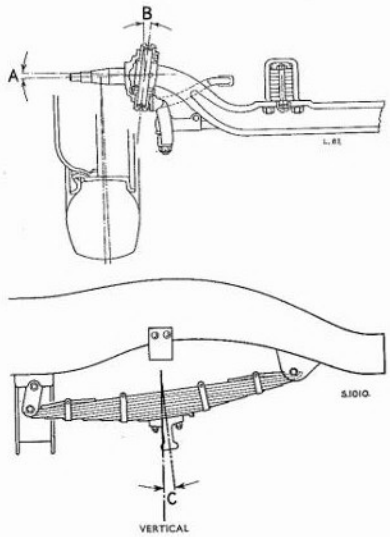
The correct adjustment for the inner column is effected by altering the thickness of the shims between the bottom cover and the steering box casing, until the limits given on the "Data" page of this section are obtained.

When refitting, ensure that the bottom cover gasket is in good condition, renewing as necessary, fully tighten the bottom cover setscrews and re-check the adjustment on completion.

Finally, refill the steering box to the correct level using the recommended grade of lubricant.

STEERING GEOMETRY

The efficient control of the vehicle on the road depends to a large extent on the correct maintenance of the following design factors:



A = WHEEL CAMBER ANGLE
B = KING PIN INCLINATION
C = CASTOR ANGLE

Fig. J.3. Steering geometry

1. Front Wheel Track (Toe-in).
This is the inward setting of the front wheels, determined at the straight ahead position, and in the horizontal plane, when the distance between the two wheels should be less at the front than at the rear.

2. Wheel Camber Angle.
Camber is the angle to the vertical at which each front wheel inclines outward at the top.

3. King Pin Inclination.
This is the angle that the upper end of the king pin inclines from the vertical position towards the centre of the front axle.

4. Castor Angle.
This is the angle formed by the rearward tilt of the front axle.

These design factors are directly influenced by the mechanical condition of the steering gear assembly, front axle and steering linkage, i.e., drop arm, steering side rod, steering arms and track rod. Therefore, before carrying out the checks detailed under this heading, it is necessary for the following to be checked and corrected.

(*a*) Hub bearing adjustment.

(*b*) Swivel pins, and bushes for wear.

(*c*) Steering side rod joints.

(*d*) Track rod joints.

(*e*) Steering gear adjustment.

(*f*) Tyre pressures.

The checks must be made with the vehicle in an unladen state and standing on a perfectly level surface.

Special equipment should be used to check front wheel track (toe-in), camber, king pin inclination and castor angle. The methods to adopt when using Churchill Tracking Gauge 95B and Churchill Wheel Alignment Gauge 121 LA are described in the ensuing sub-sections.

To Check Front Wheel Track (Toe-in).

The front wheels should "toe-in" $\frac{1}{8}$ in. (3 mm.), i.e., the distance between the front of the front wheels should be $\frac{1}{8}$ in. (3 mm.) less than the distance between the rear of the front wheels.

The correct point of measurement is at wheel centre height on the outer wall of the tyre, midway between the wheel rim and the tyre tread. It is most essential that the correct measurement is maintained at all times. The following instructions detail the use of Churchill Tracking Gauge 95B in correctly measuring "toe-in".

1. Lock the vertical arms parallel by means of the locking collars (see Fig. J.4).

2. Push the dial pointer back into its sheath and retain it there with the clamping screw provided under the dial head.

3. Loosen knobs B and C (Fig. J.4), so that the gauge can be adjusted to the width of the vehicle.

4. Place the gauge in front of the front wheels with the

dial at the right-hand side of the vehicle, and adjust for width so that the fixed pointer is resting against the outer wall of the left-hand front tyre, midway between the wheel rim and the tyre tread, and position the sheath of the dial pointer approximately $\frac{1}{4}$ in. (19 mm.) from the corresponding position on the outer wall of the right-hand front tyre.

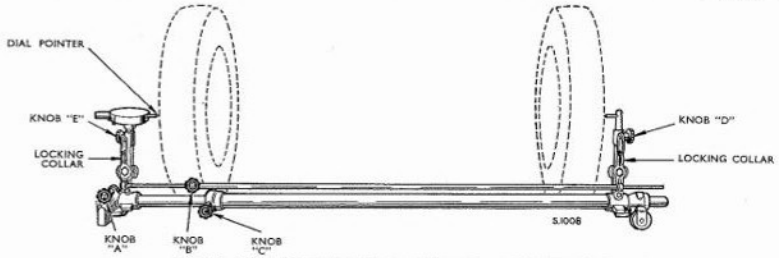


Fig. J.4. Churchill Tracking Gauge in position in front of the front wheels

5. Tighten knobs B and C.

6. Adjust the vertical pointer arms, by slackening knobs D and E, so that both pointers are at wheel centre height.

7. Release the dial pointer from its sheath.

8. Mark the tyres with chalk where the dial pointer and the fixed pointer make contact,

9. Release the locking collars.

10. Rotate the dial to "Zero" and secure in that position with the clamp screw at the side of the dial.

11. Retract the dial pointer and lock in its sheath.

12. Lock the vertical pointer arm with the locking collars.

13. Remove the tracking gauge, and place it to one side of the vehicle.

14. Roll the vehicle forward so that the wheels turn through 180°, and so that the chalk marks on the tyres are at wheel centre height, at the rear of the wheels. Slacken knob A on the tracking gauge and lower the pointer arms to the horizontal.

15. Place the gauge under the vehicle at the **rear** of the **front** wheels with the dial pointer to the left-hand side of the vehicle. (See Fig. J.5.)

16. Raise the pointer arms to the vertical and lock knob A.

17. Position the fixed pointer to the chalk mark on the tyre wall.

18. Release the locking collars.

19. Release the dial pointer and check the free movement of the gauge.

20. Take the reading on the dial. (See Fig. J.5.)

21. If correct, retract the dial pointer and remove the gauge.

To Correct Front Wheel Track (Toe-in) Setting.

1. Leave the gauge in position.

2. Slacken the clamp bolt at each track rod ball joint.

3. Note the difference between the dial reading and the recommended setting of $\frac{1}{8}$ in. (approximately 3 mm.) and halve this figure.

4. Adjust the track by rotating the track rod until the pointer on the dial has moved the amount of this final figure in the required direction. (Any adjustment made at the rear of the wheels is duplicated at the front of the wheels in the opposite direction so that the effective adjustment made to the track is double the amount shown on the dial.)

5. Re-tighten the track rod clamp bolts and ensure that the ball joints at either end of the track rod are in alignment with each other.

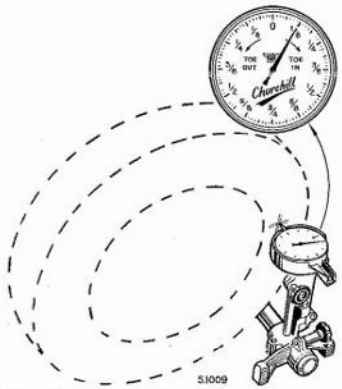


Fig. J.5. Churchill Tracking Gauge in position at the rear of the front wheels

6. If the wheels are badly out of alignment this may be due to the track rod having bent through accidental damage. In such cases the track rod should be renewed.

7. Example of correction to track setting, using the Churchill 95B track gauge.

(*a*) Correct track setting is $\frac{1}{8}$ in. (3 mm.) toe-in.

(*b*) Gauge shows $\frac{1}{4}$ in. (6·35 mm.) toe-in.

(*c*) Excess is $\frac{1}{8}$ in. (3 mm.) toe-in.

(*d*) Half of $\frac{1}{8}$ in. (3 mm.) is $\frac{1}{16}$ in. (1·5 mm.)

(*e*) $\frac{1}{4}$ in. (6·35 mm.) less $\frac{1}{16}$ in. (1·5 mm.) is $\frac{3}{16}$ in. (4·763 mm.) toe-in.

(*g*) Re-check track toe-in setting after adjustment.

Important.

With optical gauges or any type that does not require the road wheels to be turned through 180° it is vital that the wheel run-out should be checked and the points of maximum run-out set in the vertical position.

To Check Camber, Castor and King Pin angles. Using Churchill Wheel Alignment Gauge 121 LA. Gauge Description.

The gauge body consists of an aluminium casting containing a spirit level which slides in a channel between two scales, one for reading Camber Angle and the other Castor and King Pin Inclination Angles. The force required to move the spirit level holder can be adjusted to suit individual preference by means of a spring loaded screw. The Camber scale is fixed to the body, while the combined Castor and King Pin Inclination scale can be adjusted and locked in position where required. The gauge body pivots on a spindle fixed at right angles to the gauge carrier and can also revolve on this spindle.

Fig. J.6. Churchill Wheel Alignment Gauge 121LA shown in position

The gauge carrier consists of two parallel steel rods of equal length being joined at one end by a cam box and at the other by a bridge piece; both of which can be moved along the rods to suit the diameter of the road wheel to which the gauge is to be applied. The cam box contains a spindle type cam which, when rotated by the external lever, moves the box about $\frac{1}{8}$ in. (3·2 mm.) in either direction along the rods, according to which way the lever is rotated. At the same time it locks the box on to one of the steel rods and prevents movement. The bridge piece can be locked on to the rods by a thumb screw. Situated between the bridge piece and cam box is the gauge mounting plate; this slides on the rods and can be positioned where required. At each end of the bridge piece and in a boss on the cam box, a removable contact foot is fitted. Each contact foot is cut away on one side to prevent any possible fouling on the tyre and has, at its end, a screw, the head of which locates the gauge and carrier assembly on the inside of the wheel rim.

To Apply the Churchill Gauge.

1. Check and correct all tyre pressures and ensure that the vehicle is positioned on a level surface.

2. Check for slackness in the front hub bearings and adjust if necessary as detailed under the appropriate heading in the "Front Axle" section.

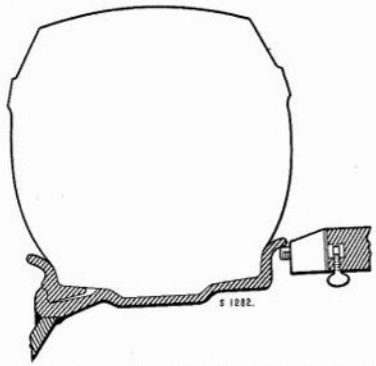


Fig. J.7. Sectional view showing the correct location for the contact foot of Churchill Wheel Alignment Gauge 121LA against the wheel rim

3. Locate the bridge piece against the wheel rim with the screw head under the flange (see Fig. J.7).

4. Slide the cam box along the rods until the foot locates against the wheel rim.

5. Turn the cam operating lever anti-clockwise to move and lock the carrier assembly to the wheel rim. The

position of the carrier on the wheel is not important although care should be taken to avoid locating the contact foot on the welded joint or any obviously damaged part of the rim. It is suggested that a convenient position for the carrier is with the rods placed parallel to the ground.

6. Slide the gauge mounting plate along the rods until the spindle is as near as possible on the centre line of the wheel and lock in position.

7. Before checking the steering geometry, it is essential that the wheel run-out is established, otherwise an incorrect reading will be given. The Churchill Wheel Alignment Gauge may be utilised for this purpose and the following procedure adopted.

(*a*) Jack up the front of the vehicle until the road wheel is free to rotate.

(*b*) Pivot the gauge body so that it lies at right angles to the road wheel and move the spirit level to a central position in the channel.

(*c*) Holding the gauge body in this position by hand, loosen the spindle locking screw and rotate the road wheel noting the bubble movement in the spirit level.

(*d*) Set the spirit level so that the bubble is centralised at one end of its range of movement and note the reading on the camber scale.

(*e*) Rotate the road wheel until the bubble is at the other end of its movement range.

(*f*) Centralise the bubble in the spirit level and note the reading.

(*g*) Move the spirit level until it registers a reading midway between those obtained in paragraphs (*d*) and (*f*).

(*h*) Rotate the wheel until the bubble is centralised in the spirit level.

(*j*) Prevent the wheel from revolving from this position by applying the footbrake, holding the pedal down with a suitable pedal depressor (Churchill No. 121 PD-B) and lower the wheel to the ground.

To Check Camber Angle.

1. Position the vehicle with the front wheels in the straight ahead condition and apply the Churchill Wheel Alignment Gauge to the front road wheel as described in the previous sub-section.

2. Lock the spindle screw so that the gauge scales are horizontal.

3. Position the gauge body so that it is at right angles to the road wheel and to the right of the spindle.

4. Centralise the spirit level bubble and note the reading on the Camber scale. The correct Camber angle is 1° Positive.

5. Repeat the same operations on the opposite front road wheel.

To Check Castor Angle.

1. Position the vehicle with the front wheels in the straight ahead condition.

2. Place a turntable (Churchill No. 121 U) centrally in front of each front wheel.

3. Set the turntable scales to zero and insert the locking pins.

4. Place the ramps (Churchill No. 121 W) in front of both front and rear wheels. The front ramps, which attach to each turntable, are to assist in the next operation (para. 5), while those at the rear, maintain the vehicle in a level condition.

5. Roll the vehicle on to the turntables and apply the handbrake. Apply the Churchill Wheel Alignment Gauge to the road wheel as detailed on page J.9.

6. Turn the gauge body at right angles to the road wheel and to the right of the spindle.

7. Remove the turntable locking pins and turn the road wheel to a 20° turn, as indicated on the turntables by moving the front of the road wheel **towards** the operator.

8. Centralise the spirit level bubble.

9. Set the combined Castor–King Pin Inclination scale to zero and tighten the scale locking screw.

10. Turn the front of the wheel **away** from the operator until the turntable reading shows 20° with the front of the wheel pointing inwards.

11. Centralise the spirit level bubble and note the reading on the Castor–King Pin Inclination scale. The correct Castor angle is quoted in the "Data" page of this section for both laden and unladen conditions.

12. Repeat the same operations on the opposite front wheel.

To Check King Pin Inclination Angle.

1. Position the vehicle with the front wheels in the straight ahead condition.

2. Place a turntable (Churchill No. 121 U) centrally in front of each front wheel.

3. Set the turntable scales to zero and insert the locking pins.

4. Place the ramps (Churchill No. 121 W) in front of both front and rear wheels. The front ramps, which attach to each turntable, are to assist in the next operation (para. 5), while those at the rear, maintain the vehicle in a level condition.

5. Roll the vehicle on to the turntables and apply the footbrake. Hold the pedal down by means of a suitable pedal depressor (Churchill No. 121 PD). Apply the Churchill Wheel Alignment Gauge to the road wheel as detailed on page J.9.

6. Turn the gauge body parallel to the road wheel.

7. Remove the turntable locking pins and turn the road wheel to a 20° turn, as indicated on the turntables, by moving the front of the road wheel **towards** the operator.

8. Centralise the spirit level bubble.

9. Set the combined Castor–King Pin Inclination scale to zero and tighten the scale locking screw.

10. Turn the front of the wheel **away** from the operator until the turntable reading shows 20° with the front of the wheel pointing inwards.

11. Centralise the spirit level bubble and note the reading on the Castor–King Pin Inclination scale. The correct King Pin Inclination angle is 8°.

12. Repeat the same operations on the opposite front road wheel.

STEERING WHEEL

To Remove.

1. Disconnect the battery leads.

2. Prise the horn push cap from the centre of the steering wheel, withdrawing at the same time the cap return spring. Lift out the contact plunger located in the drilling in the wheel hub.

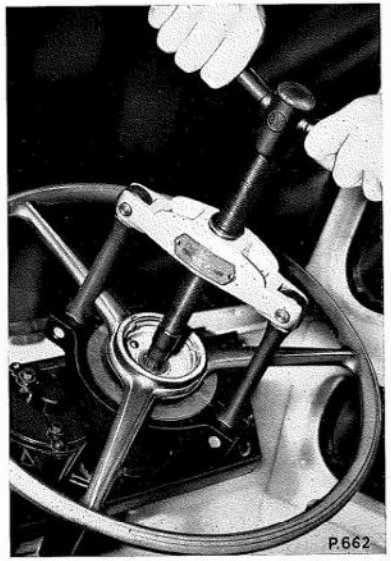


Fig. J.8. Removing the steering wheel using Churchill Tool R.G.3600 and the adaptor R.G. 3600-1

3. Release the dipper and horn leads from the steering column clips. Unscrew the dipper switch cover retaining screws, remove the end cap and temporarily secure the dipper switch, complete with electrical leads and the horn lead, to the instrument panel, away from the steering column.

4. Unscrew the securing nut on the inner column and remove the steering wheel using Churchill Tool R.G.3600 and Adaptor R.G.3600–1 (see Fig. J.8).

To Refit.

1. Align the keyway in the steering wheel hub bore with the key fitted in the inner column and refit the steering wheel. By refitting and tightening the inner column nut, the wheel can be pulled down fully on the tapered shank of the inner column.

2. Insert the horn lead in the connection in the horn slip ring and refit the dipper switch and electrical leads, retaining the switch by means of the end cap and securing screws.

3. Place the horn contact plunger in the wheel hub drilling with the hexagonal brass end of the plunger foremost. Locate the horn cap return spring on the top of the inner column and ensure that when refitting the horn push cap, the return spring locates in the centre of the cap and the top of the inner column.

4. Re-connect the battery leads and test the horn and dipper switch for correct operation.

STEERING GEAR ASSEMBLY

To Remove.

1. Disconnect the battery leads and remove the steering wheel, the horn cap and the dipper switch as detailed in the previous sub-section.

2. Remove the rear engine cover.

3. Release the pinch bolts and withdraw the clutch and brake pedal stems from their respective levers. Unscrew the accelerator lever pad, noting the spring washer located below the pad.

4. Remove the slotted screws, retaining the handbrake and steering column sealing plate to the toe-panel. Lift away the plate which is in two sections.

5. Release the slotted screws and remove the toe-panel assembly.

6. Place chocks under the road wheels and release the handbrake. Remove the jaw pin connecting the handbrake shaft relay lever to the operating rod jaw.

7. Release the brake fluid supply tank and clamp from the support bracket attached to the steering outer column socket and temporarily support the tank to the adjacent scuttle panel ledge.

8. Disconnect the steering side rod at the drop arm (see page J.15 for details of this operation).

9. Release the outer column clamp at the support bracket secured to the base of the instrument panel.

10. Remove the four nuts and spring washers retaining the steering box casing to the sidemember and the adjacent support bracket.

11. The steering gear assembly can then be carefully withdrawn, through the toe-panel aperture, complete with the handbrake lever and shaft assembly.

12. Remove the two "U" bolts clamping the handbrake shaft support brackets to the mounting brackets cast on the outer column and separate the handbrake lever and shaft as an assembly from the steering gear.

To Dismantle.

1. Unscrew the plain nut retaining the drop arm on the rocker shaft and remove the large spring washer.

2. The rocker shaft and drop arm splines are machined to include four master splines, therefore, before removing the drop arm, identify the relationship between the rocker shaft and the drop arm to facilitate reassembly.

Withdraw the drop arm using Churchill Tool R.G. 59A and the Thrust Pad R.G. 59A—2.

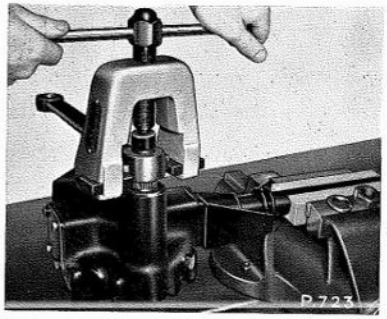


Fig. J.9. Withdrawing the drop arm using Churchill Tool R.G.59A and the Thrust Pad R.G.59A-2

3. Withdraw the setscrews and remove the side cover and the gasket. Allow the oil to drain completely.

On **KA.30 and KA.40 models,** the side cover incorporates an adjusting screw and locknut and it should only be necessary to remove these two items from the cover, if replacements are necessary.

On **KA.60 models,** shims are positioned between the side cover and the steering box casing to control the meshing of the rocker shaft peg. Remove the shims and place them in a safe place for the re-assembly operation.

4. Withdraw the rocker shaft assembly through the side cover aperture.

On **KA.30 and KA.40 models,** the rocker peg is not supplied as a separate replacement whereas, on **KA.60 models,** the rocker peg and roller assembly can be renewed. Therefore, only remove the rocker peg and roller assembly in order to fit a replacement.

5. Prise the key from the slot in the top of the inner column. Remove the setscrews and spring washers securing the outer column socket to the steering box casing and remove the brake supply tank support bracket. Lift away the outer column and socket assembly. Remove the shims and the gasket located beneath the socket flange. Ensure the shims are placed in a safe position for subsequent re-assembly.

6. Remove the setscrews and springs washers securing the bottom cover and lift off the cover, the shims and the gasket. Ensure that the shims are safely retained for the re-assembly operation.

7. The inner column and cam assembly can now be withdrawn through the bottom aperture complete with the lower ball race and cup. The upper ball race will also be removed at the same time, but the upper cup will need to be lightly tapped in order to separate it from the steering box casing.

8. Remove the oil seal from the outer end rocker bore of the casing if the sealing lip is damaged or deteriorated. Always renew the oil seal if the original seal is removed.

Inspection and Overhaul.

1. Examine the cam for excessive wear in the groove and also inspect the ball tracks formed in each end of the cam for signs of pitting. The inner column and cam are renewed as an assembly.

2. Check the fit of the rocker shaft in the bushes of the casing. The rocker shaft should be a free fit but no slackness is permissible. Should wear be apparent, remove the oil seal, press out the bushes and fit new bushes as follows:—

(*a*) Press in the new bushes to the dimensions given ensuring that the marked ends are always in the centre of the rocker shaft bore (see Fig. J.11).

(*b*) After fitting, the bushes must be machined to a diameter of 1·2498/1·2508 in. (31·730/31·745 mm.). The final diameters of the bushes must be concentric to within ·0005 in. (·013 mm.).

(*c*) Finally, press in the new oil seal until flush with the casing outer end.

3. On **KA.30 and KA.40 models,** inspect the rocker peg for signs of wear on the contact surface. The rocker peg is not supplied as a separate replacement and therefore the rocker shaft must be renewed.

On **KA.60 models,** inspect the rocker peg for signs of wear on the contact surface and also for radial slackness or rough operation of the rocker peg rollers. If any of these faults are evident, the complete peg and housing assembly must be renewed.

Should the assembly prove to be worn, press out the housing with the peg and fit a new assembly as follows:—

(*a*) Press in the housing fully against the shoulder in the

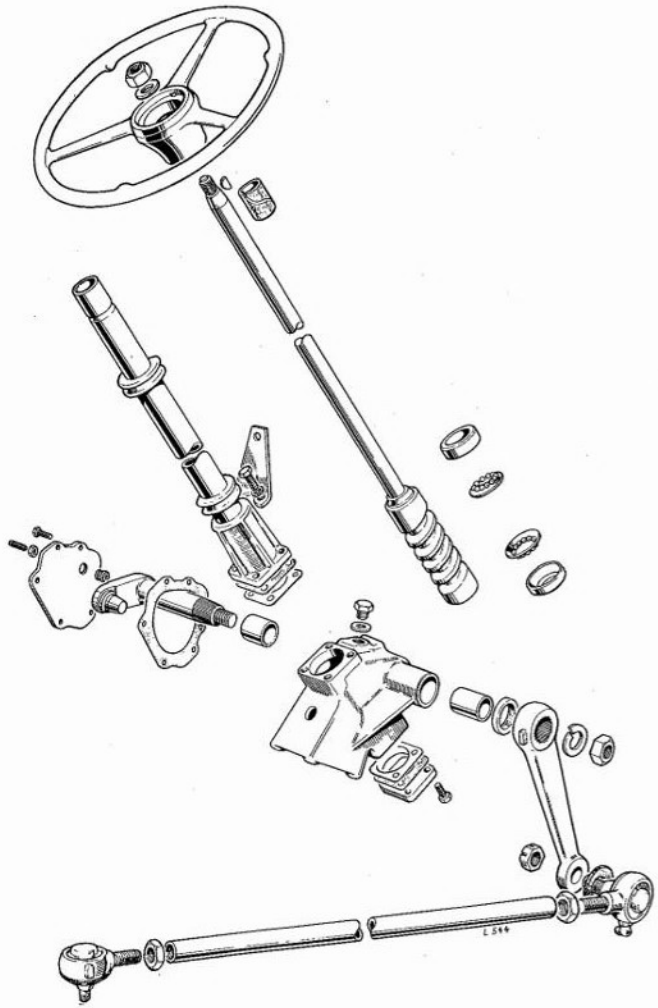


Fig. J.10 Details of the D.H. steering gear

rocker shaft bore, having first ensured that the rocker shaft bore is clean and free from burrs.

(*b*) After fitting the housing assembly the rocker shaft should be peened over in at least four places. This will prevent the housing from "creeping" forward

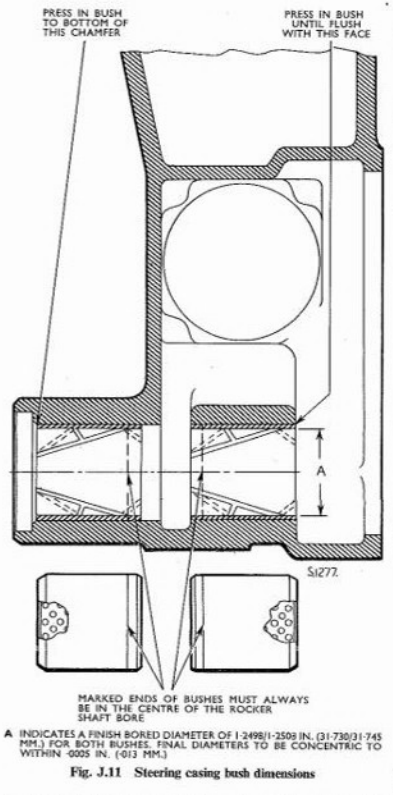


Fig. J.11 Steering casing bush dimensions

4. Inspect the drop arm for cracks and distortion. If damage is suspected, check the arm against the dimensions given in Fig. J.13. If the dimensions do not correspond or cracks are detected, renew the drop arm. Ensure that the internal splines are in good condition.

5. Check the condition of the felt bush at the top of the outer column and renew if worn.

6. Examine the ball races for wear or pitting and check the working surface of the cups for signs of pitting or scoring.

7. Inspect the rocker shaft for wear or scoring particularly on the shank diameter. Examine the splines and the thread for damage and wear.

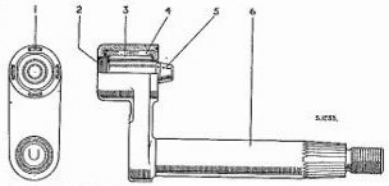


Fig. J.12. Rocker shaft roller assembly as fitted to D.H.Q. steering gear

8. Inspect the steering box casing for damage particularly at the cover faces and bearing cup bores. Ensure that the mounting face is clean, free from burrs and also that the mounting stud threads are in good condition.

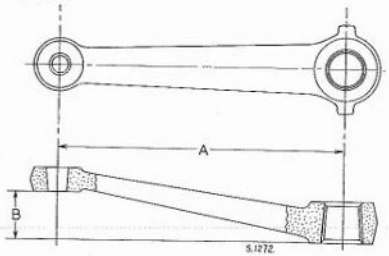
9. Check the outer column and socket assembly for damage or distortion, also ensuring that the mounting brackets for the handbrake shaft support brackets are securely mounted on the outer column. Renew the assembly if any fault is evident.

To Re-assemble.

Re-assembly is a reversal of the dismantling procedure with the following additions:—

1. When refitting each cover always use a new gasket.

2. Refit the original number of shims at the bottom cover face. Check that the correct end float is present (see page J.7).



A — 8·90 IN. (22·6 CM.)
B — 1·36/1·39 IN. (34·54/35·31 MM.)

Fig. J.13. Drop arm dimensions

3. Ensure that the rocker shaft peg meshes correctly with the cam (see page J.6).

4. Before refitting the rocker shaft it is advisable to temporarily tape the splined end to prevent damaging the oil seal. Refit the rocker shaft and remove the tape.

5. After refitting the inner column and cam assembly, ensure that the cam shoulders are seating fully in the ball races and cups.

6. Refit the drop arm using the identification marks made during dismantling to align the correct master splines of each component. Refit the spring washer and the plain nut, tightening the nut to a torque wrench reading of 150 lb. ft. (20·74 kg.m.).

7. When re-assembling the outer column and socket assembly setscrews, do not omit to refit the brake fluid supply tank bracket at the same time.

To Refit.

Refitting the steering gear is a reversal of the removal procedure noting the following points.

1. Refit the handbrake lever and relay shaft assembly to the outer column brackets ensuring that the "U" bolt nuts are tightened securely. Check that the handbrake lever is in the "off" position and connect the relay lever at the base of the shaft to the operating rod jaw using a new split pin in the slotted nut. Always check the handbrake for correct operation on completion of the steering gear refitment.

2. Ensure that the mounting stud nuts are tightened securely.

3. Refit the steering wheel, the horn cap and the dipper switch as detailed in the previous sub-section.

4. Use a new split pin for the slotted nut on the steering side rod ball joint assembly, after fully tightening the nut.

5. Refill the steering box to the correct level, using the recommended grade of lubricant.

6. Refit the clutch and brake pedal stems to their respective correct heights as detailed in the "Clutch" and "Brakes" sections.

STEERING SIDE ROD

Lubrication.

Lubricate the steering side rod ball joints, at the lubricating points provided, every 2,000 miles (3,000 kms.).

To Check for Wear.

Provided the ball joints are lubricated every 2,000 miles (3,000 kms.), wear will be negligible at these points. To check for wear, however, each ball joint assembly should be grasped and tested for up and down movement. Whilst each ball joint assembly should be free to articulate on its ball pin, no other movement between ball pin and socket should be present. As these ball joint assemblies are self-adjusting, no other means of adjustment is provided and they must be renewed as assemblies if wear becomes apparent.

To Remove.

1. Extract the split pin in each ball pin and slacken the slotted nut a few turns.

2. Apply a brass or copper hammer to the nuts and drive the ball pins out of the tapered fit in their respective bosses. During this operation, do not omit to support the drop arm or steering arm on the opposite side to counteract the hammer blows.

Note: On no account must the drop arm or steering arm be heated to assist in the removal of ball pins as this method will destroy the temper of the metal.

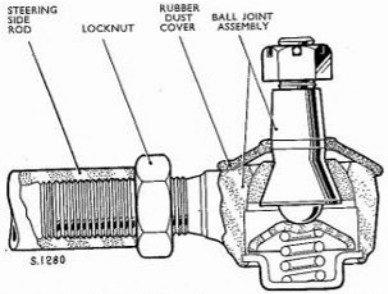


Fig. J.14. Sectional view of the steering side rod ball joint assembly

3. Finally, unscrew the nuts entirely, fully tap out the ball pins taking care not to damage the threads and lift away the steering rod.

To Dismantle.

1. Slacken the locknuts on the intermediate rod and thread the ball joint assemblies off the rod, noting that the threads of each assembly are right-hand.

Note: The ball joint assemblies are sealed and should not be dismantled. They must each be renewed as a complete assembly when wear is evident.

2. Remove the rubber dust covers.

Inspection and Overhaul.

1. Check the rod for bend and straighten if evident. **Do not use heat** to straighten the rod as this will destroy the temper of the metal.

2. Renew the rubber dust covers if they are split or deteriorated.

3. As stated in para. 1. "To Dismantle", each ball joint assembly must be renewed as a complete assembly if wear is evident.

To Re-assemble.

1. Screw the ball joint assemblies on to their respective ends of the rod according to the right or left hand thread, but before tightening the locknuts, **ensure that the distance between the ball pin centres is 14·4 in. (36·576 cm.) with the ball pins at 90° to each other.**

2. Refit the rubber dust covers.

To Refit.

1. With the front wheels pointing straight ahead, fit the steering side rod to the steering arm and add the slotted nut to the ball pin. Tighten the nut securely and insert a new split pin.

2. Assuming that the ball pin centres are set correctly as detailed in para. 1 under "To Re-assemble", rotate the steering wheel until the opposite ball pin can be inserted into the drop arm without strain. Add the slotted nut and fit a new split pin after ensuring that the nut is tightened securely.

On completion, ensure that full right and left lock is obtainable by turning the steering wheel and checking for full contact at the axle stops. Adjust the length of the steering side rod if full contact on both stops is not evident.

3. Lubricate the ball joints at the nipples provided with the recommended grade of lubricant.

TRACK ROD

Lubrication.

Lubricate the track rod ball joints at the lubricators provided every 2,000 miles (3,000 kms.).

To Check for Wear.

Wear can be checked in the track rod ball joints by grasping each ball joint assembly in turn and attempting to move it backwards and forwards. Whilst the ball joint should be free to articulate slightly on its ball pin, no other movement between ball pin and socket should be present. As these ball joint assemblies are self-adjusting, no other means of adjustment is provided and they must be renewed as an assembly if wear becomes apparent.

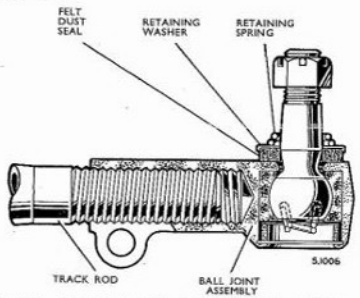


Fig. J.15. Sectional view of the track rod ball joint assembly

To Remove.

1. Extract the split pin in each ball pin and slacken the slotted nut a few turns.

2. Apply a brass or copper hammer to each nut in turn and drive the ball pins out of the tapered fit in their respective bosses. During this operation do not omit to support the steering arm on the opposite side.

3. Finally, remove the nuts entirely, tap out the ball pins taking care not to damage the threads, and remove the dust enclosure details, i.e., spring, retaining washer and the felt seal.

Note: On no account must the steering arm be heated to assist in the removal of the ball pins, as this method will destroy the temper of the metal.

To Dismantle.

1. Remove the clamp bolt, spring washer and nut at each end of the track rod and unscrew each ball joint assembly noting that the threads of each assembly are opposite, i.e., left hand or right hand.

Note: The ball joint assemblies are sealed and should not be dismantled. They must each be renewed as a complete assembly when wear is evident.

Inspection and Overhaul.

1. Examine the intermediate rod for cracks. Also check the rod for bend and straighten if evident. **The rod must not be heated to assist with the straightening operation otherwise the temper of the metal will be destroyed.**

2. Check the threads at each end of the intermediate rod for worn or slack threads by screwing the respective ball joint assemblies down the threaded portion.

3. Ensure that the felt dust seal, the retaining washer and spring are in good condition. Renew as necessary.

4. As stated in para. 1 "To Dismantle", the ball joint assemblies must be renewed as complete assemblies if wear is evident.

To Re-assemble.

1. Screw the ball joint assemblies on to their respective ends of the track rod, ensuring that they are each screwed on an equal distance towards the rod centre.

2. Using new spring washers, fit the clamp bolts and nuts to the ball joint casings but do not tighten at this stage.

3. Assemble the felt dust seal, retaining washer and spring on to the shank of the ball pin in that order with the large end of the spring abutting the retaining washer.

To Refit.

Reverse the operations for removal noting the following points:

1. Ensure that the ball pin shanks and the tapered bores in the steering arms are clean and free from burrs before refitting the track rod.

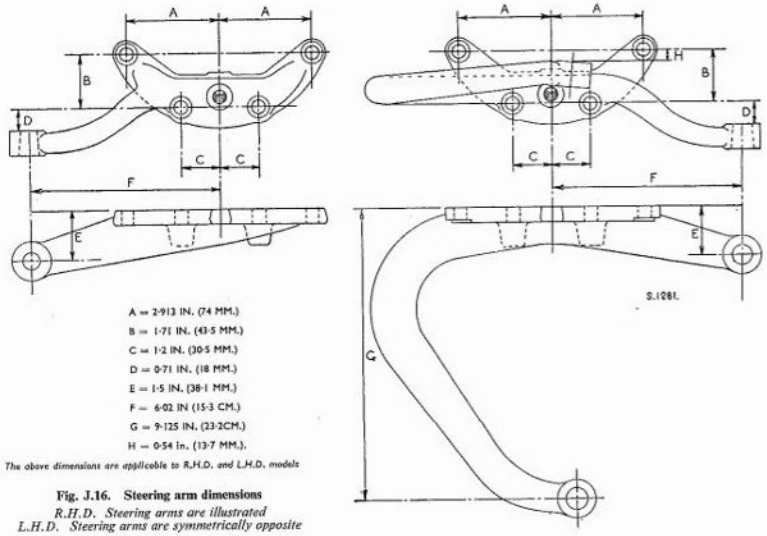
2. The lubrication nipples must face the rear of vehicle and these points should be lubricated after finally refitting the track rod.

3. Ensure the slotted nuts are tightened securely and locked with new split pins.

4. Adjust the length of the track rod to give the correct amount of "toe-in" to the front wheels (see pages J.7 and J.8).

5. After adjusting the correct "toe-in", ensure that the ball joint assemblies are in alignment with each other before thoroughly tightening the clamp bolts in each assembly.

6. Re-check the "toe-in" after completing the refitting of the track rod.



A = 2·913 IN. (74 MM.)
B = 1·71 IN. (43·5 MM.)
C = 1·2 IN. (30·5 MM.)
D = 0·71 IN. (18 MM.)
E = 1·5 IN. (38·1 MM.)
F = 6·02 IN (15·3 CM.)
G = 9·125 IN. (23·2CM.)
H = 0·54 in. (13·7 MM.).

The above dimensions are applicable to R.H.D. and L.H.D. models

Fig. J.16. Steering arm dimensions
R.H.D. Steering arms are illustrated
L.H.D. Steering arms are symmetrically opposite

Note: Should the mounting bolt holes be worn in the arm, both the arm and the mounting bolts should be renewed.

2. Check the arms against the dimensions given in Fig. J.16 for R.H.D. or L.H.D. Should the arms not correspond with these dimensions **they must be renewed.**

3. Ensure that the threads of the mounting bolts and nuts are in good condition.

STEERING ARMS

To Remove.

1. Remove the front hub and brake drum assemblies (see "Front Axle" section).

2. Remove the track rod (see page J.16).

3. Disconnect the steering side rod from the steering arm (see page J.15).

4. Extract the split pins and remove the nuts and bolts securing the steering arms to the stub axles, allowing the arms to be withdrawn.

Inspection and Overhaul.

Thoroughly clean the steering arms before inspection.

1. Carefully inspect the arms for cracks and damage. Check the mounting bolt holes and the tapered holes in the bosses for elongation. Renew if either fault is evident.

To Refit.

Refit the steering arms by reversing the removal procedure, noting the following points:—

1. Ensure that the ball pin shanks and the steering arm tapered bores are clean before fitting.

2. Refit the front hub and brake drum assemblies and adjust the hub bearings as detailed in the "Front Axle" section.

3. Finally, check and, if necessary, adjust the front wheel "toe-in" as detailed on pages J.7 and J.8.

SERVICE DATA

Note :—This page is provided for recording references to Service Data Bulletins applicable to the preceding Section

SERVICE DATA			WORKSHOP MANUAL	
DATE	SHEET NO.	VOLUME NO.	PAGE REF.	SUBJECT

BRAKES

SECTION K

INDEX

BRAKES

DATA

Make	Girling
Type of system	Hydraulic. A servo unit is fitted as standard on KA.60 models.
Operation	
Foot brake	Hydraulic on all four wheels
Handbrake	Mechanical on rear wheels only
Front brake type	
KA.30	HLSS—Hydraulic leading/sliding shoe
KA.40/60	HLSS—Hydraulic leading/sliding shoe
Rear brake type	
KAH.30 and KAD.30	HW—Hydraulic wedge
KAL.30 and KA.40/60	2LSI—Two leading shoe (one push rod)
Footbrake pedal free travel	$\frac{5}{16}$ in. (5 mm.)
Brake size	
Front	
KA.30	12 × 2½ in. (304·8 × 63·5 mm.)
KA.40/60	12¼ × 2½ in. (311·2 × 63·5 mm.)
Rear	
KAH.30 and KAD.30	12 × 2¼ in. (304·8 × 57·2 mm.)
KAL.30 and KA.40	12¼ × 2½ in. (311·2 × 63·5 mm.)
KA.60	12¼ × 3$\frac{3}{16}$ in. (311·2 × 81 mm.)
Brake lining material	
Front	Small and Parkes Don 55
Rear	Small and Parkes Don 55
Total lining area	
KAH.30 and KAD.30	214 sq. in. (1381 sq. cm.)
KAL.30	232 sq. in. (1497 sq. cm.)
KA.40	235 sq. in. (1516 sq. cm.)
KA.60	267 sq. in. (1723 sq. cm.)
Handbrake	
Make and type	Camelinat, ratchet and pawl
Location	Mounted horizontally on steering gear outer column, immediately below steering wheel
Vacuum servo unit	
Make	Girling
Type	Suspended vacuum/hydraulic

MANUFACTURING DATA

Footbrake pedal return spring	
Free length	9·5 in. (24·1 cm.)
Spring rating	To exert 13 lb. (5·9 kg.) per inch (2·5 cm.)
Brake shoe pull-off springs	
Front	
All models	
Free length	6·9 in. (17·5 cm.) overall
Fitted length rating	167/203 lb. (75·8/92·1 kg.) at 6·78 in. (17·23 cm.)

Brake shoe pull-off springs—*continued*	
Rear	
KAH.30 and KAD.30 models	
Spring (nearest expander)	
Free length	7·1 in. (18·0 cm.) overall
Spring rating	To exert 100/110 lb. (45·4/50 kg.) at 8$\frac{3}{16}$ in. (20·8 cm.)
Spring (nearest adjuster)	
Free length	5·1 in. (12·9 cm.) overall
Spring rating	To exert 63/77 lb. (28·6/35 kg.) at 5$\frac{3}{8}$ in. (13·7 cm.)
KAL.30 and KA.40/60 models	
Spring (nearest expander)	
Free length	5·3 in. (13·5 cm.) overall
Spring rating	To exert 54/66 lb. (24·5/30 kg.) at 5·63 in. (14·3 cm.) —fitted length
Spring (nearest adjuster)	
Free length	5·2 in. (13·2 cm.) overall
Spring rating	To exert 54/66 lb. (24·5/30 kg.) at 5·63 in. (14·3 cm.) —fitted length
Brake drum internal diameter	
Front	
KA.30	11·976/11·980 in. (30·42/30·43 cm.)
KA.40/60	12·225/12·230 in. (31·229/31·24 cm.)
Rear	
KAH.30 and KAD.30	11·976/11·980 in. (30·42/30·43 cm.)
KAL.30 and KA.40/60	12·226/112·230 in. (31·254/31·24 cm.)
Master cylinder	
Internal diameter	1·0 in. (25·4 mm.)
Plunger return spring	
Free length	5$\frac{26}{32}$/5$\frac{15}{32}$ in. (8·34/8·82 cm.)
Spring rating	To exert 4¾/5¼ lb. (2·16/2·38 kg.) at 3$\frac{15}{32}$ in. (9·13 cm.) —fitted length
Front wheel cylinder	
Internal diameter	1 in. (25·4 mm.)
Rear wheel cylinder	
Internal diameter	
KAH.30 and KAD.30	1·25 in. (31·7 mm.)
KAL.30 and KA.40	·7 in. (17·8 mm.)
KA.60	·812 in. (20·6 mm.)
Vacuum servo unit	
Vacuum cylinder internal diameter	6·89 in. (17·5 cm.)
Vacuum piston stroke	2·25 in. (5·72 cm.) (effective)
Hydraulic piston bore diameter	·75 in. (19·05 mm.)
Hydraulic piston fluid displacement	1 cu. in. (16·4 cu. cm.)
Vacuum piston return spring	
Free length	11 in. (28 cm.) approx.
Spring rating	To exert 17/22 lb. (7·71/9·98 kg.) at 3$\frac{3}{8}$ in. (8·6 cm.)
Output piston return spring	
Fitted length rating	4·0/4·5 lb. (1·814/2·04 kg.) at 3·25 in. (8·26 cm.)
Valve control piston spring	
Free length	·97 in. (24·64 mm.) approx.
Spring rating	To exert 2·96/3·44 lb. (1·344/1·56 kg.) at 0·49 in. (12·45 mm.)

BRAKES

DESCRIPTION

The braking system is hydraulically operated and consists of a footbrake pedal, fluid supply tank, master cylinder, pipes, hoses and front and rear brake assemblies. On certain models in the range, a vacuum servo system is employed to provide assistance to the pedal effort for brake application. In addition to being hydraulically operated, the rear brakes are mechanically operated by a handbrake.

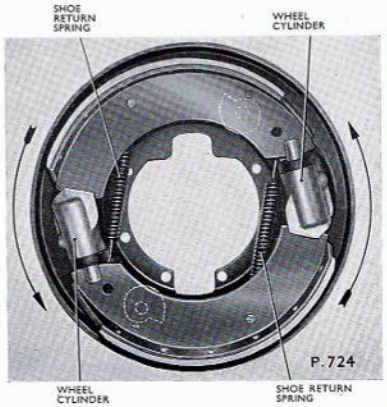


Fig. K.1. Front view of the left hand (nearside) front brake assembly. *Arrows indicate the direction of drum rotation*

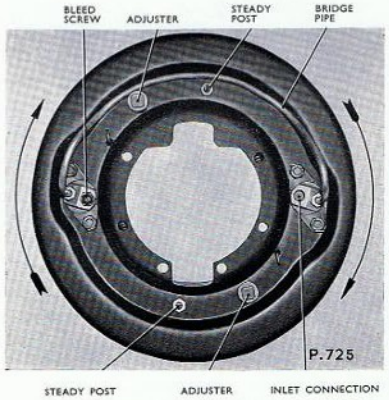


Fig. K.2. Rear view of the left hand (nearside) front brake assembly. *Arrows indicate the direction of drum rotation*

Each front brake assembly consists of two shoes, both of which are leading, two hydraulic wheel cylinders mounted internally, two shoe return springs which are connected between posts on the shoes and drilled holes in the backing plate, two snail cam adjusters each located on the backing plate towards the leading end of each shoe.

The leading end of each shoe locates in a slot in the piston of its wheel cylinder whilst the trailing opposite end of each shoe abuts a slot machined in the body of the opposing wheel cylinder.

Each wheel cylinder comprises a body, piston, rubber seal, and a spring. A rubber dust excluder which is located on the piston and the cylinder body, prevents dirt or dust from entering the hydraulic system at that point. The wheel cylinders are inter-connected by a metal bridge pipe on the external side of the backing plate and provision is made for the brake hose inlet connection and the bleed screw at the respective cylinders in each front brake assembly.

Brake shoe adjustment is provided by two snail cams which are operated by spring loaded square headed adjusters on each backing plate external face. Two steady posts retained by locknuts are screwed into the backing plate to enable the shoes to be correctly balanced.

The rear brake assembly on **KAH.30 and KAD.30 models** comprises two shoes, an adjuster unit and a wheel cylinder in which is incorporated the handbrake expander unit.

The shoes are positioned at one end in slots in the wheel cylinder pistons and at the other end in slots in the adjuster tappets. Two return springs, connected to each shoe, retain them in position.

The wheel cylinder consists of a body, two pistons, seals, and seal supports separated by a spring, the assembly being fixed to the backing plate by means of studs and self-locking nuts.

Integrally built in the wheel cylinder body is the handbrake expander housing in which is assembled a wedge and two rollers that operate on two tappets. The wedge is formed in the handbrake expander arm which, when operated, expands the brake shoes through the rollers and tappets. Adjustment for the shoes is provided by means of an adjuster unit comprising a housing into which is assembled a screwed wedge and two tappets. These tappets are slotted to accommodate the ends of the brake shoes.

The rear brake assembly on **the remaining models** in this range comprises two shoes, an adjuster unit, two shoe return springs which anchor on both shoes, a push rod, two pairs of bell cranks, an adjustable bell crank pivot pin, a brake shoe expander unit and a combined handbrake expander and wheel cylinder assembly.

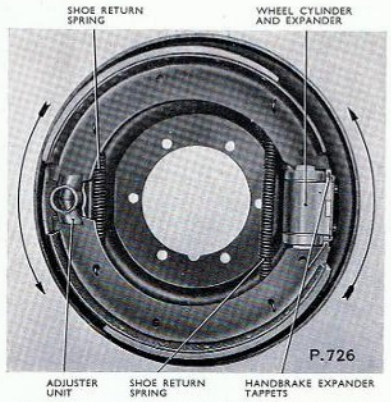


Fig. K.3. Front view of the KAH.30 and KAD.30 left hand (nearside) rear brake assembly. *Arrows indicate the direction of drum rotation*

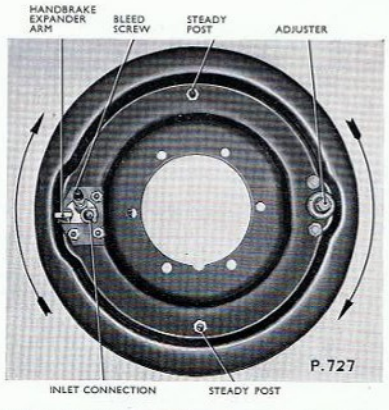


Fig. K.4. Rear view of the KAH.30 and KAD.30 left hand (nearside) rear brake assembly. *Arrows indicate the direction of drum rotation*

The shoes are located in slots machined in the expander tappets and the opposite ends of the shoes abut the slots in the adjuster tappets. A bell crank is fitted on each side of the second shoe web at both ends of the shoe and the push rod maintains the bell cranks in full contact with the expander and adjuster tappets operating the second shoe. The pivot pin for the expander tappet bell cranks is adjustable to provide the means for eliminating any clearance between the push rod ends and both pairs of bell cranks.

The adjuster unit consists of a housing, which is secured to the backing plate by two setscrews and a locking plate, two slotted tappets and a square headed wedge which is threaded to screw into the trunnion of the housing. By rotating the head of the wedge in a clockwise direction, the wedge pushes the tappets outwards and in turn, expands the shoes towards the brake drum.

The brake shoe expander unit comprises a housing and a plunger in which is located a wedge held in position by a pin. An incline faced tappet is fitted in each side of the housing bore to register with rollers which operate between the wedge in the plunger, and the tappets.

The outer portion of the plunger, which is contained in the handbrake expander housing, is slotted in the centre to accept the radiused nose of the pivoted arm of the handbrake expander, and a roller, pinned in the plunger slot, operates on the nose of the arm. An intermediate piston which operates on the end of the plunger, is also slotted to permit the full movement of the handbrake expander arm. To maintain the intermediate piston slot in correct alignment with the arm aperture in the housing, a small diameter pin is fitted near the head of the piston to locate in a machined groove in the housing.

The wheel cylinder is spigot located in the bore of the handbrake expander housing and has two tapped bosses which accept the hydraulic feed connection and the bleed screw respectively. The internal components of the wheel cylinder consist of a shouldered piston, a piston seal, which fits on the piston shoulder, and a small spring, positioned at one end on a small flange machined on the piston spigot, and at the opposite end, on an abutment integral with the cylinder body.

Note: KAL.30 and KA.40 models have twin notches machined in the wheel cylinder flange ends in order to identify the wheel cylinders from the KA.60 models which have larger piston diameters.

Retention of the combined handbrake expander and shoe expander units to the backing plate is effected by two setscrews which enter the handbrake expander flange, pass through the backing plate and screw into tappings in the body of the shoe expander unit. Two long collar-type studs are used to further secure these units, and in addition, to secure the wheel cylinder to the handbrake expander. Each setscrew and stud is locked in position by a tabwasher turned up against a convenient flat on the setscrew head or nut. A sealing

ring is fitted between the backing plate and the flange of the handbrake expander housing. A sealing gasket is located between the mounting faces of the handbrake expander and wheel cylinder housings.

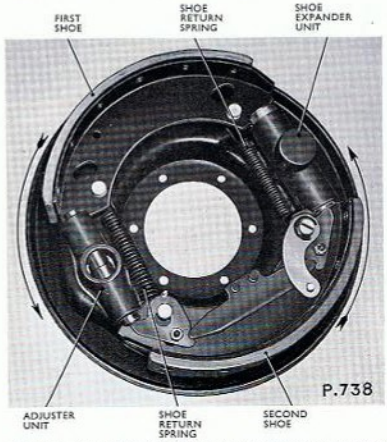


Fig. K.5. Front view of the KAL.30 and KA.40/60 left hand (near-side) rear brake assembly. *Arrows indicate the direction of drum rotation*

The master cylinder is mounted immediately behind the footbrake pedal on the frame sidemember and is connected to the pedal by an operating rod.

The master cylinder is of the barrel type and consists

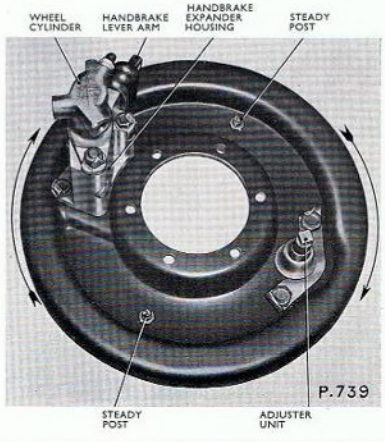
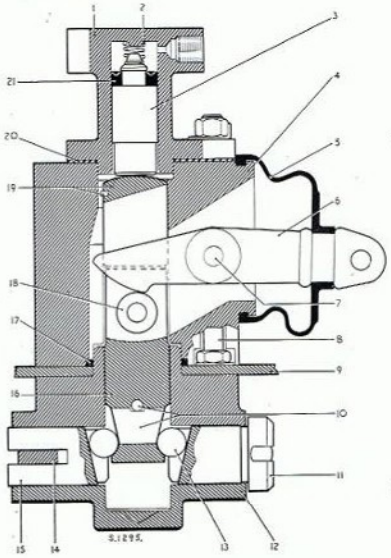


Fig. K.6. Rear view of the KAL.30 and KA.40/60 left hand (near-side) rear brake assembly. *Arrows indicate the direction of drum rotation*



1 REAR WHEEL CYLINDER BODY
2 PISTON RETURN SPRING
3 WHEEL CYLINDER PISTON
4 HANDBRAKE EXPANDER HOUSING
5 RUBBER BOOT
6 HANDBRAKE EXPANDER ARM
7 ARM PIVOT PIN
8 COLLAR TYPE FIXING STUD
9 BACKING PLATE
10 PLUNGER WEDGE AND PIN
11 FIRST SHOE TAPPET
12 SHOE EXPANDER HOUSING
13 ROLLER
14 SHOE CONTACT PLATE
15 SECOND SHOE TAPPET
16 PLUNGER
17 SEALING RING
18 EXPANDER ARM ROLLER (IN PLUNGER)
19 INTERMEDIATE PISTON AND PIN ASSEMBLY
20 WHEEL CYLINDER GASKET
21 PISTON SEAL

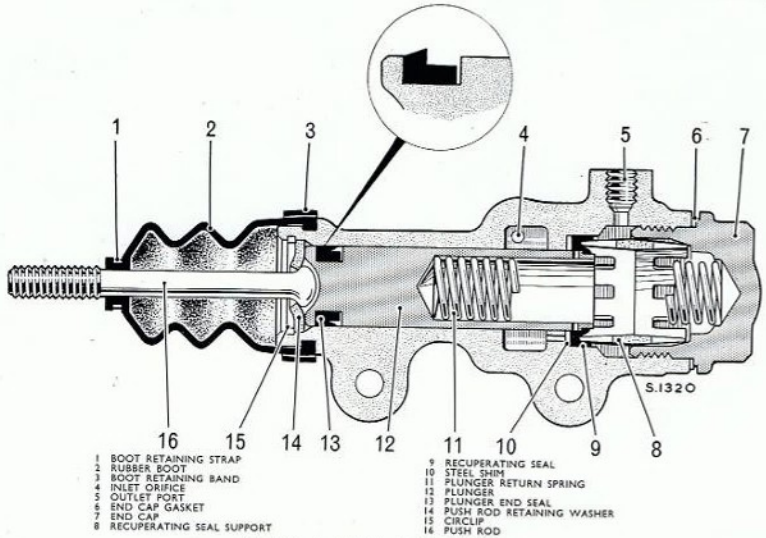
Fig. K.7. Sectional view of the combined expander assembly and the rear wheel cylinder

of a cast iron body with a highly finished bore, into which is assembled a plunger complete with an outer seal, return spring, steel shim, recuperating seal, and a recuperating seal support. The plunger is operated by a push rod with a hardened spherical end which is retained in the end of the cylinder by a dished washer backed by a circlip.

The operating end of the cylinder is enclosed by a rubber dust cover and the rear end of the cylinder is sealed by an external threaded end cap and a gasket. There are three tapped ports in the body, the inlet port

chassis sidemember and, adjacent to the servo unit, is a vacuum reserve tank secured on brackets riveted to the sidemember.

The servo is a vacuum/hydraulic unit which uses vacuum developed by the engine to give added hydraulic pressure to the wheel cylinders of the front and rear brake assemblies, thus decreasing the effort required at the brake pedal. A separate air filter, mounted in front of the cab scuttle, above the wheel arch, is connected by pipeline to the air inlet tube fitted on top of the main cylinder body. A sealed non-return valve assembly



1 BOOT RETAINING STRAP
2 RUBBER BOOT
3 BOOT RETAINING BAND
4 INLET ORIFICE
5 OUTLET PORT
6 END CAP GASKET
7 END CAP
8 RECUPERATING SEAL SUPPORT
9 RECUPERATING SEAL
10 STEEL SHIM
11 PLUNGER RETURN SPRING
12 PLUNGER
13 PLUNGER END SEAL
14 PUSH ROD RETAINING WASHER
15 CIRCLIP
16 PUSH ROD

Fig. K.8. Arrangement of the master cylinder

being located in the side of the body and, transversely opposite is an alternative inlet connection which is sealed by a blanking plug and gasket, whereas the outlet port is positioned on the top of the body. The inlet port union is connected to the pipe line leading to the supply tank which is mounted on a bracket attached to the base of the steering outer column. The outlet port union is connected to the pipe leading to the four-way connector inside the chassis frame, or to the hydraulic inlet port on the servo unit (when fitted). From this four-way connector, or servo unit, the pipe lines are connected, via flexible hoses, to the front and rear brake wheel cylinders. A switch operating on hydraulic pressure is screwed into the four-way connector to couple the stop lamp electrical circuit with the brake hydraulic system.

The vacuum servo unit, as fitted to certain models in the range, is mounted on a bracket riveted to the incorporating a banjo union end is fitted externally to the servo at the vacuum connection and a further banjo union, fitted at the same connection, connects by pipeline to the vacuum reserve tank. On KAB. models, an electrical vacuum switch is interposed in this pipeline to operate a warning light mounted on the instrument panel.

The vacuum servo comprises three basic units namely, the vacuum piston and cylinder assembly, the hydraulically actuated valve control and piston assembly and the hydraulic output piston assembly, which are combined to function as a single major unit. The valve control piston assembly and the output piston assembly are both housed in the main cylinder body.

The vacuum cylinder is clamped to the triangular end face of the main cylinder body and houses a spring loaded piston and push rod assembly.

The valve control cylinder forms the upper part of the main cylinder body and, operating in the cylinder, is a piston incorporating two spigot ends, and a transverse drilling in the piston body to accept the ball shaped end of the rocking lever. A taper rubber seal is positioned in a groove in the shorter of the piston spigots and a further taper seal, larger in diameter than the other seal, is seated on the longer piston spigot against the body of the piston. A spring loaded abutment plate is located over a small flange machined in the longer of the two spigots on the piston and the plate outer edge abuts an integral shoulder in the cylinder bore. Seated on the abutment plate is a spring which is retained at the opposite end by a retainer plate and this plate is secured on the piston spigot by a small circlip. An end plug, fitted with a square section seal is used to close the end of the cylinder bore.

The air and vacuum control valves are seated in the valve chest which is a circular compartment above the valve control cylinder and the valves control the respective air and vacuum passages in the main cylinder body. Each valve is retained by a spring clip to an arm of the rocking lever which is a "T" shaped lever having a ball-shaped end that locates in a transverse drilling in the valve control piston body; a flat horseshoe-shaped plate acting as a return spring, and a bridge type retainer guides the rocking lever. The retainer also secures the plate to the base of the compartment by two screws. A metal plate and pipe assembly and gasket, retained by four screws, provides the cover for the compartment as well as the connection from the valve chamber to the rear of the vacuum cylinder piston.

The hydraulic output cylinder is machined in the lower half of the main cylinder body and contains a

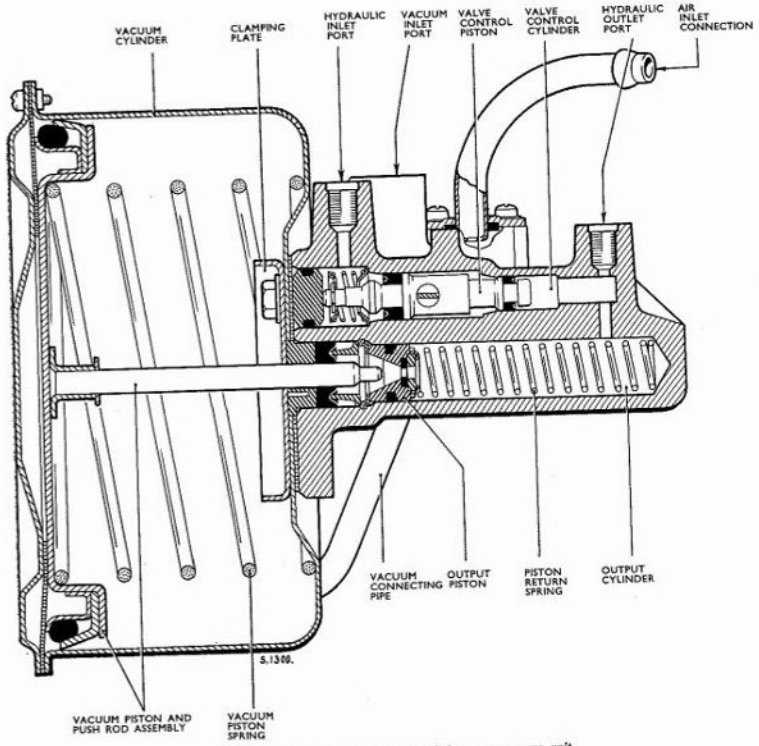


Fig. K.9. Sectional arrangement of the vacuum servo unit

piston return spring, abutting the outlet end of the cylinder at one end of the spring, and locating on the piston assembly at the opposing end of the spring. The piston assembly has a counterbore in the forward end which houses a rubber seal and a metal retaining washer which is secured by the peened over lip of the piston counterbore. Located in a groove on the piston outer diameter is a second and larger seal. The rear end of the piston assembly is taper bored and connects with the counterbore in the piston front end to accommodate the tapered end of the vacuum piston push rod. A plain washer and a circlip retain the piston assembly in the cylinder, the circlip locating in a groove in the cylinder bore. Assembled to the rear of the circlip is a nylon seal spacer, which provides a seating at the rear end for a gland seal, and finally, a shouldered bush is fitted to the end of the cylinder bore to maintain the gland seal in contact with the seal spacer.

The separate air filter is of the renewable element type and has a moulded cellular element, mounted in a metal cup secured to the support platform which also incorporates a metal outlet tube. A cover, seating on the top of the element, is retained in position by a stirrup-type spring clip.

The handbrake lever is horizontally mounted on the steering column immediately below the steering wheel and is of the ratchet and pawl type of operation. The trigger of the handbrake lever is pivoted, and connects to the pawl by means of a spring loaded control rod. The ratchet is secured between distance pieces seated on bosses on the support bracket for the ratchet lower face and in bosses integral with the top cover on the upper face. The lever has a serrated bush at the inner end of the casing, which fits on the serrations of a relay shaft and the lever assembly is retained on the shaft with a plain washer and self locking nut. The relay shaft is carried in a self-lubricating spherical bush in the upper support bracket on the steering column and is guided at the lower extremity by a self-lubricating bush housed in the bottom support bracket. A relay lever, welded to the base of the relay shaft, is connected by means of a jaw to an operating rod which is attached, again by a jaw, at the opposite end to a further relay lever pivoted on a frame mounted support bracket. A second operating rod is connected to this relay lever and finally, joins with the threaded cable end of the handbrake cable, by means of an internally threaded coupling nut. The handbrake operating rod passes through a rubber bushed steady bracket just before entering the coupling nut.

On **KAH.30 and KAD.30 models,** the handbrake cable is connected by means of a jaw to the upper arm of the compensator lever. The compensator lever is bushed and carried on a link and pin assembly extending from a bushed bracket bolted to the rear axle casing. Extending from the two symmetrically opposed lugs on the compensator lever body, are the transverse rods with jaw ends to couple with the handbrake expander arms of the rear wheel cylinders.

On **the remaining models** in this range, the handbrake cable connects, via a compensator lever, directly with the handbrake expander arm of the nearside rear wheel cylinder (offside on L.H.D. models). The bushed compensator lever, (spring loaded on R.H.D. models), pivots on a pin welded in a support bracket which is in turn, welded to the rear cover of the axle casing. The lever splits into two similar sections which are bolted together to form a single component and, located in a large drilling in the upper end of each lever arm, is the handbrake cable abutment through which the handbrake inner cable passes. A secondary cable, connected by a jaw to the opposite handbrake expander arm, is anchored at the opposite end in a slot machined in the handbrake cable abutment held between the compensator lever arms.

OPERATION

Movement of the footbrake pedal is transmitted to the push rod of the master cylinder, via the operating rod, and causes the push rod to force the plunger rearwards along the bore of the master cylinder body. Initial travel of the plunger, blanks off the drillings at the rear end of the plunger from the passages leading from the supply channel, thereby cutting off the supply of fluid to the pressure end of the master cylinder. Continued travel of the plunger displaces fluid on the pressure side, out of the master cylinder into the pipelines leading to the wheel cylinders thereby building up pressure at the wheel cylinders, which in turn, causes the brake shoes to expand against the brake drums.

When a servo unit is fitted, the unit is installed in the hydraulic system between the master cylinder and the wheel cylinders, with the outlet pipe from the master cylinder connected to the servo hydraulic inlet port and the servo hydraulic outlet port is connected to the pipelines leading to the wheel cylinders. With no pressure in the hydraulic system, an open passage is provided through the centre of the hydraulic output piston, in the servo, to the output cylinder and so into the hydraulic system.

However, when brake pedal application causes fluid displacement from the master cylinder, the initial hydraulic pressure enters the main cylinder of the servo and, passing through the output piston, exerts equal pressure at both ends of the valve control piston. As the surface of the innermost end of the piston is smaller in area than the surface of the opposite end of the piston, an equal pressure per square inch on both ends, causes a proportionately greater thrust to be exerted on the larger piston end, and the piston moves against the ball end of the rocking lever located in the piston body. This lever then pivots and opens the atmospheric valve, retained on one of the lever arms, to admit air into the valve chest compartment and out through the connecting pipe in the compartment top cover to the rear of the vacuum cylinder.

Atmospheric pressure, acting on the rear face of the vacuum piston, will move the piston and the attached push rod, forward in the cylinder. The push rod end,

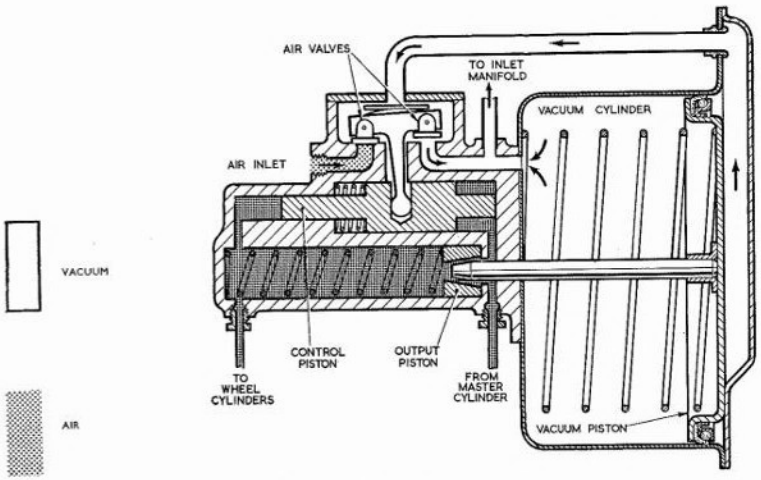


Fig. K.10. Vacuum servo in the fully released position

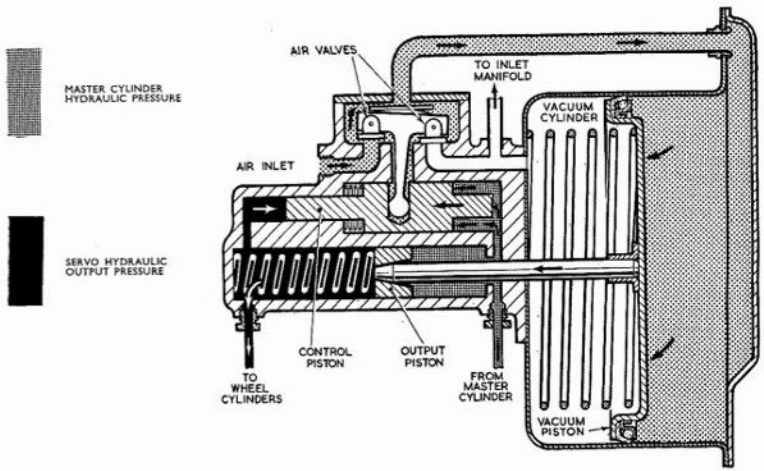


Fig. K.11. Vacuum servo in the applied position

For diagrammatic clarity, the valve control piston spring is shown forward of the piston in these illustrations.

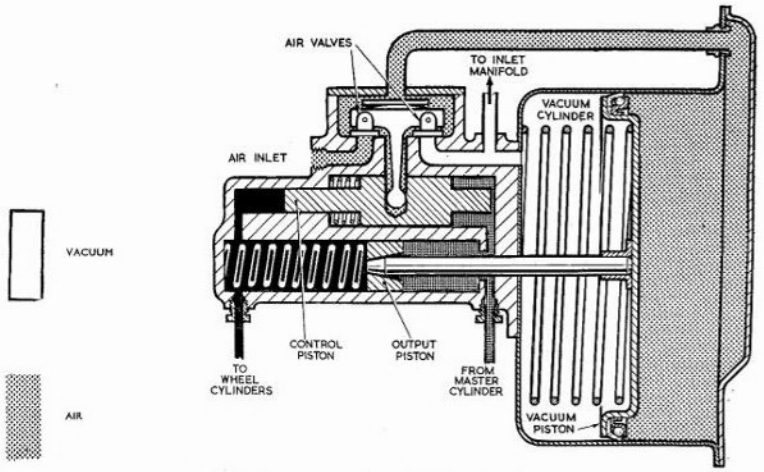


Fig. K.12. Vacuum servo in the applied "holding" position

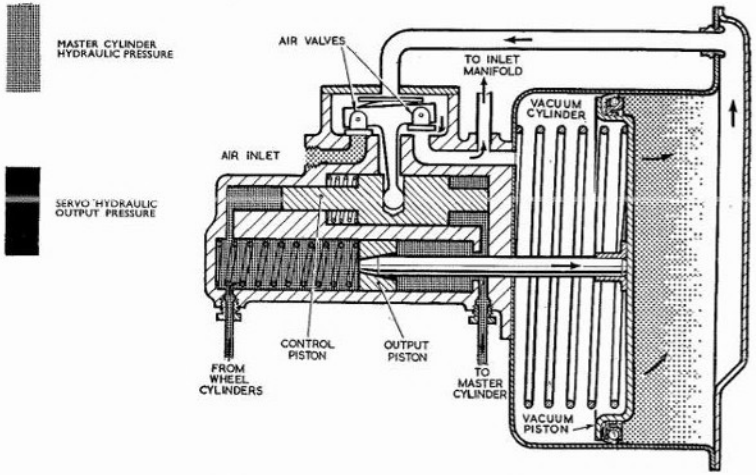


Fig. K.13. Vacuum servo in the "releasing" position

For diagrammatic clarity, the valve control piston spring is shown forward of the piston in these illustrations.

being centrally disposed in the tapered rear bore of the output piston, will first move forward to seal the open passage through the output piston bore, and continuing the forward movement, cause this piston to displace fluid from the output cylinder to apply pressure at the wheel cylinders.

At the same time, this increased output pressure also acts on the smaller end of the valve control piston and when this pressure is sufficient to overcome the fluid pressure from the master cylinder, on the larger end of the valve control piston, the piston is moved back thus pivoting the rocking lever and closing the air valve.

At this stage, both the air and vacuum valves are closed and the brake pedal is held, giving the desired degree of braking. Should the pedal pressure be reduced, the fluid pressure, from the master cylinder, on the valve control piston is also reduced which allows the piston to move further to the rear and pivot the rocking lever to open the vacuum valve. Air is drawn out of the vacuum cylinder, the vacuum piston moves rearwards and the piston push rod decreases its pressure on the output piston which in turn reduces the hydraulic pressure at the wheel cylinders, until once again a state of balance is reached with the valve control piston. If the pedal pressure is increased, the fluid pressure on the valve control piston from the master cylinder will also increase, and move the piston forward again to open the air valve, which will bring additional pressure to bear on the rear of the vacuum piston. This piston will then move further forward and the piston push rod will cause the output piston to increase the fluid pressure in the pipelines to the wheel cylinders, until the state of balance is again achieved with the valve control piston.

On complete release of the brake pedal, all hydraulic pressure on the valve control piston is relieved and the piston will operate the rocking lever and open the vacuum valve. Vacuum will then pass to the rear of the vacuum piston, removing the atmospheric pressure, allowing the vacuum piston and push rod to fully return, thus withdrawing the push rod pressure on the output piston and releasing the hydraulic pressure from the wheel cylinders. The complete return of the piston push rod will open the centre passage in the output piston permitting free circulation of the fluid through the hydraulic system.

LUBRICATION

Lubricating nipples are provided at the following points and should be lubricated every 2,000 miles (3,000 km.) with the recommended grade of lubricant.

(*a*) Handbrake compensator body (KAH.30 and KAD.30 models only).

(*b*) Handbrake cable. The lubricating nipple is fitted in the outer casing of the cable.

Additionally, periodical oil can lubrication should be applied to all linkage jaw joints, pedal bushes and the handbrake lever pawl and ratchet.

BLEEDING THE HYDRAULIC SYSTEM

Bleeding the hydraulic system is not a routine maintenance operation and should only be carried out when any part of the hydraulic system has been disconnected, or if the presence of air is suspected in the system, or if the fluid level has been allowed to fall so low in the supply tank, as to permit air to enter the master cylinder. If air has entered the system, the cause should be found and rectified, as bleeding the system without remedying the fault will only give a temporary cure.

To bleed the brakes, the following items are required, a length of rubber tubing, a clean glass jar and a supply of clean brake fluid that has been standing, to allow any air bubbles that may be present, to disperse.

Note: Do not carry out the bleeding operation with the engine rotating, particularly on models fitted with a vacuum servo.

Fig. K.14. Bleeding the hydraulic system

(*a*) **Slacken** off the **front** brake shoe adjusters by turning them **anti-clockwise** as far as possible, and **expand** the **rear** brake shoes until they fully contact the drums by turning the adjuster stems **clockwise.**

(*b*) Ensure that the supply tank is topped up with brake fluid and maintain the tank at this level throughout the bleeding operation.

(*c*) With all hydraulic connections secure, commence operations at the wheel cylinder furthest from the master cylinder. Remove the rubber dust cover on the bleed nipple and fit the rubber tube end over the nipple, immersing the free end of the tube in a clean glass jar containing a small quantity of clean brake fluid.

(*d*) Unscrew the bleed nipple about three-quarters of a turn, and operate the brake pedal with slow, full strokes until the fluid entering the glass jar is completely free of air bubbles. Then, during a down stroke of the pedal, tighten the bleed nipple to a torque loading of 6/8 lb. ft. (0·8/1·1 kg.m.) and refit the rubber dust cover.

(*e*) Repeat these operations at the remaining wheel cylinders, working from the furthest cylinder from the master cylinder, to the nearest cylinder.
Always ensure that the correct fluid level in the supply tank is maintained during these operations and on completion, top up the supply tank to the correct level which should be one inch (2·5 cm.) below the level of the filler cap.

Important: Never use fluid which has been bled from the system to top up the supply tank. Fluid which appears dirty or emulsified should be expelled from the system and replenished with fresh, clean brake fluid of the recommended grade.

(*f*) Adjust the brake shoes as detailed in the following sub-section.

ADJUSTMENTS

Footbrake Pedal Adjustment.

It is essential that there is $\frac{1}{16}$ in. (5 mm.) of free movement at the brake pedal pad before the plunger in the master cylinder commences to move forward. This free travel ensures that the master cylinder plunger is fully returned against the stop washer in the cylinder bore.

To adjust the free travel, release the jaw connected to the brake pedal extension, slacken the locknut, and adjust the jaw, to increase or decrease the dimension between the pedal and the square section operating rod, until the correct amount of free travel is present at the brake pedal pad with the jaw connected.

Front Brake Adjustment.

1. Apply the handbrake and jack up the front axle until the front road wheels are free to rotate.

2. Adjust each shoe in turn, by spinning the wheel and turning the square headed adjuster head on the backing plate in a clockwise rotation until the shoe begins to rub the brake drum.

3. Slacken the adjuster just sufficiently to allow the wheel to spin freely with no indication of the shoe rubbing.

4. Repeat this operation on the remaining shoes of the front brake assemblies. If the brake shoes have been removed and refitted just prior to adjustment, it is possible that they may be incorrectly centralised. To rectify this condition, refer to the "Brake Centralisation" sub-section.

Rear Brake Adjustment.

1. Place chocks under the front road wheels and release the handbrake. Jack up the rear axle until the rear road wheels are free to rotate.

2. Turn the squared end of the adjuster stem in a clockwise direction until the brake shoes are fully expanded against the brake drum.

3. Unscrew the adjuster anti-clockwise two or three "clicks" until the wheel revolves freely without the brake shoes rubbing. If rubbing still occurs, it is possible that the shoes require centralising, refer to the ensuing sub-section.

Brake Centralisation.

Front Brakes

1. Adjust the snail cams until the brake shoes lightly rub against the brake drums.

1. Adjust the snail cams or adjuster stems until the brake shoes lightly rub against the brake drums.

2. Spin the road wheels fairly fast and apply the brake pedal. Repeat this operation two or three times and the brake shoes will automatically centralise.

3. Correctly balance the brake shoes against the steady posts, by releasing the steady post locknuts and slackening off the steady posts, two turns anti-clockwise.

4. Fully expand the brake shoes against the brake drums by turning the adjusters clockwise.

5. With the shoes in this locked position, turn the steady posts clockwise until the nose of the posts just contact the shoe webs, indicated by a slight resistance to turning. Hold the steady posts in this position, with the screwdriver, and re-tighten the locknuts.

6. Finally, adjust the brakes as detailed in the previous sub-section on front brake adjustment.

Rear Brakes.

KAH.30 and KAD.30 models

1. Turn the adjuster stems clockwise until the brake shoes lightly rub against the brake drums.

2. Spin the road wheels fairly fast and apply the brake pedal. Repeat this operation two or three times and the brake shoes will automatically centralise.

3. Correctly balance the brake shoes against the steady posts, by releasing the steady post locknuts and slackening off the steady posts, two turns anti-clockwise.

4. Fully expand the brake shoes against the brake drums by turning the adjusters clockwise.

5. With the shoes in this locked position, turn the steady posts clockwise until the nose of the posts just contact the shoe webs, indicated by a slight resistance to turning. Hold the steady posts in this position, with the screwdriver, and re-tighten the locknuts.

6. Finally, adjust the brakes as detailed in the previous sub-section on rear brake adjustment.

KAL.30, KA.40 and KA.60 models

1. Release the locking plate tab ends at the adjuster housing setscrews and slacken off the setscrews. Release the steady post locknuts and then slacken off the steady posts, two turns anti-clockwise.

2. Turn the adjuster stems clockwise until the shoes are expanded hard against the brake drums.

3. With the shoes in this locked position, tighten the adjuster housing setscrews to a torque reading of 39/48 lb. ft. (5·39/6·64 kg. m.) and lock in position by bending the locking plate ends against the setscrew heads.

Turn the steady posts clockwise until the nose of the posts just contacts the shoe webs, indicated by a slight resistance to turning. Hold the steady posts in this position with the screwdriver, and re-tighten the locknuts.

4. Finally, adjust the rear brakes as detailed in the previous sub-section.

Handbrake Cable Adjustment.

See pages K.34 and K.35.

FOOTBRAKE PEDAL

R. H. D. Models

To Remove.

1. Remove the accelerator pedal as detailed in the "Fuel System" section.

2. Release the clamp bolt, spring washer and nut securing the brake pedal stem to the pedal lever and withdraw the pedal stem.

3. Disconnect the fork on the master cylinder operating rod from the pedal lever foot, by removing the split pin, slotted nut and jaw pin. Also disconnect the pedal return spring. The spring anchor pin in the pedal lever foot is removed after prising off the retainer clip.

4. Remove the spring ring and the plain washer and slide the pedal lever off the shaft.

Inspection and Overhaul.

1. Check the pedal lever bushes for wear or scoring and renew if evident. The bushes are a press fit in the pedal boss and when pressing in the new bushes, ensure that each bush is flush with the appropriate boss face.

Note: Completely immerse the new bushes in thin oil for 24 hours prior to fitting to allow the pores of bushes to fill with lubricant. Do not ream the bushes after fitting otherwise the lubricant properties of the bushes will be destroyed.

2. Examine the pedal shaft and if badly worn, renew as detailed under the clutch pedal overhaul sub-section in the "Clutch and Propeller Shaft" section.

3. Check the pedal return spring. The free length is 9·5 in. (24·1 cm.) and the spring rating is 13 lb. (5·9 kg.) per inch (2·5 cm.) approximately.

To Refit.

This operation is a reversal of the removal procedure noting the following points.

1. When refitting the jaw pin slotted nut, use a new split pin.

2. Ensure that the spring ring retaining the pedal lever on the shaft is a good fit in the shaft groove. Fit a new spring ring if the fit is not satisfactory.

3. Refer to the "Fuel System" section for refitting the accelerator pedal.

4. The brake pedal stem must be refitted to the correct height in order to facilitate full stroking of the master cylinder during bleeding operations. The correct height for the stem is 8·0 in. (20·3 cm.) measured in a straight line from the stem aperture in the toe-panel to the underside of the pedal stem pad.

5. Always use a new retainer clip if the spring anchor pin in the pedal lever has been removed.

6. Check the brake pedal free travel on completion.

FOOTBRAKE PEDAL

L. H. D. Models

To Remove.

1. Remove the clutch pedal as detailed in the "Clutch and Propeller Shaft" section.

2. Release the clamp bolt, spring washer and nut securing the brake pedal stem to the pedal lever and withdraw the stem.

3. Disconnect the fork on the master cylinder operating rod from the pedal lever foot by removing the split pin, slotted nut and jaw pin. Also disconnect the pedal return spring. The spring anchor pin in the pedal lever foot is removed after prising off the retainer clip.

4. Slide the pedal lever off the shaft, preceded by the plain washer.

Inspection and Overhaul.

1. Check the pedal lever bushes for wear or scoring and renew if evident. The bushes are a press fit in the pedal boss and when pressing in the new bushes, ensure that each bush is flush with the appropriate boss face.

Note: Completely immerse the new bushes in thin oil for 24 hours prior to fitting to allow the pores of the bushes to fill with lubricant. Do not ream the bushes after fitting otherwise the lubricant properties of the bushes will be destroyed.

2. Examine the pedal shaft and if badly worn, renew as detailed under the clutch pedal overhaul sub-section in the "Clutch and Propeller Shaft" section.

3. Check the pedal return spring. The free length is 9·5 in. (24·1 cm.) and the spring rating is 13 lb. (5·9 kg.) per inch (2·5 cm.) approximately.

To Refit.

This operation is a reversal of the removal procedure noting the following points:

1. When refitting the jaw pin slotted nut, use a new split pin.

2. Refer to the "Clutch and Propeller Shaft" section for refitting the clutch pedal.

3. The brake pedal stem must be refitted to the correct height in order to facilitate full stroking of the master cylinder during bleeding operations. The correct height for the stem is 8·0 in. (20·3 cm.) measured in a straight line from the stem aperture in the toe-panel to the underside of the pedal stem pad.

4. Always use a new retainer clip if the spring anchor pin in the pedal lever has been removed.

5. Check the brake pedal free travel on completion.

MASTER CYLINDER

To Remove.

1. Drain the brake fluid from the system by attaching a bleed tube to the bleed screw on one of the wheel cylinders, release the bleed screw and pump the brake pedal, catching the escaping fluid in a clean container. Continue to pump the pedal until no further fluid enters the container.

2. Disconnect the inlet and outlet pipe unions at the master cylinder.

3. Remove the jaw pin securing the master cylinder operating rod to the brake pedal.

4. Remove the two bolts, spring washers and nuts retaining the master cylinder to the frame sidemember and lift away the master cylinder complete with the operating linkage.

5. Release the two locknuts and unscrew the jaw and the operating rod from the master cylinder push rod.

To Dismantle.

1. Unscrew the end cap and remove the cap gasket. Lift out the plunger return spring and the recuperating seal support from inside the cylinder bore.

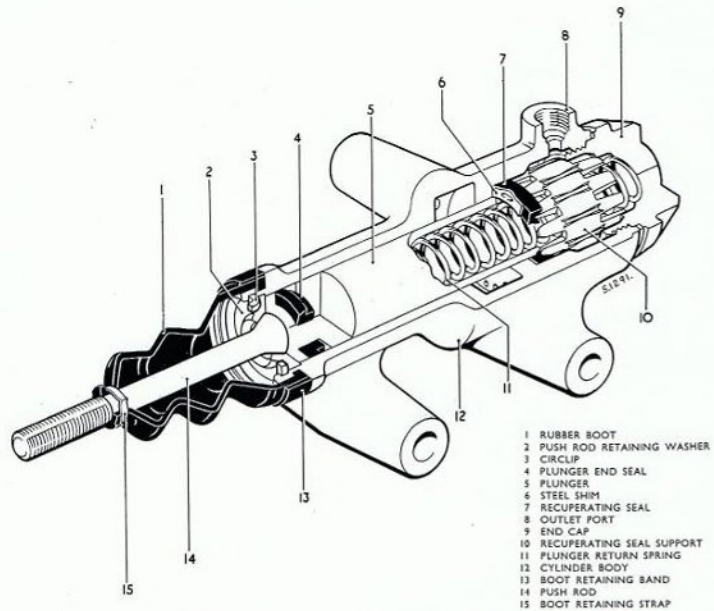


Fig. K.15. Sectional view of the master cylinder assembly

2. Release the rubber boot from the groove in the body and turn back the rubber boot sufficiently to permit the circlip inside the cylinder bore to be withdrawn.

3. Withdraw the circlip using suitable circlip pliers. The push rod together with the retaining washer can then be removed. If it is necessary to remove the rubber boot from the push rod, prise up the metal strap which is crimped to retain the boot at the end of the threaded section of the rod. On opening up the strap, the boot can be withdrawn off the push rod. Slide off the rubber retaining band from the boot and the retaining steel washer from the push rod.

4. Push out the plunger, complete with the end seal, from the pressure end of the cylinder. Remove the end seal by carefully easing the seal, over the end flange of the plunger, with the fingers.

5. Withdraw the recuperating seal and the steel shim from the internal shoulder inside the bore.

Inspection and Overhaul.

Extreme cleanliness is essential when working on hydraulic components. No grease, mineral oil, trichlorethylene, paraffin or petrol should be allowed under any circumstances to contact any hydraulic component. For cleaning purposes, only "Girling Cleaning Fluid" should be used.

1. Always renew both seals when overhauling the master cylinder.

2. Check the return spring for weakness (see spring details on "Data" page).

3. Inspect the plunger and the cylinder bore for scores and renew if evident.

4. Check the remaining components for wear or damage, renewing as necessary.

To Re-assemble.

Immerse all working parts in clean brake fluid and re-assemble in the wet condition.

1. Place the steel shim against the internal shoulder inside the bore, followed by the recuperating seal with the seal lips facing the pressure end of the cylinder. Ensure that the seal is seating correctly.

2. Ease the end seal over the push rod end of the plunger and into the groove machined in the plunger, ensuring that the end face on the tapered section of the seal abuts the push rod end of the plunger groove (see Fig. K.15).

3. Dip the plunger and end seal again in clean brake fluid and slide the plunger, open end first, into the cylinder bore from the push rod end.

4. If the rubber boot has been detached from the push rod, first place the retaining washer on the rod, then slide the boot on the rod and retain in position using a new metal strap. Crimp the strap at opposing points to just retain the boot adjacent to the threaded section of the push rod.

Note: Before refitting the rubber boot, smear the mouth of the cylinder bore and the inside of the boot with Wakefield Rubber Grease No. 3 (Red).

5. Place the rounded end of the push rod in the operating end of the plunger, push down the retaining washer and retain both components in the cylinder bore with the circlip, ensuring that the circlip fits fully in the groove in the bore. Refit the rubber boot in the groove of the cylinder body and secure with the rubber retaining band.

6. Re-assemble the seal support in the pressure end of the cylinder bore, checking that the leading edge of the support, seats between the lips of the recuperating seal.

7. Enter the return spring in the plunger bore and refit the end cap using a new gasket. Tighten the end cap securely.

To Refit.

Refitting is a reversal of the removal procedure with attention to the following points.

1. After refitting the inlet and outlet pipes to the master cylinder, fill up the brake supply tank to the correct level and bleed the brake system as detailed within this section.

2. After connecting the push rod to the operating rod and subsequently the brake pedal, check and adjust the pedal free travel as detailed within this section.

FRONT BRAKE ASSEMBLY

To Dismantle.

1. Jack up the front axle and remove the front hub and drum assembly (see "Front Axle" section).

2. Remove the brake shoes individually as follows.

(*a*) First prevent the wheel cylinder pistons from sliding out of the cylinder bodies, by securing with a strong rubber band.

(*b*) Prise one of the shoes out of the slot in the body of the wheel cylinder and move the shoe inwards towards the centre of the brake assembly. Disengage the opposite end of the shoe from the slot in the opposing piston and after releasing the shoe return spring from the hole in the backing plate, lift the shoe away.

(*c*) Repeat operation (*b*) on the remaining shoe.

3. **Front Wheel Cylinders.** To remove and dismantle the wheel cylinders, proceed as follows.

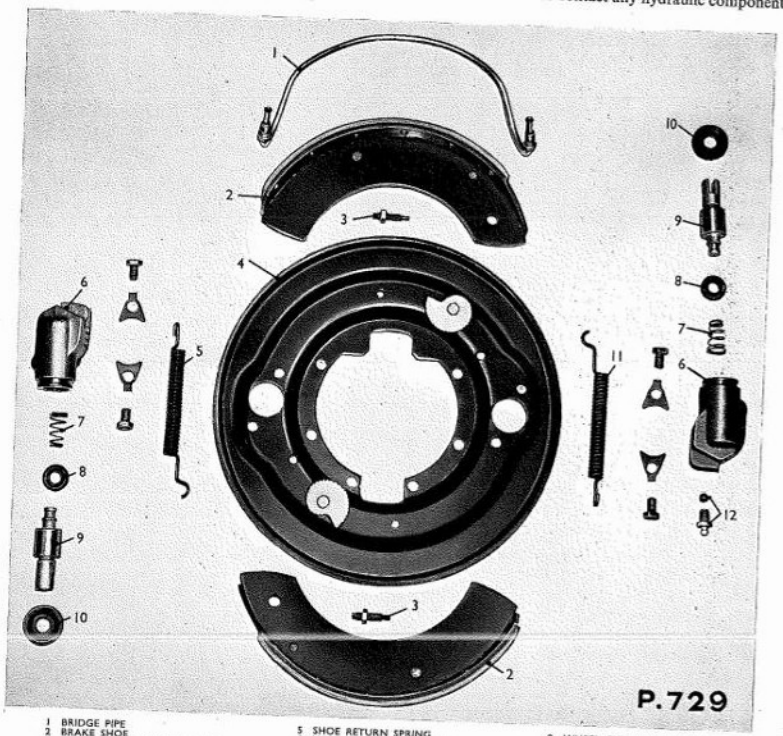
(*a*) Attach a bleed tube to the bleed screw on the wheel cylinder, release the bleed screw and pump the brake pedal, catching the escaping fluid in a clean container. Continue to pump the pedal until no further fluid enters the container. Remove the flexible hose connected to the rear of the wheel cylinder as detailed on page K.26.

(*b*) Disconnect the metal bridge pipe connecting the two wheel cylinders at the rear of the backing plate.

(*c*) Tap down the tab of the lockwasher on each setscrew securing the wheel cylinders and remove the setscrews and lockwashers. The wheel cylinders can then be lifted away from the backing plate.

Inspection and Overhaul.

Extreme cleanliness is essential when working on hydraulic components. No grease, mineral oil, trichlorethylene, paraffin or petrol should be allowed under any circumstances to contact any hydraulic component.



1 BRIDGE PIPE
2 BRAKE SHOE
3 STEADY POST AND LOCKNUT
4 BACKING PLATE
5 SHOE RETURN SPRING
6 WHEEL CYLINDER BODY
7 PISTON SPRING
8 PISTON SEAL
9 WHEEL CYLINDER PISTON
10 RUBBER DUST COVER
11 SHOE RETURN SPRING
12 BLEED SCREW AND BALL

Fig. K.16. Details of the front brake assembly

(*d*) To dismantle the wheel cylinders, ease each rubber dust cover from the groove in the cylinder body, and pull out the piston complete with the dust cover, piston seal and piston spring. The piston spring is withdrawn over the spigoted end of the piston and the seal is removed by easing with the fingers over the small shoulder machined in the piston spigot. The dust cover is lifted away from the groove in the slotted end of the piston.

For cleaning purposes, only "Girling Cleaning Fluid" should be used.

1. Always renew the seal when overhauling the wheel cylinder.

2. Ensure the piston spring is not weak or damaged.

3. Inspect the piston and cylinder bore for scores or damage, renewing if evident.

4. Examine the brake linings for excessive or uneven wear, grease or oil contamination and if either fault is evident, replacement shoe and lining assemblies should be fitted. In territories where it is necessary to reline the original shoes, it is recommended that equipment specially designed for brake relining be employed, in order to maintain accuracy during the operation. Always ensure that the correct linings are used, as it is important that the specified lining material be used. Check that the new linings are free from grease or oil.

When special equipment is not available, carefully punch out the old rivets, remove the faulty linings, inspect the exposed surface of the shoe for burrs etc., clean the area before mounting the new linings, clamp and rivet the new linings to the shoe face, starting from the centre of the shoe face and working towards the ends. Place the rivet head against the end of a punch which is securely held in a vice. The end of the punch should be of the same diameter as the rivet head, and on positioning the rivet head on the punch, carefully spread the tubular end of the rivet.

5. Check the brake shoe return springs for weakness (see "Data" page for spring rating). It is advisable to renew the shoe return springs when new linings are fitted.

6. Check the backing plate for damage and distortion. Ensure that the snail cams are not worn and are operating freely.

7. Examine the brake drum (see "Brake Drum" sub-section).

8. Ensure that the bridge pipe is clean and free from obstruction. Inspect the pipe for damage or cracks.

To Re-assemble.

1. **Front Wheel Cylinders.** Re-assemble the wheel cylinders as follows:

(*a*) Dip each internal component in clean brake fluid and assemble in the wet condition. Ensure that the cylinder bore is perfectly clean and also the piston.

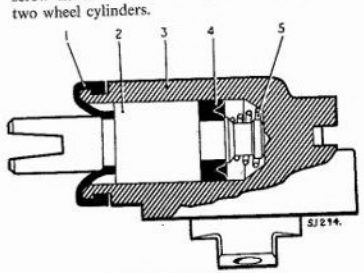
(*b*) Re-assemble the piston seal on the spigot end of the piston, using only the fingers and noting that the groove in the seal end face must be nearest the closed end of the cylinder bore when assembled. Check that the seal is fully seated on the piston shoulder.

(*c*) Refit the piston spring to the piston, locating the small diameter of the conical spring on the small shoulder machined in the centre of the spigot length.

(*d*) Locate the rubber dust cover in the groove on the neck of the piston.

(*e*) Smear the inside of the cylinder bore with clean brake fluid and slide the assembled piston in the cylinder body, piston spring end leading, until the dust cover outer edge can be located in the groove in the cylinder body.

(*f*) Mount the wheel cylinders on the backing plate securing with the setscrews which must be tightened to a torque reading of 12/14 lb. ft. (1·66/1·94 kg.m.). Locate the lockwashers under the setscrew heads and on tightening the setscrews, prise up the tab end of the washer against the adjacent flat on the set-screw head. Refit the bridge pipe connecting the two wheel cylinders.



1 RUBBER DUST COVER
2 WHEEL CYLINDER PISTON
3 WHEEL CYLINDER BODY
4 PISTON SEAL
5 PISTON SPRING

Fig. K.17. Sectional view of the front wheel cylinder assembly

2. Before refitting the brake shoes, ensure that the backing plate is clean and free from grease, and that the steady posts work freely in their threads.

All metal working surfaces such as contact edges of brake shoes and steady post spigots should be lightly smeared with Girling White Brake Grease.

Ensure that the snail cam adjusters are set to the maximum "off" position.

Both shoes are identical on each front brake assembly but the shoes are handed, i.e., the two left hand shoes must be fitted to the left hand brake assembly and the two right hand shoes to the right hand brake assembly. When re-assembling the shoes, ensure that the snail cam posts are on the inside of the shoe webs and that the longer of the two protruding ends of the shoe web is fitted in the respective wheel cylinder piston slot.

To mount the brake shoes, proceed as follows:

(*a*) Enter the smaller radiused end of the shoe return spring through the hole in the backing plate.

(*b*) Hook the larger radiused end of the return spring to the spring post on the shoe web ensuring that when assembled, the spring will be inside the shoe web, i.e., nearest the backing plate.

(*c*) Locate the end of the shoe with the longest protruding web clearance beyond the shoe, in the wheel cylinder piston slot. The opposite end of the shoe will require springing into position in the opposite wheel cylinder body slot.

(*d*) Repeat the foregoing procedure on the remaining shoe.

3. Refit the hub and drum assembly (see "Front Axle" section).

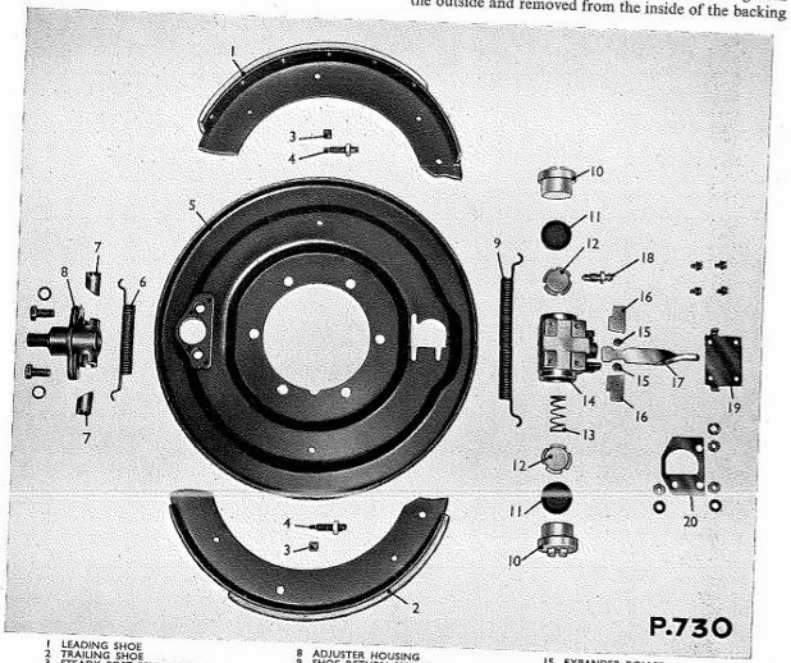
4. Bleed the brake system as detailed in the sub-section headed "Bleeding the Hydraulic System".

5. Centralise and adjust the brakes as detailed in sub-sections headed "Brake Centralisation", and "Front Brake Adjustment".

REAR BRAKE ASSEMBLY
(Fitted to KAH.30 and KAD.30 Models)

To Dismantle.

1. Place chocks under the front road wheels and fully release the handbrake. Jack up the rear axle and remove the rear hub and drum assembly (see "Rear Axle" section).



1 LEADING SHOE
2 TRAILING SHOE
3 STEADY POST FELT BUSH
4 STEADY POST AND LOCKNUT
5 BACKING PLATE
6 SHOE RETURN SPRING
7 ADJUSTER TAPPET
8 ADJUSTER HOUSING
9 SHOE RETURN SPRING
10 WHEEL CYLINDER PISTON
11 PISTON SEAL
12 SEAL SUPPORT
13 PISTON SPRING
14 WHEEL CYLINDER BODY
15 EXPANDER ROLLER
16 EXPANDER TAPPETS
17 EXPANDER ARM
18 BLEED SCREW
19 EXPANDER COVER PLATE
20 DUST COVER PLATE

Fig. K.18. Details of the rear brake assembly as fitted to the KAH.30 and KAD.30 models

2. Fit a rubber band over the wheel cylinder piston heads to prevent them being ejected on removing the shoe assemblies. Prise the end of one of the shoes from the wheel cylinder piston, lift forward clear of the wheel cylinder and release the shoe end. Repeat the same procedure at the opposing end of the shoe and withdraw the shoe end from the adjuster tappet.

With the tension now released from the shoe return springs, the other shoe is easily disengaged and the two shoes and springs can be lifted away.

3. Disengage the shoe return springs from the holes drilled in the shoe webs.

4. To dismantle the adjuster unit, it is not normally necessary to remove the housing from the backing plate as the two tappets will slide out of the bore and the adjuster wedge can be screwed through the housing from the outside and removed from the inside of the backing plate. Should the housing require removal, remove the two setscrews and washers and lift off the housing.

Note: The adjuster tappets are handed, therefore before removal, suitably identify each tappet to facilitate re-assembly.

5. Rear Wheel Cylinder and Expander. The handbrake expander mechanism can be dismantled from the wheel cylinder in position and conversely, the wheel cylinder components can be withdrawn without necessarily removing the handbrake expander mechanism. Both operations are detailed in this paragraph as follows:

(*a*) To remove the wheel cylinder, disconnect the handbrake transverse rod at the expander arm on the backing plate.

(*b*) Attach a bleed tube to the bleed screw on the wheel cylinder, release the bleed screw and pump the brake pedal, catching the escaping fluid in a clean container. Continue to pump the pedal until no further fluid enters the container. Detach the bleed tube and disconnect the brake pipe at the wheel cylinder connection.

(*c*) Remove the three nuts and washers securing the cylinder body to the backing plate and remove the cylinder. The dust cover plate at the rear of the cylinder can then be lifted off the backing plate.

(*d*) To dismantle the wheel cylinder, remove the rubber band and allow the pistons to push out of the cylinder bore. Remove the piston seals, seal supports and piston spring from inside the bore.

(*e*) To dismantle the handbrake expander, whether in situ or with the wheel cylinder removed from the brake assembly, remove the four screws and washers, lift off the cover plate from the cylinder body, and withdraw the rollers, tappets, and expander arm; the arm being drawn through the backing plate when dismantled in position.

Inspection and Overhaul.

Extreme cleanliness is essential when working on hydraulic components. No grease, mineral oil, trichlorethylene, paraffin or petrol should be allowed under any circumstances to contact any hydraulic component. For cleaning purposes, only "Girling Cleaning Fluid" should be used.

1. Always renew the seals when overhauling the wheel cylinder.

2. Ensure the piston spring is not weak or damaged.

3. Examine the cylinder bore and pistons for scores, ridging or damage, renewing if evident. Also inspect for wear at the channels in which the handbrake expander mechanism operates.

4. Check the expander tappets, rollers and arm for wear, renewing the items preferably as an assembly.

5. Examine the brake linings for excessive or uneven wear, grease or oil contamination and if either fault is evident, replacement shoe and lining assemblies should be fitted. In territories where it is necessary to reline the original shoes, it is recommended that equipment specially designed for brake relining be employed, in order to maintain accuracy during the operation. Always ensure that the correct linings are used, as it is important that the specified lining material be used. Check that the new linings are free from grease or oil.

When special equipment is not available, carefully punch out the old rivets, remove the faulty linings, inspect the exposed surface of the shoe for burrs etc., clean the area before mounting the new linings, clamp and rivet the new linings to the shoe face, starting from the centre of the shoe face and working towards the ends. Place the rivet head against the end of a punch which is securely held in a vice. The end of the punch should be of the same diameter as the rivet head, and on positioning the rivet head on the punch, carefully spread the tubular end of the rivet.

6. Check the brake shoe return springs for weakness (see "Data" page for spring rating). It is advisable to renew the shoe return springs when new linings are fitted.

7. Check the backing plate for damage and distortion.

8. Examine the brake drum (see "Brake Drum" sub-section).

9. Inspect the adjuster tappets and wedge for wear, renewing as necessary.

To Re-assemble.

1. Rear Wheel Cylinder and Expander. To re-assemble the expander mechanism to the cylinder body, proceed as follows:

(*a*) Apply a smear of Girling White Brake Grease to the channels in which the parts operate on the top of the body, and also smear the underside of the cover plate with the same type of grease.

(*b*) Re-assemble the tappets, rollers and expander arm in the channels and refit the cover plate securing with the four screws and washers.

To re-assemble the wheel cylinder, immerse all internal components in clean brake fluid and assemble in the wet condition as follows:

(i) Place the seal supports inside the cup of the piston seals.

(ii) Enter one seal and support in an end of the cylinder bore with the seal support foremost thus ensuring that the widest end of the seal also enters the bore first. Follow up the seal by sliding a piston in the same end of the bore.

(iii) Retain these components in position and fit the piston spring in the open end of the bore, seating the spring in the centre section of the seal support. Enter the second seal and support in the same procedure as the first, locating the support correctly on the piston spring. Place the second piston in the bore and gently compress the two pistons inwards sufficiently to enable the rubber band to be fitted to retain them. Finally, refit the assembled wheel cylinder to the backing plate and at the same time, refit the dust cover plate, over the wheel cylinder studs, at the rear of the backing plate. Secure by means of the three self locking nuts and thackeray washers. After fully tightening the locking nuts, slacken each nut back half a turn, in order to allow slight movement of the wheel cylinder housing on the backing plate which is essential for the efficient working of the handbrake. Any difference in wear of the two linings is compensated by the slight movement of the wheel cylinder and therefore the handbrake applies equal pressure to the two shoes at all times.

2. If the adjuster housing has been removed from the backing plate, refit and secure with the two setscrews and washers, tightening the setscrews to a torque reading of 20 lb. ft. (2·77 kg. m.).

Screw the adjuster wedge into the housing after smearing Girling White Brake Grease on the wedge serrations and in the bores of the housing.

Slide the adjuster tappets in their respective bores as identified during dismantling.

3. Ensure that the shoes are correctly paired and attach the shoe return springs to the drilled holes in the shoe webs so that the return springs lie between the shoe webs and the backing plate when re-assembled.

The longer of the two return springs is fitted nearest to the wheel cylinder, whilst the shorter spring fits nearest to the adjuster unit.

4. Apply a smear of Girling White Brake Grease to the shoe contact surfaces of the wheel cylinder pistons, adjuster tappets and the tops of the steady posts.

The shoes are then re-assembled to the backing plate in the reverse order of the dismantling operation ensuring that the rubber band is removed from the wheel cylinder, when fitting the shoes.

5. Ensuring that the adjuster stem is turned anti-clockwise as far as possible, refit the hub and drum assembly (see "Rear Axle" section).

6. Balance the brake shoes on the steady posts as detailed in the sub-section headed "Brake Centralisation".

7. Re-connect the handbrake transverse rod at the expander arm on the backing plate and re-connect the brake pipe to the wheel cylinder. Bleed the brake system as detailed in the sub-section "Bleeding the Hydraulic System".

8. Adjust the brakes as detailed in the sub-section headed "Rear Brake Adjustment". Lower the rear axle, remove the jack and check the handbrake and footbrake for operation.

REAR BRAKE ASSEMBLY

(Fitted to all models except KAH.30 and KAD.30 models)

To Dismantle.

1. Place chocks under the front road wheels and fully release the handbrake. Jack up the rear axle and remove the rear hub and drum assembly (see "Rear Axle" section).

2. Prise the end of one of the shoes from the expander tappet, lift forward clear of the expander housing and release the shoe end. Repeat the same procedure at the opposing end of the shoe and withdraw the shoe end from the adjuster tappet.

With the tension now released from the shoe return springs, the other shoe is easily disengaged and the two shoes and springs can be lifted away. Note the contact plate fitted in the expander tappet for the second shoe.

4. To dismantle the bell cranks from the second shoe proceed as follows:

(*a*) At the expander unit bell cranks, remove the circlip under the slotted head of the adjustable pivot pin; lift off the retaining plate which is anchored to a separate post pressed in the shoe web, allowing the pivot pin to be withdrawn. Unscrew the self locking nut and remove the bolt retaining the two bell cranks to the web of the shoe; lift away the bell cranks noting that a tubular distance piece is loosely fitted in the web at the bell crank retaining bolt drilled hole. The push rod can then be withdrawn.

(*b*) At the adjuster unit bell cranks, unscrew the self locking nut, remove the bell crank retaining bolt and lift away the two bell cranks, noting that a further distance piece is also fitted in the shoe web at the bell crank retaining bolt position.

5. To dismantle the adjuster unit, it is not normally necessary to remove the housing from the backing plate as the two tappets will slide out of the bore and the adjuster wedge can be screwed through the housing from the outside and removed from the inside of the backing plate. Should the housing require removal, tap down the tab ends of the locking plate, unscrew the two setscrews in the backing plate and remove the housing and the locking plate.

Note: Identify the housing position on the backing plate, before removal, to enable the housing to be re-fitted to its correct position on re-assembly.

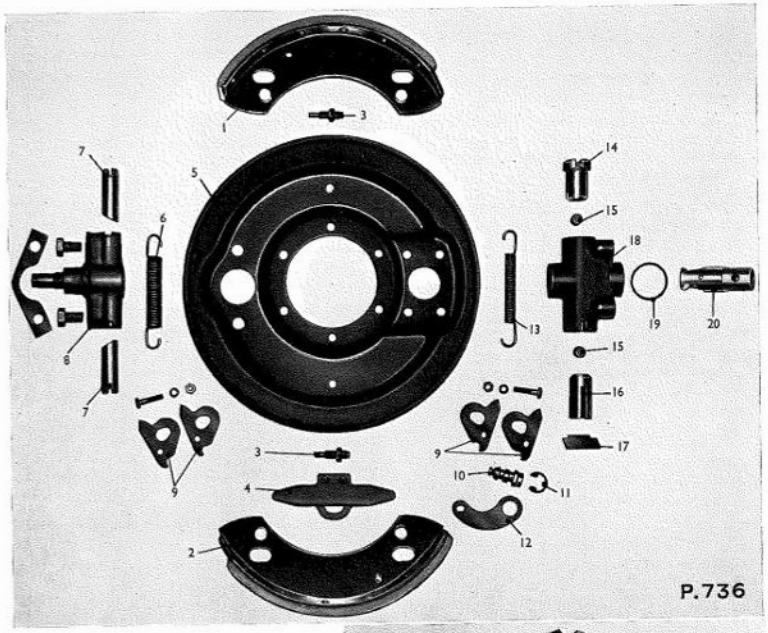
6. Rear Wheel Cylinder and Expander. To remove the brake shoe expander unit, it is first necessary to remove the combined rear wheel cylinder and handbrake expander. The following operations include the removal and dismantling of these units:

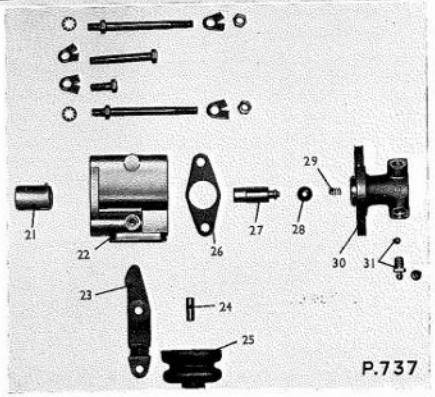
(*a*) Disconnect the handbrake cable from the handbrake expander arm at the respective rear wheel cylinder.

(*b*) Attach a bleed tube to the bleed screw on the wheel cylinder, release the bleed screw and pump the brake pedal, catching the escaping fluid in a clean container. Continue to pump the pedal until no further fluid enters the container. Detach the bleed tube and disconnect the brake pipe at the wheel cylinder connection.

(*c*) Tap down the tab ends of the lockwashers, unscrew the two nuts retaining the wheel cylinder to the handbrake expander housing and lift off the wheel cylinder and the marcelline gasket.

Slide the piston assembly out of the cylinder body, detach the conical piston spring and the piston seal from the spigot end of the piston.





1 FIRST SHOE
2 SECOND SHOE
3 STEADY POST AND LOCKNUT
4 PUSH ROD
5 BACKING PLATE
6 SHOE RETURN SPRING
7 ADJUSTER TAPPET
8 ADJUSTER HOUSING
9 BELL CRANK
10 ADJUSTABLE PIVOT PIN
11 RETAINING PLATE CIRCLIP
12 PIVOT PIN RETAINING PLATE
13 SHOE RETURN SPRING
14 FIRST SHOE EXPANDER TAPPET
15 TAPPET ROLLER
16 SECOND SHOE EXPANDER TAPPET
17 SECOND SHOE CONTACT PLATE
18 SHOE EXPANDER HOUSING
19 SEALING RING
20 PLUNGER AND WEDGE ASSEMBLY
21 INTERMEDIATE PISTON
22 HANDBRAKE EXPANDER HOUSING
23 HANDBRAKE EXPANDER ARM
24 ARM PIVOT PIN
25 RUBBER BOOT
26 WHEEL CYLINDER GASKET
27 WHEEL CYLINDER PISTON
28 PISTON SEAL
29 PISTON SPRING
30 WHEEL CYLINDER HOUSING
31 BLEED SCREW AND BALL

Fig. K.19. Details of the rear brake assembly fitted to all models except KAH.30 and KAD.30 models

(*d*) Tap down the tab ends of the lockwashers, unscrew the two setbolts retaining the handbrake expander housing to the backing plate and lift the housing over the two collar studs remaining on the backing plate, and withdraw clear. Note that the two setbolts are different in length.

The handbrake lever arm and the intermediate piston will be withdrawn with the housing. Slide the piston out of the housing noting that it is pin located in a slot machined in the housing bore.

Detach the rubber boot from the groove in the housing and the recess in the lever arm. Should removal of the lever arm be required, slide out the pivot pin located in the housing and free the arm.

(*e*) To remove the shoe expander unit, unscrew at the hexagon collar of the two studs, remove the studs and the shakeproof washers, identify the relative position of the studs to the expander housing to facilitate re-assembly. Carefully withdraw the expander unit from inside the backing plate and at the same time, ensure that the sealing ring located on the protruding spigot of the expander housing is removed from the outside of the backing plate.

On removal of the expander unit, slide out the plunger, the two tappets and rollers and tap out the contact plate in the expander housing slot, after first identifying the position of the plate in the slot, as the steps in the plate are unequal in length.

Inspection and Overhaul.

Extreme cleanliness is essential when working on hydraulic components. No grease, mineral oil, trichlorethylene, paraffin or petrol should be allowed under any circumstances to contact any hydraulic component. For cleaning purposes, only "Girling Cleaning Fluid" should be used.

1. Always renew the seal when overhauling the wheel cylinder.

2. Ensure the piston spring is not weak or damaged.

3. Inspect the piston and cylinder bore for scores, ridges or damage, renewing if evident. Inspect the handbrake expander housing and intermediate piston for wear, scores or damage. Check that the intermediate piston pin is in good condition. Ensure that the handbrake lever arm pivots freely, but without slackness.

4. Check the expander tappets, rollers and wedge insert for wear, renewing as necessary. The wedge insert is removed from the plunger after tapping out the retaining pin. Ensure that the roller pinned in the slotted end of the plunger is not worn excessively and rotates freely.

5. At normal overhaul periods, it is advisable to renew the sealing ring and wheel cylinder gasket.

6. Examine the brake linings for excessive or uneven wear, grease or oil contamination and if either fault is evident, replacement shoe and lining assemblies should be fitted. In territories where it is necessary to reline the original shoes, it is recommended that equipment specially designed for brake relining be employed, in order to maintain accuracy during the operation. Always ensure that the correct linings are used, as it is important that the specified lining material be used. Check that the new linings are free from grease or oil.

When special equipment is not available, carefully punch out the old rivets, remove the faulty linings, inspect the exposed surface of the shoe for burrs etc., clean the area before mounting the new linings, clamp and rivet the new linings to the shoe face, starting from the centre of the shoe face and working towards the ends. Place the rivet head against the end of a punch which is securely held in a vice. The end of the punch should be of the same diameter as the rivet head, and on positioning the rivet head on the punch, carefully spread the tubular end of the rivet.

7. Check the brake shoe return springs for weakness (see "Data" page for spring rating). It is advisable to renew the shoe return springs when new linings are fitted.

8. Check the backing plate for damage and distortion.

9. Examine the brake drum (see "Brake Drum" subsection).

10. Inspect the adjuster tappets and wedge for wear, renewing as necessary.

11. Ensure that the push rod, bell cranks and pivot pins are not worn.

12. Examine the rubber boot, renewing if split or deteriorated.

To Re-assemble.

1. Rear Wheel Cylinder and Expander.

(*a*) To re-assemble the shoe expander unit, smear all components with Girling White Brake Grease, slide the plunger in the housing bore with the angled faces of the wedge insert facing the tappet bores, place the roller in the leading slot of each expander tappet, retaining in position with the white brake grease, and slide each tappet and roller into its respective tappet bore noting that the first shoe tappet, identified by the circular head, is located in the shorter of the two tappet bores, and that the roller slots in the tappets are parallel to the wedge angles. Position the contact plate in the outer slot of the second shoe tappet as identified during dismantling, and retain the tappets temporarily with a rubber band.

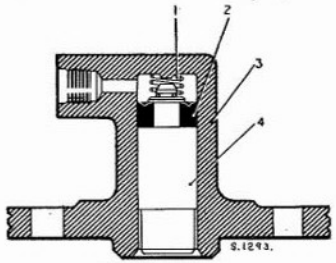
Secure the shoe expander unit to the backing plate by means of the two collar studs using shakeproof washers under the hexagon collars. The collar studs are refitted to the expander housing as identified during removal.

Ease the sealing ring over the protruding end of the expander housing until the ring fits against the backing plate.

(*b*) Smear the nose of the handbrake lever arm and the bore of the handbrake expander housing with Girling White Brake Grease. Also smear the inside of the rubber boot with Wakefield Rubber Grease No. 3 (Red) and fit the boot into the grooves formed in the housing and the lever arm.

Position the expander housing on the collar studs with the lever arm uppermost and secure the housing with the two setbolts. The setbolts each have a lockwasher and must be tightened to a torque reading of 12/14 lb. ft. (1·66/1·94 kg. m.), finally locking the setbolt heads by turning up the tab end of the lockwashers.

(*c*) The intermediate piston should be smeared with Girling White Brake Grease prior to entering in the bore of the handbrake expander housing, locating the piston in the small slot machined in the housing bore by means of the pin fitted in the piston external diameter.



1 PISTON SPRING
2 PISTON SEAL
3 WHEEL CYLINDER HOUSING
4 WHEEL CYLINDER PISTON

KA.40 Rear wheel cylinder illustrated denoted by the two identification grooves on the cylinder flange.

Fig. K.20. Sectional view of the rear wheel cylinder assembly

(*d*) Re-assemble the wheel cylinder assembly. After first ensuring that the components are perfectly clean, immerse the piston, spring and seal in clean brake fluid and assemble in the wet condition. Ease the seal over the small flange machined on the spigot end of the piston with the fingers, until the seal seats fully on the broad shoulder at the base of the spigot. When assembled, the radiused face of the seal should be uppermost, i.e., facing the spigoted end of the piston.

Next fit the piston spring on the piston spigot ensuring that the smaller diameter of the spring is positively clipped in the groove located immediately above the small flange on the spigot.

Smear the wheel cylinder bore with clean brake fluid and slide the piston assembly, spigot end foremost into the bore.

(*e*) Place the marcelline gasket on the wheel cylinder mounting flange and refit the wheel cylinder noting that the bleed screw boss, identified by the angular projection on the boss face, must be in alignment with the handbrake lever arm. Secure the wheel cylinder on the two collar studs with the lockwashers and nuts, tightening the nuts to a torque reading of 12/14 lb. ft. (1·66/1·94 kg. m.). Turn up the tab end of the lockwashers against a convenient flat on each nut.

Note: KAL.30 and KA.40 models have twin notches machined in the wheel cylinder flange ends in order to identify the wheel cylinders from the KA.60 model cylinders which have larger piston diameters.

2. If the adjuster housing has been removed from the backing plate, refit as identified during the removal operation and secure with the two setscrews and locking plate. Do not fully tighten the setscrews until the brake centralisation operation is carried out at a later stage (see para 9.).

Screw the adjuster wedge into the housing after smearing Girling White Brake Grease on the wedge serrations and in the bores of the housing.

Slide the tappets in their respective bores ensuring that the correct relationship of the tappet slot angles is obtained, to accept the shoe end contours. Temporarily retain the tappets in position with a rubber band.

3. Apply a smear of Girling White Brake Grease on the second shoe ends at the area of the bell crank operation. Re-assemble the bell cranks to the second shoe ensuring that a tubular distance piece is positioned in the drilled hole at each end of the shoe web and that the bell crank retaining bolts pass through the distance pieces. Note that the bolt heads must be fitted nearest the backing plate. Fit new self locking nuts on the bolts but leave the nuts slack at this stage.

Refit the adjustable pivot pin through the expander unit bell cranks and shoe web with the slotted end of the pin outermost.

Each bell crank has a "pear-shaped" slot to permit the entry of each pivot pin which should then be moved into the smaller radius of the slot to retain the pin in position.

4. Pivot both sets of bell cranks (the retaining bolt nuts being left slack as described in para. 3) until one end of the push rod can be located in the radiused nose of the bell cranks, which will then allow the opposite end to be pushed forward into position in the nose of the opposing bell cranks. Note that the push rod must be fitted with the large diameter hole below the shoe web in order to give access for the steady post when the shoe is assembled to the backing plate.

Gripping the push rod between the two pairs of bell cranks, tighten the retaining bolt nuts, but do not fully tighten at this stage.

5. Pair up the first and second shoe of the particular brake assembly and fit the two return springs to their respective anchor posts on the shoe webs with the hooked ends of each spring pointing to the rear of each brake assembly when mounted. The return spring

nearest the expander unit is coloured red and has smaller diameter coils than the black coloured spring fitted adjacent to the adjuster unit.

6. Apply a smear of Girling White Brake Grease to the shoe contact surfaces of the expander tappets, adjuster tappets and the tops of the steady posts.

The shoes are then re-assembled to the backing plate in the following order. Mount the second shoe in position, refit the first shoe in the expander tappet head and finally prise the first shoe end into the adjuster tappet slot. Ensure that the rubber bands retaining the adjuster and expander tappets are removed when fitting the shoes and also that the large diameter hole in the lower segment of the push rod is located over the nose of the second shoe steady post.

7. After refitting the shoe assemblies, the bell cranks must be adjusted to ensure that both ends of the second shoe are in full contact with their respective tappet abutments and that no clearance exists between the push rod and the bell cranks. To adjust, turn the adjustable pivot pin, by means of a screwdriver, in the required direction until the correct adjustment is obtained. In order to retain the pivot pin in this position, refit the pivot pin retaining plate by first placing the smaller end of the plate on the adjacent anchor post and then match the serrations in the opposite end of the plate with the corners of the hexagon head on the pivot pin.

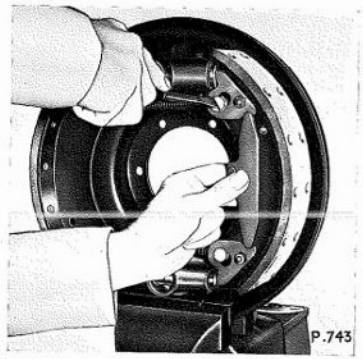


Fig. K.21. Adjusting the bell cranks by means of the adjustable pivot pin

The plate is then secured to the pivot pin by fitting the circlip. Fully tighten the bell crank retaining bolt nuts and check the adjustment again after locking the pivot pin in position.

8. Ensuring that the adjuster stem is turned anti-clockwise as far as possible, refit the hub and drum assembly (see "Rear Axle" section).

9. Centralise the rear brakes and balance the brake shoes on the steady posts as detailed in the sub-section headed "Brake Centralisation".

10. Re-connect the handbrake cable to the expander arm and re-connect the brake pipe to the rear wheel cylinder noting that the bleed screw must be fitted in the tapped hole in alignment with the expander arm. Bleed the brake system as detailed in the sub-section headed "Bleeding the Hydraulic System".

11. Adjust the brakes as detailed in the sub-section headed "Rear Brake Adjustment". Lower the rear axle, remove the jack and check the footbrake and handbrake operation on completion.

BRAKE DRUMS

The operations necessary to remove and refit the front and rear brake drums are detailed under the "Hubs and Bearings" sub-section in the respective axle section.

Inspection and Overhaul.

Examine the friction surface of the drums for excessive scoring or evidence of "crazing", renewing the drum if evident.

Also check the drums for ovality, and renew if ovality is present.

HYDRAULIC PIPE LINE FLEXIBLE HOSES

To Remove.

During service operations which involve the removal or refitting of the flexible hoses, great care must be taken to avoid damaging them by twisting or straining. Proceed as follows:

1. Release the tube nut (A) (see Fig. K.22).

2. Release the locknut (B), securing the flexible hose spigot to the sidemember or bracket, ensuring at the same time that the flexible hose does not turn by holding the nut (C) with a spanner.

3. Withdraw the spigot from the frame or the bracket, and unscrew the hose at its opposite end in the same manner, noting the small copper ring gasket.

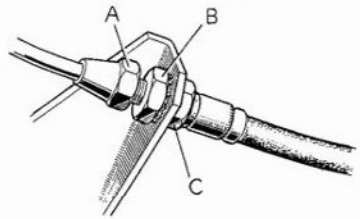


Fig. K.22. Flexible hose connection details

To Refit.

1. When refitting the hose, first screw in and tighten the hose end which connects with the brake cylinder or junction, ensuring that the copper ring gasket is fully seated.

2. Fit the spigot at the other end of the hose to the frame or bracket and tighten the locknut (B) at the same time holding the hexagon (C) in the hose to prevent movement.

3. Refit the tube nut (A) and tighten securely.

4. Bleed the brake system as detailed in this section, and finally check for leaks with the brake pedal applied hard.

VACUUM SERVO UNIT
(when fitted)

To Remove.

1. With the engine switched off, disconnect and remove both vacuum pipes at the servo vacuum connection banjo unions. Release the hose at the air inlet pipe.

2. Drain the brake fluid from the system by attaching a bleed tube to the bleed screw on one of the wheel cylinders, release the bleed screw and pump the brake pedal, catching the escaping fluid in a clean container. Continue to pump the pedal until no further fluid enters the container.

3. Disconnect the pipes leading to the hydraulic inlet and outlet unions.

4. Unscrew the three setscrews with the spring washers securing the servo unit to the support bracket and remove the unit.

Note: On removing the unit, it is advisable to temporarily seal all vacuum and hydraulic pipes leading to the unit, to prevent the entry of dirt or dust etc.

To Dismantle.

When dismantling the servo unit, absolute cleanliness is essential. It is recommended that the bench area be cleared and a clean sheet of paper placed adjacent to the vice on which to lay out the components as they are dismantled.

1. Hold the unit in a vice, supporting by means of the mounting lugs on the output cylinder body.

2. Remove the eight setscrews and nuts in the vacuum cylinder flange, at the same time supporting the cylinder cover against the pressure of the vacuum piston return spring. Lift away the end plate and the gasket.

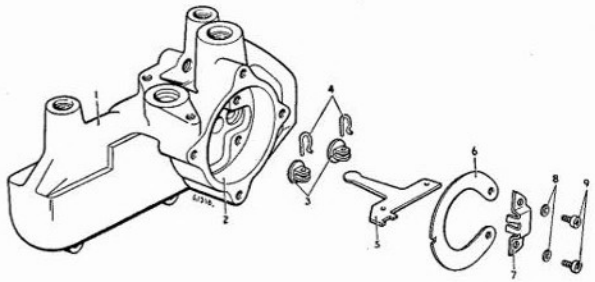
3. Withdraw the vacuum piston and rod assembly complete, followed by the piston return spring. The piston and rod assembly should not be dismantled and is renewed as an assembly. Remove the nylon stop washer from the piston push rod.

4. The removal of the vacuum piston and spring will reveal the securing setscrews and clamping plate retaining the main cylinder body to the vacuum cylinder. Unscrew the three setscrews and washers, and remove the vacuum cylinder with the released clamping plate, noting the gasket fitted between the mounting faces of the two cylinder bodies.

As the vacuum cylinder is withdrawn, the vacuum connecting pipe will also be released simultaneously at the rubber grommet fitted in the end flange of the vacuum cylinder. Remove the grommet and the grommet cover plate from the cylinder flange.

5. Unscrew the four setscrews with the shakeproof washers and remove the vacuum connecting pipe assembly from the valve chest compartment. A gasket is fitted below the cover plate section of the connecting pipe assembly.

6. Unscrew the two setscrews, remove the air inlet pipe assembly and remove the rubber sealing washer fitted below the cover plate section of the air inlet pipe assembly.



1 MAIN CYLINDER BODY
2 VALVE CHEST COMPARTMENT
3 AIR AND VACUUM VALVES
4 VALVE SPRING CLIPS
5 ROCKING LEVER
6 LEVER RETURN SPRING
7 ROCKING LEVER GUIDE
8 COPPER WASHERS
9 SECURING SETSCREWS

Fig. K.23. Servo valve chest compartment details

7. Dismantle the valve chest details as follows:

(*a*) Unscrew the two setscrews with the large copper washers which will enable the rocking lever guide to be lifted out.

(*b*) The rocking lever spring, which is horseshoe shaped, can then be withdrawn followed by the rocking lever complete with the attached valves.

(*c*) Before removing the spring clips and detaching the two valves from the rocking lever arms, identify each valve to its position to enable the valves to be re-assembled to their original locations.

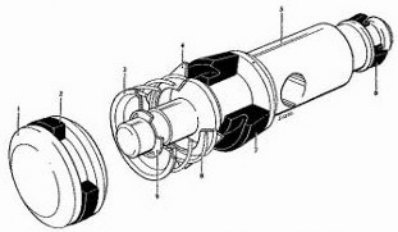
8. The valve control details occupy the upper bore in the main cylinder body and are dismantled as follows:

(*a*) Ease out the end plug which seals the bore and remove the rubber seal fitted in the groove machined in the outer diameter of the plug.

(*b*) With the end plug removed, the end of the control piston can be gripped to facilitate the withdrawal of the complete piston assembly.

(*c*) Prise out the small circlip from the groove in the neck of the piston and detach the dished spring retainer plate, the piston spring and the dished abutment plate from the piston neck.

(*d*) The large and small piston seals should be eased, with the fingers, out of their respective grooves in the piston body.



1 END PLUG
2 END PLUG SEAL
3 RETAINER PLATE
4 ABUTMENT PLATE
5 VALVE CONTROL PISTON
6 PISTON SEAL (SMALL)
7 PISTON SEAL (LARGE)
8 PISTON SPRING
9 CIRCLIP

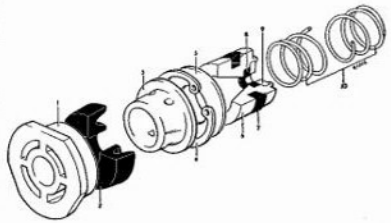
Fig. K.24. Details of the valve control piston and end plug assembly

9. The output piston components are housed in the lower bore in the main cylinder body and are removed as follows:

(*a*) Withdraw the flanged bush located in the end of the bore and remove the rubber seal and the seal spacer fitted immediately behind the bush.

(*b*) Remove the circlip seated in the groove machined in the cylinder bore, using suitable circlip pliers (Churchill Tool 7065). On removing the circlip, the plain washer, followed by the piston assembly and the piston return spring will be ejected in that order from the cylinder bore.

(*c*) Ease the large piston seal, with the fingers, out of the piston body groove. The small seal in the piston counterbore is retained by a metal washer secured by the peened-over lip of the piston counterbore. It will be necessary to renew the piston assembly when the small piston seal requires renewal.



1 FLANGED BUSH
2 RUBBER SEAL
3 SEAL SPACER
4 CIRCLIP
5 PLAIN WASHER
6 OUTPUT PISTON BODY
7 PISTON SEAL (LARGE)
8 PISTON SEAL (SMALL)
9 SEAL RETAINING WASHER
10 PISTON RETURN SPRING

Fig. K.25. Details of the output cylinder

Inspection and Overhaul.

Extreme cleanliness is essential when working on hydraulic components. No grease, mineral oil, trichlorethylene, paraffin or petrol should be allowed under any circumstances to contact any hydraulic component. For cleaning purposes, only "Girling Cleaning Fluid" should be used, except for the vacuum cylinder which is specially treated on the cylinder inner surfaces with a lubricating agent, at the factory and therefore, should not at any time be cleaned other than by careful wiping with a clean dry, fluffless cloth.

1. It is recommended that all seals and gaskets in the servo unit be renewed when the unit is dismantled for overhaul. To renew the small seal in the output piston counterbore, it is necessary to renew the piston as an assembly.

2. There should be no evidence of corrosion, pitting, scoring or ridges on the piston rod, pistons or bores and all working surfaces should be smooth to the touch.

3. The vacuum piston and rod assembly is renewed as an assembly, when necessary.

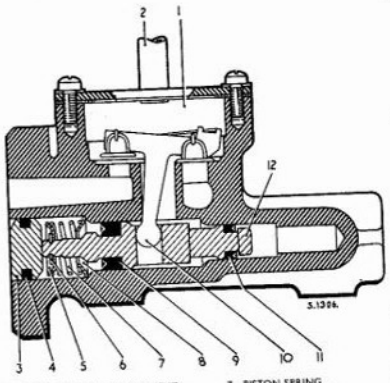
4. Check the three return springs for damage or weakness (see the "Data" page of this section for details of the spring ratings).

5. Inspect the faces of the two rocking lever valves for damage, scores or ridges, renewing as necessary.

To Re-assemble.

Lubricate the hydraulic parts, i.e., pistons, seals and bores with clean brake fluid before re-assembly and always exercise extreme cleanliness during the operation.

1. Re-assemble the valve control details as follows (see Fig. K.26).



1 VALVE CHEST COMPARTMENT
2 VACUUM CYLINDER CONNECTING PIPE
3 END PLUG
4 END PLUG SEAL
5 RETAINER PLATE
6 CIRCLIP
7 PISTON SPRING
8 ABUTMENT PLATE
9 PISTON SEAL (LARGE)
10 ROCKING LEVER
11 PISTON SEAL (SMALL)
12 VALVE CONTROL PISTON

Fig. K.26. Sectional view of the valve control piston assembly and associated components

(*a*) Fit the new small rubber seal to the groove on the shorter spigot of the control piston ensuring that the grooved face of the seal is nearest the spigot end.

(*b*) Fit the new large rubber seal to the opposite spigot of the piston, seating the seal fully on the broad shoulder of the piston body, and ensuring that the grooved face of the seal is farthest from the piston body.

(*c*) Position the dished abutment plate on the longer spigot of the piston as shown in Fig. K.26 and seat the piston spring on the abutment plate flange. The spring retainer plate can then be fitted on the spigot as shown in Fig. K.26 and retained by fitting the new circlip in the groove at the piston neck.

(*d*) Carefully ease the assembled piston in the upper bore of the main cylinder body, with the shorter spigot foremost paying particular attention to the entry of the seals into the bore. When refitting the piston assembly, the hole in the piston body must align with the hole for the rocking lever in the bore.

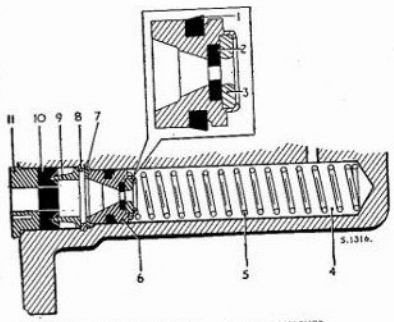
(*e*) Re-assemble the new rubber seal to the end plug groove and refit the plug to seal the end of the bore.

2. Re-assemble the output piston components as follows:

(*a*) Fit the new rubber seal to the groove in the outer diameter of the piston, with the larger diameter of the seal taper nearest the end of the piston which houses the smaller seal.

(*b*) Enter the piston return spring in the lower bore in the main cylinder body. Ease the assembled piston into the bore taking care that the piston seal is gently eased in the mouth of the bore. Refit the plain washer and retain the components in the bore by fitting a new circlip in the groove in the bore.

(*c*) Slide the seal spacer into the bore followed by the rubber seal with the grooved face of the seal foremost and seal the end of the bore by refitting the flanged bush.



1 OUTPUT PISTON SEAL (LARGE)
2 OUTPUT PISTON SEAL (SMALL)
3 SEAL RETAINING WASHER
4 OUTPUT CYLINDER BORE
5 PISTON RETURN SPRING
6 PISTON ASSEMBLY
7 PLAIN WASHER
8 CIRCLIP
9 SEAL SPACER
10 RUBBER SEAL
11 FLANGED BUSH

Fig. K.27. Sectional view of the output cylinder details

3. Re-assemble the valve chest details as follows:

(*a*) Attach the two valves to the respective arms of the rocking lever as identified during dismantling, by fitting the spring clips.

(*b*) Position the rocking lever in the valve chest ensuring that the foot of the lever engages in the hole drilled in the valve control piston body and the two valves are seated over the respective drillings in the valve chest base. The arm of the lever with the raised projections should be positioned furthest from the two tapped holes in the valve chest base.

(*c*) Refit the lever return spring, engaging the small cut-out in the larger diameter, between the two raised projections on the lever arm.

(*d*) Refit the rocking lever guide on top of the lever spring with the two feet projecting downward centrally positioned over the lever arm. The guide is located with the two feet projections nearest to the rocking lever centre. Secure the guide and the lever spring by fitting and fully tightening the two setscrews ensuring that the large copper washers are located below the setscrew heads.

4. Refit the vacuum connecting pipe to the valve chest with the gasket, using the four setscrews and shakeproof washers, tightening the screws to a torque wrench reading of 2/3 lb. ft. (·277/·415 kg. m.). Slide the rubber grommet and its retaining plate on the open end of the pipe, ready for re-assembly to the vacuum cylinder.

5. The air inlet pipe assembly is then refitted after first seating a new rubber sealing washer in the mounting face shoulder. Secure the assembly with the two setscrews tightening to a torque wrench reading of 2/3 lb. ft. (·277/·415 kg. m.)

6. Locate the main cylinder body gasket on the cylinder end face and offer up the vacuum cylinder securing the vacuum cylinder by fitting the clamping plate flange outwards, with the three setscrews and washers. Tighten the setscrews to a torque wrench reading of 10/12 lb. ft. (1·383/1·66 kg. m.). Locate the rubber grommet of the vacuum connecting pipe in the flange of the vacuum cylinder.

7. Ensure that the inner surfaces of the vacuum cylinder are clean (see opening para. of "Inspection and Overhaul"). Refit the nylon stop washer on the piston push rod and insert the vacuum piston assembly locating the push rod spigot in the bush of the output cylinder.

8. Fit a new end plate gasket on the vacuum cylinder flange and refit the end plate with the setscrews and nuts, tightening to a torque wrench reading of 2/3 lb. ft. (·277/·415 kg. m.). Two of the securing setscrews and nuts are required for retaining the vacuum pipe grommet retaining plate.

To Refit.

Refitting is a reversal of the removal operation with attention to the following points.

1. Ensure that all pipe and hose connections are secure on completion.

Bleed the hydraulic system as detailed in this section.

2. After bleeding the system, run the engine for a short period and check the brake operation to ensure that the servo assistance is operating.

VACUUM NON-RETURN VALVE

The vacuum non-return valve is fitted integral with the engine-to-servo pipe banjo connection at the servo vacuum connection and is a sealed unit requiring no attention. In the event of the valve becoming faulty, a new valve unit must be fitted.

VACUUM RESERVE TANK

The tank is mounted on a support bracket adjacent to the servo unit and is connected to the unit by a single pipe line. On KAB models, an electrical vacuum switch is fitted in the banjo union connection on the tank.

As the tank is sealed, no servicing is required, except that periodically it is advisable to remove the tank and drain off any moisture which may have collected in the tank.

VACUUM SWITCH

(KAB models only)

For information on the vacuum switch, refer to the "Electrical Equipment" section.

SERVO AIR FILTER

The moulded cellular filter element requires no attention and it is recommended that a new element be fitted when new brake shoes are fitted after normal wear.

To Renew the Filter Element.

Release the stirrup type clip retaining the filter cover and lift away the cover.

The element can then be lifted out and the new element fitted. Locate the element in the shallow cup on the support platform and refit the filter cover retaining by means of the clip.

To Remove.

Removal of the air filter entails releasing the hose below the filter platform and removing the two setscrews, nuts and washers securing the filter to the support bracket.

To Refit.

Reverse the removal operation.

HANDBRAKE LEVER AND SHAFT ASSEMBLY

Ratchet and Pawl Renewal.

In order to renew the handbrake ratchet and pawl, it is not necessary to remove the handbrake lever from the vehicle. Remove both components as follows:

1. Place chocks under the road wheels and release the handbrake.

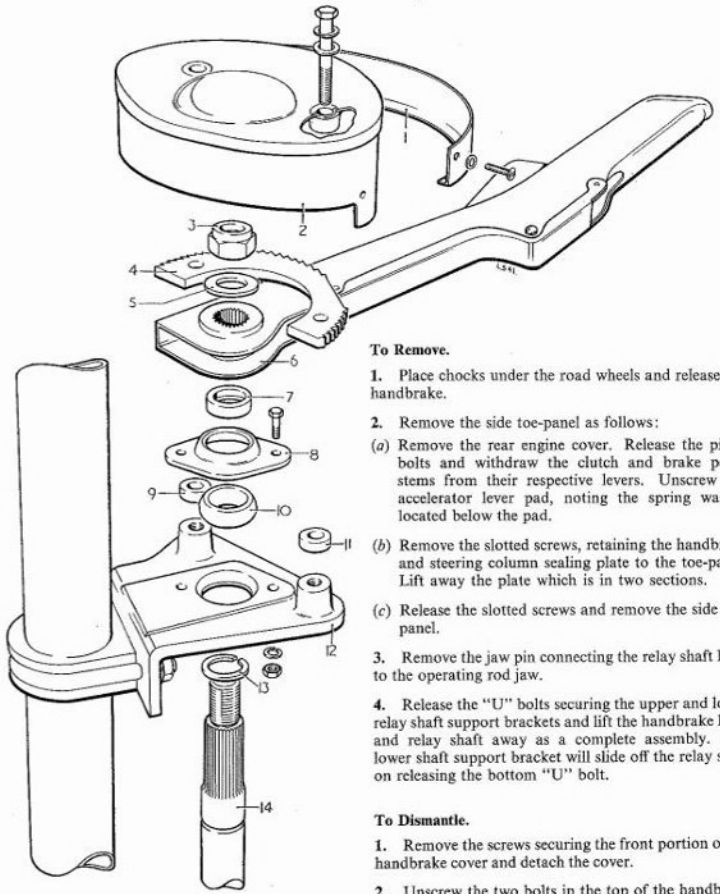
2. Remove the screws securing the front portion of the handbrake cover and detach the cover.

3. Unscrew the two bolts in the top of the handbrake cover noting the plain and spring washers, and lift off the cover.

4. Depress the handbrake lever trigger in order to lift the lever pawl thus enabling the ratchet plate to be withdrawn through the slot in the front of the lever casing. A distance piece is fitted between each tapped boss of the upper support bracket and the underside of the ratchet plate. Note the direction of the ratchet teeth to assist in refitting.

5. To withdraw the lever pawl, from the handbrake lever, refer to para. 8 under "To Dismantle" in this sub-section for details of this operation, which can be carried out with the handbrake lever in position.

6. Refitting these components is a reversal of the removal operations, referring to para. 2 under "To Re-assemble" in this sub-section for re-assembling and correctly positioning the lever pawl. Test the handbrake operation on completion.



1 HANDBRAKE COVER (FRONT)
2 HANDBRAKE COVER (TOP)
3 RELAY SHAFT LOCKING NUT
4 RATCHET PLATE
5 PLAIN WASHER
6 HANDBRAKE LEVER
7 DISTANCE PIECE
8 RETAINING CAP
9 DISTANCE PIECE
10 SPHERICAL BUSH
11 DISTANCE PIECE
12 SUPPORT BRACKET
13 SPRING RING
14 RELAY SHAFT

Fig. K.28. Exploded details of the handbrake lever shaft assembly

To Remove.

1. Place chocks under the road wheels and release the handbrake.

2. Remove the side toe-panel as follows:

(*a*) Remove the rear engine cover. Release the pinch bolts and withdraw the clutch and brake pedal stems from their respective levers. Unscrew the accelerator lever pad, noting the spring washer located below the pad.

(*b*) Remove the slotted screws, retaining the handbrake and steering column sealing plate to the toe-panel. Lift away the plate which is in two sections.

(*c*) Release the slotted screws and remove the side toe-panel.

3. Remove the jaw pin connecting the relay shaft lever to the operating rod jaw.

4. Release the "U" bolts securing the upper and lower relay shaft support brackets and lift the handbrake lever and relay shaft away as a complete assembly. The lower shaft support bracket will slide off the relay shaft on releasing the bottom "U" bolt.

To Dismantle.

1. Remove the screws securing the front portion of the handbrake cover and detach the cover.

2. Unscrew the two bolts in the top of the handbrake cover noting the plain and spring washers, and lift off the cover.

3. Depress the handbrake lever trigger in order to lift the lever pawl thus enabling the ratchet plate to be withdrawn through the slot in the lever casing. Note

that a distance piece is fitted between each tapped boss of the upper support bracket and the underside of the ratchet plate.

4. Unscrew the self locking nut securing the handbrake lever boss on the relay shaft and remove the plain washer.

5. Release the two nuts and spring washers located on the underside of the upper support bracket thus releasing the retaining cap on the top face of the bracket. Prise the spring ring from the groove positioned on the relay shaft immediately below the upper support bracket, and slide the ring temporarily down the shaft.

6. It is essential that the handbrake lever location on the relay shaft serrations is identified before separating the two components as the angular relationship must be maintained between the handbrake lever and the relay lever welded to the lower end of the shaft.

7. Place the handbrake lever and shaft assembly on a press, using the underside of the upper support bracket arm as a base.

Using a short $\frac{7}{16}$ in. (11 mm.) diameter bar, press the relay shaft through the lever boss and out of the support bracket. The handbrake lever can then be lifted clear followed by the distance washer, retaining cap, cap bolts and spherical bush. Slide the spring ring off the relay shaft.

8. The handbrake lever is dismantled as follows:

(*a*) Prise out the lower end of the cover on the front face of the lever body which will enable the cover to pivot away from the body.

(*b*) Remove the retaining clip securing the trigger pivot pin. The pin can then be removed, and the thackeray washer removed from under the head of the pin.

(*c*) Push the trigger inwards through the slot in the body until the trigger emerges through the aperture on the opposite side of the body. Note that a dished washer is located on each side of the trigger at the pivot pin bore and care must be taken to retain these washers as the trigger is moved inwards.

(*d*) Once clear of the lever aperture, the trigger, together with the pawl control rod, return spring and pawl can be withdrawn as an assembly. The pawl control rod can be unscrewed from the barrel nut in the trigger and the return spring, the spring retaining washer and the pawl separated from the control rod.

Note: Before removing the pawl from the lever, note the direction of the teeth to the centre boss.

Inspection and Overhaul.

1. Inspect the relay shaft for wear and damage particularly at the serrated section, and the spring ring groove. Check the shaft for distortion and ensure that the bottom relay lever is secure on the shaft. Examine the condition of the shaft threads.

2. Inspect the upper support bracket for damage or cracks and ensure that the spherical ball seating is free from damage or scoring.

3. Examine the lower support bracket bush for wear or scores and check that the bush housing is secure in the bracket. The bush is staked at both ends in the bush housing and to renew the bush, it will be necessary to remove the staking before pressing out the bush. Press in the new bush ensuring that the bush is finally positioned equidistant from the ends of the housing bore. Stake the new bush at diametrically opposite points at both ends of the housing after pressing in.

Note: Completely immerse the new bush in thin oil for 24 hours prior to fitting to allow the pores of the bush to fill with lubricant. Do not ream the bush after fitting otherwise the lubricating properties of the bush will be destroyed.

4. The self lubricating spherical bush should always be renewed when the relay shaft assembly has been dismantled. The bush is a transition fit on the shaft, i.e., the limits provided are between ·0005 in. (·0127 mm.) interference and ·0037 in. (·094 mm.) clearance.

Note: Completely immerse the new bush in thin oil for 24 hours prior to fitting to allow the pores of the bush to fill with lubricant. Do not ream the bush, otherwise the lubricating properties of the bush will be destroyed.

5. Examine the distance pieces, distance washer and retaining cap for wear, burrs or damage, renewing as necessary.

6. Renew the shaft spring ring.

7. Inspect the "U" bolts retaining the support brackets and ensure that the bolt threads are in good condition. Also check the security of the 'D' shaped brackets which are integral with the outer column.

8. Ensure that the ratchet plate teeth are not worn as indicated by flattening of the teeth extremities. Also check that the two bolt holes in the plate are not worn or elongated. Renew if either fault is evident.

9. If it is possible to rotate the self-locking nut down the thread of the relay shaft, by hand only, until the thread projects through the insert in the head of the nut, it is necessary to renew the nut.

10. The component parts of the handbrake lever are inspected as follows:

(*a*) Examine the pawl for wear on the teeth extremities and renew as necessary.

(*b*) Check the return spring for weakness.

(*c*) Ensure that the serrations in the lever boss are not worn or damaged.

(*d*) Inspect the trigger pivot hole and the pivot pin for wear.

To Re-assemble.

Reverse the dismantling procedure, noting the following points.

1. Should a new relay shaft assembly or a new handbrake lever assembly be fitted, it is most important that the identification marks, made during dismantling on the original components, are accurately transferred on to the new assemblies to ensure that the angular relationship between the bottom lever and the handbrake lever is maintained. If however, new parts are to be fitted without the necessary identification marks, reassemble the handbrake lever on the relay shaft serrations in the position shown in Fig. K.29.

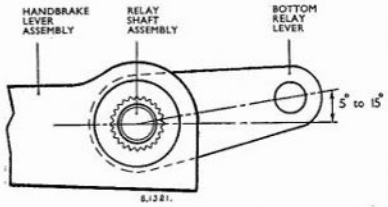


Fig. K.29. Showing the angular relationship of the handbrake lever to the bottom relay lever

2. Re-assemble the handbrake lever as follows:

(*a*) Re-assemble the return spring on the control rod and place the retaining washer on the top of the spring coils.

(*b*) Screw the control rod into the barrel nut in the trigger to approximately the centre of the rod thread length.

(*c*) Enter the radiused arm of the control rod in the pawl and slide the whole assembly into the lever body engaging the spring retaining washer under the ledge welded to the lever body.

(*d*) To correctly position the pawl, set the tips of the pawl teeth at a radius of 1 3/16 in. (50 mm.) from the centre of the lever boss, and at the same time refitting the pawl with the teeth relationship to the centre boss as noted during dismantling. To adjust the pawl height, it will be necessary to remove the sub-assembly comprising the trigger, spring, rod and pawl. Screw the control rod in or out of the barrel nut as required, refit the sub-assembly, and check the dimension. Repeat this operation until the correct setting is obtained.

(*e*) To complete the re-assembly, refit a new dished washer to each side of the trigger, between the lever body and the trigger, and place a new thackeray washer under the pivot pin head. Enter the pivot pin and secure using a new retainer clip. Finally, swing the cover into position and finger press the lower end into the lever slot.

3. Before re-assembling the handbrake lever to the relay shaft, fit a new spring ring in the shaft groove, slide the upper support bracket on the shaft, boss protrusions uppermost, followed by the spherical bush, the distance washer and the retaining cap in that order. Note that the narrow chamfered face of the distance washer must be adjacent to the top face of the spherical bush. Refit the two bolts, nuts and washers securing the retaining cap.

4. To re-assemble the handbrake lever to the relay shaft, grip the shaft, close to the spring ring, in a vice and tap the boss of the lever down the shaft serrations, using a tubular drift on the boss top face, until the

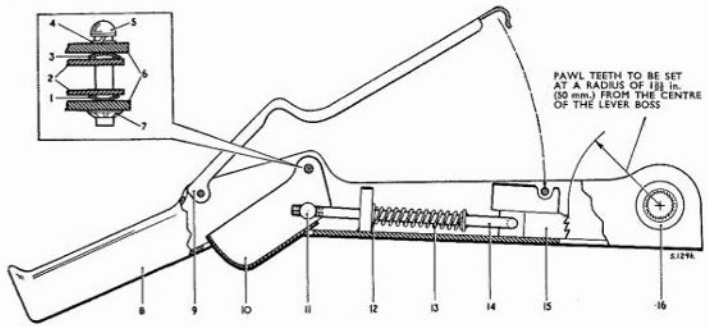


Fig. K.30. Sectional view of the handbrake lever assembly

lower face of the lever boss firmly abuts the distance washer. It is important to ensure that the identification marks made during dismantling are coincident when re-assembling or alternatively, refer to Fig. K.29 for the correct assembly position.

5. When refitting the ratchet plate, position a distance piece on each bracket boss, below the ratchet plate.

6. Re-assemble the plain washer and the self-locking nut on the shaft above the handbrake lever boss and ensure that the nut is tightened securely.

7. Ensure that the handbrake cover retaining bolts also pass through the ratchet plate holes and the distance pieces. A spring washer and a plain washer is fitted under the head of each bolt.

To Refit.

Reverse the removal procedure and check the handbrake operation on completion.

HANDBRAKE RELAY AND COMPENSATOR LINKAGE

To Adjust the Handbrake Cable.

Normally the handbrake is adjusted automatically when the rear brake shoes are adjusted, but in the event of excessive handbrake travel being evident, after the brake shoes have been correctly adjusted, proceed as follows:

1. Place chocks under the front road wheels and jack up the rear axle until the road wheels are free to revolve.

2. Release the handbrake lever to the full "off" position.

3. Turn each rear brake adjuster clockwise until the brake shoes are fully expanded.

4. On **KAH.30 and KAD.30 models,** disconnect the handbrake cable jaw at the arm of the compensator lever and adjust the lengths of the transverse rods, leading to the wheel cylinder arm, until the compensator links are parallel to the chassis centre line and with the opposed lugs of the compensator lever sufficiently offset from the link centre line so as to prevent the lugs passing over this centre line when the handbrake is normally applied (see Fig. K.31).

Adjust the handbrake cable lengths by means of the cable jaw so that the jaw pin can be inserted through the jaw and the compensator lever arm without strain and with no slackness in the cable. Refit the jaw pin nut and secure with a new split pin. Check that all jaw and rod locknuts are securely tightened.

On **the remaining models** in this range, slacken the locknut at the rear of the main brake cable jaw and disconnect the jaw at the wheel cylinder lever. Adjust the cable length by rotating the jaw on the threaded sleeve on the cable end, until the jaw pin can be inserted through the jaw and the lever without strain and with no slackness in the cable. Refit the jaw pin nut, secure with a new split pin, and fully tighten the jaw locknut.

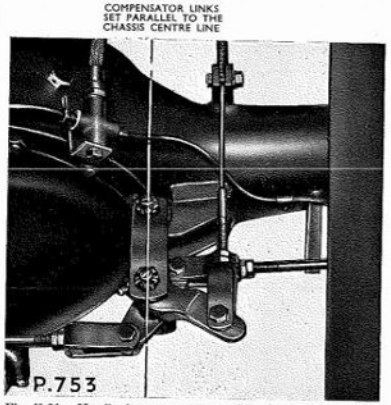


Fig. K.31. Handbrake compensator position for handbrake cable adjustment

5. Release the adjuster at each rear brake assembly by two or three clicks until the wheels are free to revolve without the brake shoes rubbing.

6. Lower the rear axle and test the handbrake for correct operation.

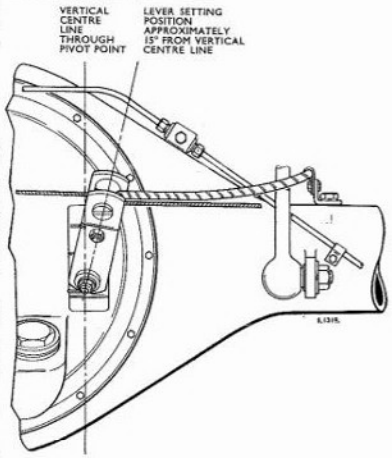


Fig. K.32. Setting position for the handbrake compensator lever when adjusting the handbrake secondary cable
R.H.D. illustrated—L.H.D. symmetrically opposite.

To Adjust the Handbrake Secondary Cable (not fitted on KAH.30 and KAD.30 models).

Release the jaw pin at the wheel cylinder lever and adjust the length of the secondary cable to eliminate any slackness so that the jaw pin will enter both the jaw and the lever, without strain, with the handbrake off and the compensator lever set as shown in Fig. K.32, in relation to the rear axle cover, when viewed from the rear of the vehicle.

To Remove.

1. Place chocks under the road wheels and release the handbrake to the full "off" position.

2. Remove the operating rod connected between the lever welded to the handbrake relay shaft and the relay lever secured to the bracket on the frame sidemember.

3. Disconnect the operating rod attached to the opposing side of the relay lever which will allow the rod to be unscrewed from the cable coupling nut, after releasing the locknut. The rod can be withdrawn through the steady bracket bush after unscrewing the coupling nut from the rod.

4. Remove the split pin in the relay lever pivot pin and withdraw the plain and thackeray washers followed by the relay lever. The relay lever bracket is removed after releasing the four retaining setscrews, nuts and spring washers.

5. Release the two setscrews, nuts and spring washers retaining the rubber bush clip to the steady bracket on the frame sidemember. The steady bracket is removed by unscrewing the two setscrews, nuts and washers.

6. Unscrew the two setscrews, nuts and spring washers retaining the cable abutment and thimble to the underside of the crossmember.

7. On **KAH.30 and KAD.30 models,** the handbrake cable is then removed after releasing the cable jaw pin and nut at the compensator lever, and the pinch bolt at the cable abutment on the axle casing.

On **the remaining models** in this range, release the clip securing the cable to the bracket on the axle casing, remove the outer arm of the compensator lever by unscrewing both the self-locking nut on the pivot pin, and the bolt, nut and spring washer clamping the two arms of the lever together. The abutment barrel clamped between the arms of the compensator lever will then be released and the secondary cable ferrule can be slipped through the slot in the end of the abutment barrel.

Finally disconnect the jaw pin securing the main handbrake cable jaw to the wheel cylinder lever and withdraw the main handbrake cable assembly and remove the secondary cable by the same procedure.

8. On **KAH.30 and KAD.30 models,** disconnect the transverse rod jaws both at the wheel cylinder and at the compensator lever lugs. Remove the slotted nuts securing the top link of the compensator, remove the top link, lift off the sealing ring at the top of the innermost link pin and withdraw the bottom link and pin assembly together with the compensator lever. Note the sealing ring on the bottom of the innermost link pin.

On **the remaining models** in this range, disconnect the secondary cable jaw pin at the wheel cylinder lever and remove the cable assembly. The inner arm of the compensator lever is lifted off the pivot pin which is welded to the pivot bracket. Note that on R.H.D. models, a lever return spring is fitted on the pivot pin, anchoring on the pivot bracket at one end and the lever arm at the opposing end.

Inspection and Overhaul.

1. Check for wear or scoring in the relay lever bush and on the relay bracket pin. To renew the bush, press out using a shouldered mandrel and press in the new bush, ensuring that the bush does not protrude beyond the faces of the lever boss.

Note: Completely immerse the new bush in thin oil for 24 hours prior to fitting to allow the pores of the bush to fill with lubricant. Do not ream the bush after fitting, otherwise the lubricating properties of the bush will be destroyed.

2. Ensure that the rubber bush in the rod steady bracket is in good condition, renewing as necessary.

3. On **KAH.30 and KAD.30 models,** inspect the compensator lever bushes for wear or scoring and renew as necessary. The bushes are a press fit in the lever body and each bush must be pressed in until flush with the body face.

Note: Completely immerse the new bushes in thin oil for 24 hours prior to fitting to allow the pores of the bushes to fill with lubricant. Do not ream the bushes after fitting, otherwise the lubricating properties of the bushes will be destroyed.

On **the remaining models** in this range, a single bush is pressed in the compensator lever arm sleeve and is renewed in the same method as described in the previous paragraph. Also ensure that the pivot pin is not damaged or scored, and that the lever return spring (on R.H.D. models only) is not weak or damaged.

4. On **KAH.30 and KAD.30 models,** ensure that the bushed compensator bracket on the axle casing is secure. Inspect the bushes for wear or scoring, renewing as necessary by the identical method described previously for the compensator lever bushes. The bracket is removed from the axle casing by releasing the two setscrews and spring washers. The bushes must be pressed in flush with the face of the bracket tube. Also renew the link pin sealing rings if they have deteriorated.

To Refit.

Refitting is a reversal of the removal operations noting the following points:

1. When refitting the handbrake operating rods, check that the respective jaw pin will just pass through the jaw and the connecting hole in the appropriate lever without strain. Tighten the jaw pin securely and fit a new split pin.

2. Ensure that the thackeray washer, plain washer and a new split pin are refitted to the relay lever pin after sliding the relay lever on the pivot pin. Note that the larger offset of the relay lever boss should be nearest the bracket face.

3. On R.H.D. models (except KAH.30 and KAD.30 models), refit the compensator lever return spring to the lever pivot pin before refitting the lever, anchoring the spring short hooked end to the pivot bracket and the long hooked end to the lever.

4. Adjust the handbrake cable as detailed on page K.34. If necessary to adjust the secondary cable or a new secondary cable is fitted, refer to page K.35 for details.

WHEELS AND TYRES

SECTION L

INDEX

WHEELS AND TYRES

DATA

Road wheels.

	KA.30	KA.40	KA.60
Description	6·00 G—16, semi-drop centre	4·50 E—16, semi-drop centre	5·50 F—16, semi-drop centre
Rim width inside flanges	6·0 in. (152 mm.)	4·5 in. (114 mm.)	5·5 in. (140 mm.)
Nominal rim diameter	16 in. (406 mm.)	16 in. (406 mm.)	16 in. (406 mm.)
Offset	1·25 in. (31·750 mm.)	4·05 in. (102·87 mm.)	4·7 in. (119·38 mm.)
Diameter of wheel bore	6·339 in. (161 mm.)	6·339 in. (161 mm.)	6·339 in. (161 mm.)
P.C.D. of stud holes ..	8·071 in. (205 mm.)	8·071 in. (205 mm.)	8·071 in. (205 mm.)
Diameter of stud holes	0·843 in. (21·412 mm.)	0·875 in. (22·225 mm.)	0·875 in. (22·225 mm.)

Standard tyre equipment and pressures.

Model	*Tyre size*		*Pressure (cold tyres)* *lb./sq.in.*	*kg./sq.cm.*
KA.30	7·50—16—8 ply rating	Front	35	2·46
		Rear	55	3·87
KA.40	6·50—16—8 ply rating	Front	45	3·17
		Rear	55	3·87
KA.60	7·00—16—8 ply rating	Front	45	3·16
		Rear	60	4·22

Note: The above tyre sizes and pressures are applicable to both petrol and diesel models.

WHEELS AND TYRES

Description.

Single front and twin rear road wheels are fitted to KA.40 and KA.60 models, whereas KA.30 models have single front and rear road wheels. The road wheels are of the two piece type and are interchangeable between front and rear on any one vehicle.

To Remove.

1. Slacken off the road wheel nuts by diagonal selection with a brace, bearing in mind that the nearside nuts have a left-hand thread and the offside nuts have a right-hand thread, i.e., always loosen towards rear of the vehicle.

2. Raise the axle by means of a jack so that the wheel spins freely off the ground. Support the axle by stands beneath the axle, remove the wheel nuts and withdraw the road wheel from the studs.

To Dismantle.

1. Lay the road wheel and tyre on the ground, locking ring uppermost, and deflate the tyre by removing the valve core.

2. Ensure that the tyre is completely deflated and remove the locking ring by inserting the tapered end of the standard tyre lever in the gap between the ends of the locking ring and prise the ring up. Tap the lever round the wheel rim until the locking ring is free and lift it off.

3. Turn the road wheel and tyre over, and support the wheel centre on a block. Drive the tyre and tube off the wheel rim with a hammer and a wooden block, taking care not to damage the valve. When a tyre is held by rust, the normal procedure is to use one of the well known brands of bead knocker, taking care that the bead knocker does not damage the bead of the tyre.

4. Remove the rubber flap and the tube from the tyre.

Inspection and Overhaul.

1. Check that the rims are clean and free from rust, cleaning any rust from the rims, if evident, and applying a coat of tyre rim paint. Examine the road wheels for cracks and also for badly worn stud holes. If either are apparent, renew the wheel. Clean also any rust from the locking ring and check that the ring is not bent or distorted, renewing if necessary.

2. Clean any oil and grease from the tyre, and remove any nails, flints or stones that have become embedded in the treads.

3. Cuts on the treads and side-walls should be cleaned and filled with tread filling compound. If the cut is severe, penetrating into the plies, the repair should be carried out by a tyre repair specialist or the tyre manufacturer.

4. On KA.30 models, check for loose rivets round the wheel rims and fit oversize rivets, if necessary, ensuring that they do not protrude beyond the height of the original rivet.

To Re-assemble.

1. Position the road wheel, flange downwards on the ground.

2. Check the inside of the tyre for foreign matter and remove if evident.

3. Slightly inflate the inner tube, until it is just rounded, and dust the inside of the tyre cover and the tube exterior with talc to ensure the tube seats correctly. Re-insert the tube in the cover, placing the flap in position, ensuring that it is not creased, and that the valve stem is centrally in the hole of the flap.

4. Lay the tyre on the wheel with the valve aligned with its recess, then lower the tyre into position on the wheel.

5. Refit the split locking ring, making sure that full location is obtained.

6. Inflate the tyre to its correct pressure, and check the valve core for leaks, renewing if faulty.

Note: To guard against the possibility of accident due to an inaccurately fitted split locking ring, use a safety cage when inflating the tyre. If no cage is available, ensure that the split locking ring side of the wheel is against a wall or on the ground before and during inflating.

To Refit.

Reverse the removal procedure ensuring that each wheel nut is finally tightened with the road wheel tyre on the ground. With twin wheels, ensure that the valve position on the outer wheel is diametrically opposite the valve position on the inner wheel.

WHEEL STUDS

For information concerning the removal of front and rear wheel studs, refer to the respective hub section in the "Front Axle" or "Rear Axle" sections.

TYRE FAULT DIAGNOSIS

Symptom	Cause	Cure
Rasped appearance—feather edges.	Misalignment or bent track rod.	Regular tyre inspection will quickly reveal this type of wear. Wheel alignment and steering layout should be checked.
Rapid wear on shoulders.	Under-inflation or overloading conditions which cause the centre of the tread to buckle inwards, resulting in excessive loading and consequently in more rapid wear of the outer ribs of tread pattern.	Ensure that tyres are inflated to correct pressures; avoid overloading.
Rapid wear in centre of tread.	Over-inflation reduces road contact area and concentrates the load on a small area in the centre of the tread which consequently wears very rapidly.	Ensure tyres are inflated to correct pressures.
Worn or polished circumferentially on inner sidewall of twins sometimes with fabric exposed.	Twins touching in service.	Check the tyre pressures. Check for correct wheel offset and over-sized tyres.
Scuffing or kerbing damage—buttress or sidewall rubber worn away.	Driving up against kerbs, loading bays, etc.; backing into narrow opening or manoeuvring in confined areas.	Keep clear of kerbs, etc. Tyres showing signs of wear should be changed to alternative positions or reversed on their rims.
Rubber gouged away, or circumferential groove.	Projecting object fouling tyre; sometimes caused by settled springs or misaligned axle.	Remove the cause—inspect tyres frequently.
Scooped or irregular wear.	Faulty or loose wheel bearings, worn bushes or swivel pins.	As soon as irregular wear is observed a mechanical check should be made including wheel alignment. This type of wear usually occurs on front wheels—change damaged tyre to rear position.
Excessive localised wear in one area.	Ovality of brake drum, or high spot on drum causing wheel to be braked continuously in same position—badly adjusted unequalised brakes.	Check tyres regularly and ensure that brakes are operating correctly. Tyres can often be repaired providing the damage is not extensive.
Deflation damage—partial or complete collapse of sidewalls and general break-up of the tyre casing.	Driving on a totally deflated tyre, or long distances on a tyre holding only a few lbs. pressure.	Stop the vehicle immediately a deflated tyre is experienced—fit spare wheel and tyre.
Concussion burst diagonal, or star fracture or double concussion fracture low on the wall due to "rim crush".	Tyre striking hard, or projecting, object—more liable to occur when a tyre is over-inflated. When a tyre is under-inflated it is possible for the sidewall to be nipped between the rim of the wheel and the kerb resulting in "rim crush".	Maintain recommended pressures. Avoid kerbing and overloading. This type of failure often occurs some time after the impact blow was sustained.